

PROGRAM BOOK



Virtual **41ST** **ANNUAL MEETING**

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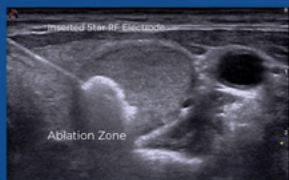
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**as of April 8, 2021*

THE AMERICAN ASSOCIATION OF
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**41ST Annual Meeting
APRIL 25-27, 2021**

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2018-2019	Herbert Chen	Sonia Sugg	James Lee	Paul Gauger	Sareh Parangi
2017-2018	Martha Zeiger	Carmen Solorzano	Rebecca S. Sippel	Paul Gauger	Sareh Parangi
2016-2017	Peter Angelos	Samuel Snyder	Rebecca S. Sippel	Cord Sturgeon	Sareh Parangi
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2013-2014	Sally E. Carty	Julie Ann Sosa	Nancy D. Perrier	Herbert Chen	
2012-2013	Miguel F. Herrera	Allan Siperstein	Nancy D. Perrier	Herbert Chen	
2011-2012	Ashok R. Shaha	Thomas J. Fahey, III	Peter Angelos	Herbert Chen	
2010-2011	Douglas B. Evans	Gerard M. Doherty	Peter Angelos	Steven K. Libutti	
2009-2010	Janice L. Pasieka	Jeffrey E. Lee	Peter Angelos	Steven K. Libutti	
2008-2009	Michael J. Demeure	Jeffrey F. Moley	Sally E. Carty	Steven K. Libutti	
2007-2008	Geoffrey B. Thompson	Terry C. Lairmore	Sally E. Carty	Douglas B. Evans	
2006-2007	Christopher R. McHenry	John B. Hanks	Sally E. Carty	Douglas B. Evans	
2005-2006	Robert Udelsman	Collin J. Weber	Janice L. Pasieka	Douglas B. Evans	
2004-2005	John A. Kukora	Andrew W. Saxe	Janice L. Pasieka	Geoffrey B. Thompson	
2003-2004	Paul LoGerfo	Ashok R. Shaha	Janice L. Pasieka	Geoffrey B. Thompson	
2002-2003	Quan-Yang Duh	Gary B. Talpos	Christopher R. McHenry	Geoffrey B. Thompson	
2001-2002	Clive S. Grant	Miguel F. Herrera	Christopher R. McHenry	Michael J. Demeure	
2000-2001	Barbara K. Kinder	Martha A. Zeiger	Christopher R. McHenry	Michael J. Demeure	

Year	President	Vice President	Secretary	Recorder
1999-2000	Jay K. Harness	John S. Kukora	Paul LoGerfo	Michael J. Demeure
1998-1999	George L. Irvin, III	Barbara K. Kinder	Paul LoGerfo	Quan-Yang Duh
1997-1998	Blake Cady	E. Christopher Ellison	Paul LoGerfo	Quan-Yang Duh
1996-1997	Jon A. van Heerden	George L. Irvin, III	Jay K. Harness	Quan-Yang Duh
1995-1996	Richard A. Prinz	Jeffrey A. Norton	Jay K. Harness	George L. Irvin, III
1994-1995	John M. Monchik	Jon A. van Heerden	Jay K. Harness	George L. Irvin, III
1993-1994	Orlo H. Clark	Glen W. Geelhoed	Blake Cady	George L. Irvin, III
1992-1993	Robert C. Hickey	Patricia J. Numann	Blake Cady	Robert D. Croom, III
1991-1992	Stuart D. Wilson	Joseph N. Attie	Blake Cady	Robert D. Croom, III
1990-1991	Caldwell B. Esselstyn	Brown M. Dobyns	Richard A. Prinz	Robert D. Croom, III
1989-1990	Colin G. Thomas, Jr.	Carl R. Feind	Richard A. Prinz	Jon A. van Heerden
1988-1989	John R. Brooks	Melvin A. Block	Richard A. Prinz	Jon A. van Heerden
1987-1988	Edward Paloyan	Caldwell B. Esselstyn	Stuart D. Wilson	Jon A. van Heerden
1986-1987	Oliver Behars	Robert C. Hickey	Stuart D. Wilson	
1985-1986	Chiu-An Wang	Edward Paloyan	Stuart D. Wilson	
1984-1985	Leonard Rosoff	John M. Monchik	Stuart D. Wilson	
1983-1984	Stanley R. Friesen	John A. Palmer	John M. Monchik	
1982-1983	Edwin L. Kaplan	Blake Cady	John M. Monchik	
1981-1982	Norman W. Thompson	Orlo H. Clark	John M. Monchik	
1980-1981	Norman W. Thompson	Orlo H. Clark	John M. Monchik	

OLIVER COPE MERITORIOUS ACHIEVEMENT AWARD

In April of 1984 at the American Association of Endocrine Surgeons Meeting in Kansas City, Drs. Edward Kaplan, Jack Monchik, Leonard Rosoff, Norm Thompson and Stuart Wilson proposed to the Council a new achievement award. The award honors a member of the AAES in recognition for contributions in the field of endocrine surgery as an investigator, teacher and clinical surgeon. It is not an annual award but is to be given to members of our Association who truly aspire to the spirit of this award.

On April 15, 1985 at the annual meeting of the AAES in Toronto, our President, Leonard Rosoff announced the first member to receive this award, Dr. Oliver Cope. In giving this award to Dr. Cope the decision of the Council was that from this day forward the award would be known as the Oliver Cope Meritorious Achievement Award for the American Association of Endocrine Surgeons.



Oliver Cope, MD

Professor of Surgery, Harvard University and the Massachusetts General Hospital

Awarded in Ontario in April 1985.



Stanley R. Friesen, MD, PhD

Professor of Surgery, University of Kansas

Awarded in Detroit, MI in April 1994.

Dr. Friesen served as the President of our Association in 1983-1984.



Norman W. Thompson, MD

Henry King Ransom Professor of Surgery, University of Michigan

Awarded in Atlanta, GA in April 2001.

Dr. Thompson served as our inaugural President from 1980-1982.



Jon A. van Heerden, MD

Professor of Surgery Mayo Clinic

Awarded in Charlottesville, NC in April 2004.

Dr. van Heerden served as our Recorder from 1987-1990, as our Vice-President in 1994-1995, and as President in 1996-1997.



Orlo H. Clark, MD

Professor of Surgery, UCSF Mount Zion Medical Center
Awarded in New York, NY in May 2006.
Dr. Clark served as our inaugural Vice-President from 1980-1982, and as President in 1993-1994.



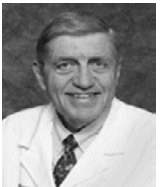
Edwin L. Kaplan, MD

Professor of Surgery, University of Chicago
Awarded in Madison, WI in May 2009.
Dr. Kaplan served as our President in 1982-1983.



George L. Irvin, III, MD

Professor Emeritus of Surgery, University of Miami
Awarded in Pittsburgh, PA in April 2010.
Dr. Irvin served as our Recorder from 1993-1996, as Vice-President in 1996-1997, and as President in 1998-1999.



Stuart D. Wilson, MD

Professor Emeritus of the Department of Surgery,
Medical College of Wisconsin Awarded in Baltimore, MD
in April 2016.
Dr. Wilson served as our Secretary-Treasurer from 1984-1988 and President in 1991-1992.



Quan-Yang Duh, MD

University of California San Francisco
Awarded in Los Angeles, CA in April 2019.
Dr. Duh served as our Recorder from 1996-1999 and President in 2002-2003.

HONORARY MEMBERS

**Individuals who have made outstanding contributions
to the discipline of Endocrine Surgical Disease:**

J. Aidan Carney, Pathologist

Stuart D. Flynn, Pathologist

Ian D. Hay, Endocrinologist

Virginia A. LiVolsi, Pathologist

Frank LoGerfo, Surgeon

G. E. "Ace" Pearse, Endocrinologist

Thomas S. Reeve, Endocrine Surgeon

F. John Service, Endocrinologist

Britt Skogseid, Endocrinologist

R. Michael Tuttle, Endocrinologist

William F. Young, Endocrinologist

RESIDENT/FELLOW RESEARCH AWARD WINNERS & POSTER COMPETITION WINNERS

The AAES Resident/Fellow Research Award was established in 1990 to encourage interest in endocrine surgery by those training as students and residents in general surgery. Presented work may be honored in either the Clinical or Basic Research categories. The AAES Poster Competition was established in 2007.

1990

Michael J. Demeure — San Francisco, California

“Actin Architecture of Cultured Human Thyroid Cancer Cells: Predictor of Differentiation?”

Gerard M. Doherty — Bethesda, Maryland

“Time to Recovery of the Hypothalamic-Pituitary-Adrenal Axis After Curative Resection of Adrenal Tumors in Patients with Cushing’s Syndrome”

1992

Rodney Pommier — New York, New York

“Eleven Year Experience with Adrenocortical Carcinoma”

1996

Jennifer Meko — St. Louis, Missouri

“Evaluation of Somatostatin Receptor Scintigraphy in Detecting Neuroendocrine Tumors”

Beth A. Ditkoff — New York, New York

“Detection of Circulating Thyroid Cells in Peripheral Blood”

1997

Herbert Chen — Baltimore, Maryland

“Implanted Programmable Insulin Pumps: 153 Patient Years of Surgical Experience”

K. Michael Barry — Rochester, Minnesota

“Is Familial Hyperparathyroidism a Unique Disease”

1998

Julie Ann Sosa — Baltimore, Maryland

“Cost Implications of the Different Management Strategies for Primary Hyperparathyroidism in the US”

David Litvak — Galveston, Texas

“A Novel Cytotoxic Agent for Human Carcinoid”

1999

Andrew Feldman — Bethesda, Maryland

“Results of Heterotrophic Parathyroid Autotransplantation: A 13-Year Experience”

Alan Dackiw — Houston, Texas

“Screening for MEN1 Mutations in Patients with Atypical Multiple Endocrine Neoplasia”

2000

Electron Kebebew — San Francisco, California

“ID1 Proteins Expressed in Medullary Thyroid Cancer”

2001

Nestor F. Esnaola — Houston, Texas

“Optimal Treatment Strategy in Patients with Papillary Thyroid Cancer: A Decision Analysis”

Katherine T. Morris — Portland, Oregon

“High Dehydroepiandrosterone-Sulfate Predicts Breast Cancer Progression During New Aromatase Inhibitor Therapy and Stimulates Breast Cancer Cell Growth in Tissue Culture: A Renewed Role for Adrenalectomy”

2002

Rasa Zarnegar — San Francisco, California

“Increasing the Effectiveness of Radioactive Iodine Therapy in the Treatment of Thyroid Cancer Using Trichostatin A (TSA), A Histone Deacetylase (HDAC)”

Denise M. Carneiro — Miami, Florida

“Rapid Insulin Assay for Intraoperative Confirmation of Complete Resection of Insulinomas”

2003

Petra Musholt — Hanover, Germany

“RET Rearrangements in Archival Oxyphilic Thyroid Tumors: New Insights in Tumorigenesis and Classification of Hürthle Cell Carcinoma”

Tina W.F. Yen — Houston, Texas

“Medullary Thyroid Carcinoma: Results of a Standardized Surgical Approach in a Contemporary Series of 79 Consecutive Patients from The University of Texas, M. D. Anderson Cancer Center in Houston”

2004

Rebecca S. Sippel — Madison, Wisconsin

“Does Propofol Anesthesia Affect Intra-Operative Parathyroid Hormone Levels During Parathyroidectomy? A Randomized Prospective Trial”

David Finley — New York, New York

“Molecular Analysis of Hürthle Cell Neoplasms by Gene Profiling”

2005

Mark Cohen — St. Louis, Missouri

“Long-Term Functionality of Cryopreserved Parathyroid Autografts: A 13-Year Prospective Analysis”

Kepal N. Patel — New York, New York

“MUC1 Plays a Role in Tumor Maintenance in Aggressive Thyroid Carcinomas”

2006

Kyle Zanocco — Chicago, Illinois

“Cost-Effectiveness Analysis of Minimally Invasive Parathyroidectomy for Asymptomatic Primary Hyperparathyroidism”

Ashley Kappes Cayo — Madison, Wisconsin

“Lithium Ions: A Novel Agent for the Treatment of Pheochromocytomas and Paragangliomas”

2007

Tracy S. Wang — New Haven, Connecticut “How Many Endocrine Surgeons Do We Need?”

David Yu Greenblatt — Madison, Wisconsin

“Valproic Acid Activates Notch1 Signaling and Inhibits Growth in Medullary Thyroid Cancer Cells”

2008

Elizabeth G. Grubbs — Houston, Texas

“Preoperative Vitamin D (VITD) Replacement Therapy in Primary Hyperparathyroidism (PHPT): Safe But Beneficial?”

Linwah Yip — Pittsburgh, Pennsylvania

“Loss of Heterozygosity of Selected Tumor Suppressor Genes in Parathyroid Carcinoma”

POSTER: Pierre Leyre — Poitiers, France

“Does the Risk of Compressive Hematoma After Thyroidectomy Authorize One-Day Surgery?”

2009

Insoo Suh — San Francisco, California

“Candidate Germline Alterations Predisposing to Familial Nonmedullary Thyroid Cancer Map to Distinct Loci on Chromosomes 1 and 6”

Susan C. Pitt — Madison, Wisconsin

“Tertiary Hyperparathyroidism: Is Less Than a Subtotal Resection Ever Appropriate? A Study of Long-term Outcomes”

POSTER: Matthew Nehs — Boston, Massachusetts

“Inhibition of B-RAFV600 Oncoprotein Prevents Cell Cycle Progression and Invasion In Vitro and Reduces Tumor Growth and Metastasis in an In Vivo Orthotopic Model of Thyroid Cancer”

POSTER: Bian Wu — Los Angeles, California

“Utilization of Parathyroidectomy in the Elderly: A Population-Based Study”

2010

David T. Hughes — Ann Arbor, Michigan

“Routine Central Lymph Node Dissection For Papillary Thyroid Cancer”

Matthew A. Nehs — Boston, Massachusetts

“Thyroidectomy With Neoadjuvant Plx4720 Extends Survival And Decreases Tumor Burden In An Orthotopic Mouse Model Of Anaplastic Thyroid Cancer”

POSTER: Aarti Mathur — Bethesda, Maryland

“Adrenal Venous Sampling in Primary Hyperaldosteronism: Standardizing A Gold Standard”

2011

Paxton V. Dickson — Houston, Texas

“Achieving Eugastrinemia in MEN1 Patients: Both Duodenal Inspection and Formal Lymph Node Dissection are Important”

Matthew Nehs — Boston, Massachusetts

“Necroptosis is a Novel Mechanism

of Radiation-Induced Cell Death in Anaplastic Thyroid Cancer and Adrenocortical Cancer”

POSTER: Luc G.T. Moris — New York, New York

“Rising Incidence of Second Primary Cancer in Low-Risk Patients Receiving Radioactive Iodine Therapy”

2012

Ashley K. Cayo — Milwaukee, Wisconsin

“Predicting the Need for Calcium and Calcitriol Supplementation After Total

Thyroidectomy: Results of a Prospective, Randomized Study”

Thomas J. Quinn — Bronx, New York

“Pasireotide (Som230) Is Effective for the Treatment of Pancreatic Neuroendocrine Tumors in a Multiple Endocrine Neoplasia Type 1 Conditional Knockout Mouse Model”

POSTER: Kevin Shepet — Madison, Wisconsin

“Parathyroid Cryopreservation Following Parathyroidectomy: A Worthwhile Practice?”

2013

Kai-Pun Wong — Hong Kong

“A Prospective Evaluation of Surgeon-Performed Transcutaneous Laryngeal Ultrasonography in Assessing Vocal Cord Function Before and After Thyroidectomy”

Scott K. Sherman — Iowa City, Iowa

“Gastric Inhibitory Polypeptide Receptor: A Future Alternative to Somatostatin Type 2 Receptor Imaging and Treatment in

Neuroendocrine Tumors?”

POSTER: Sara Murray — Madison, Wisconsin

“Timing of Symptom Improvement After Parathyroidectomy”

2014

Heather Wachtel — Philadelphia, Pennsylvania

“Long-term Blood Pressure Control in Patients Undergoing Adrenalectomy for Primary Hyperaldosteronism”

Jessica Maxwell — Iowa City, Iowa

“A Practical Method to Determine the Site of Unknown Primary in Metastatic Neuroendocrine Tumors”

POSTER: Ben James — Chicago, Illinois

“A Novel Ultra-Rapid PTH Assay to Distinguish Parathyroid from Non-Parathyroid Tissue”

2015

Diana I. Ortiz — Medical College of Wisconsin “Cosyntropin Stimulation Testing On Postoperative Day 1 Allows for Selective Glucocorticoid Replacement Therapy in Patients Undergoing Adrenalectomy for Hypercortisolism: Results of a Novel, Multidisciplinary-Derived Institutional Protocolb”

Melanie A. McWade — Vanderbilt University

“Fluorescence Detection of the Parathyroid Gland: Realizing the Potential for Intraoperative Guidance”

POSTER: Idit Dotan — McGill University Health Center

“Bio-Conjugated Nanotechnology to Target Papillary Thyroid

Cancer in Vitro” POSTER: Uma Rajhbeharrysingh – Oregon Health and Science University “Ionized Calcium And The Utility Of Maxpht To Evaluate Gastric Bypass Patients and Others With Non-Renal Secondary Hyperparathyroidism”

2016

Bruna Babic – National Institute of Health, National Cancer Institute

“Pediatric Patients with Pheochromocytoma and Paragangliomas Should Have Routine Preoperative Genetic Testing for Common Susceptibility Genes and Imaging to Detect Extra-Adrenal and Metastatic Tumors”

Peter T. White – University of Michigan

“A Novel Heat Shock Protein 90 Inhibitor Overcomes Receptor Tyrosine Kinase Resistance in Differentiated Thyroid Cancer”

POSTER: Selena Brouwer – University Medical Center Utrecht

“Intratumoral Heterogeneity of MicroRNA Expression is a Pervasive Feature in Papillary Thyroid Carcinoma”

POSTER: Wouter Kluijfhout – University of California San Francisco

“CEA Should Not Routinely be Used for Detection of a First Recurrence in Patients With MTC”

2017

Kendall J. Keck – University of Iowa Carver College of Medicine

“Gene expression changes in small bowel neuroendocrine tumors associated with progression to metastases”

Omar Shariq – Mayo Clinic

“Contralateral suppression of aldosterone at adrenal venous Sampling predicts hyperkalemia following adrenalectomy for primary Aldosteronism”

POSTER: Priya Dedhia – University of Michigan

“Human intestinal tissue generates functional insulin producing cells”

POSTER: Heather Wachtel – Massachusetts General Hospital

“A multi-institutional analysis of adrenalectomy for secondary malignancy”

2018

John Tierney – Rush University Medical Center

“Expression of Programmed Death Ligand-1 and 2 in Adrenocortical Cancer Tissues: An exploratory study”

Kristen Limbach – Oregon Health & Science University “Prospective Study of the Pathophysiology of Carcinoid Crisis”

POSTER: Sarah Fisher – MD Anderson Cancer Center

“Genetic characterization of childhood survivors of the Chernobyl accident with medullary Thyroid cancer”

POSTER: Wessel Vorselaars – University Medical Center Utrecht

“Clinical outcomes after unilateral adrenalectomy for primary hyperaldosteronism - a large worldwide and recently operated cohort of 435 patients”

2019

Ton Wang – University of Michigan

“A novel heat shock protein 90 inhibitor potently targets adrenocortical carcinoma tumor suppression via alteration of long non-coding RNA expression”

Amin Madani – Columbia University

“Defining the Competencies for Laparoscopic Transabdominal Adrenalectomy: An Investigation of Intra-Operative Behaviors and Decisions of Experts”

POSTER: Frances T. Lee – Northwestern University

“An Effective Tolerance Approach for Porcine islet Xenotransplantation in Humanized Mice”

POSTER: Wessel MCM Vorselaars

– University Medical Center Utrecht
“Geographic Validation of the Aldosteronoma Resolution Score”

2020

No competition was held in 2020. The Annual Meeting was cancelled due to the COVID-19 pandemic.

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- 1981 **Washington, DC**
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Peter J. Fabri
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- 2000 **Joint Meeting: London,
United Kingdom/Lille,
France**
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Jack Monchik
- 2001 **Atlanta, Georgia**
Local Arrangements Chair:
Collin Weber
- 2002 **Banff, Alberta, Canada**
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Janice L. Pasieka
- 2003 **San Diego, California**
Local Arrangements Chairs:
Jay K. Harness & John
Kukora
- 2004 **Charlottesville, Virginia**
Local Arrangements Chair:
John B. Hanks

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| 2005 | Cancun, Mexico
Local Arrangements Chair:
Miguel F. Herrera | 2013 | Chicago, Illinois
Local Arrangements Chair:
Peter Angelos |
| 2006 | New York, New York
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Ashok R. Shaha | 2014 | Boston, Massachusetts
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Local Arrangements Chair:
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Nancy D. Perrier | 2019 | Los Angeles, California
Local Arrangements Chair:
Michael Yeh |
| 2012 | Iowa City, Iowa
Local Arrangements Chair:
Ronald Weigel | 2020 | Canceled due to COVID-19
pandemic |

SPECIAL SESSIONS

Attendees are welcome to attend any sessions unless specifically stated.

HOW I HANDLE IT: EXPERT TIPS AND TRICKS FOR CHALLENGING OPERATIVE SCENARIOS

Sunday, April 25, 2021 3:15 PM – 4:15 PM CT

There's never a dull moment in surgery. Whether it's an unforeseen finding of locally invasive thyroid cancer or dealing with IVC bleeding during adrenalectomy, managing unexpected operative situations can be challenging. Join us as our panel of experts discuss their thoughts and approaches to a variety of difficult scenarios.

ETHICS IN SURGERY SESSION

Monday, April 26, 2021 9:00 AM – 10:00 AM CT

Join this breakfast session for a panel discussion of the ethical issues associated with early adoption of innovative surgical techniques. The panel will each present on different issues with plenty of time for audience discussion.

AAES PRESIDENTIAL PANEL ON DIVERSITY EQUITY AND INCLUSION (DEI). FROM AWARENESS TO ACTION: ACTIONABLE WAYS TO EFFECT DEI EFFORTS IN SURGERY

Monday, April 26, 2021 12:45 PM – 1:45 PM CT

The AAES Presidential Panel on Diversity Equity and Inclusion demonstrates our organization's commitment to creating opportunities for important dialogue in our field. This year, the theme aims to provide the audience practical approaches that can be reproduced at your local institution at various levels. The session was organized under the leadership of our DEI Committee.

ADRENAL DISEASES PATIENT ADVOCACY PANEL

Monday, April 26, 2021 2:45 PM – 3:45 PM CT

The National Adrenal Diseases Foundation (NADF) and the AAES have partnered together to bring this session to the Annual Meeting. Join the case-based discussion for an exciting conversation on adrenal diseases.

CESQIP SESSION

Tuesday, April 27, 2021 11:45 AM – 12:45 PM CT

During the CESQIP session, we will hear research talks using CESQIP data, discuss use of the data for quality improvement projects, and review best practices.

MEDICAL COLLEGE OF WISCONSIN- STUART D. WILSON, M.D. HISTORICAL LECTURER



“Evaluating and Achieving Surgical Quality in 2021”

Clifford Ko, MD, MS, MSHS, FACS, FASCRS
American College of Surgeons

Monday, April 26, 2021

3:45 PM – 4:30 PM CT

Dr. Clifford Ko is the Director of the Division of Research and Optimal Patient Care at the American College of Surgeons. He oversees all the quality improvement programs, including the Bariatric Surgery Accreditation Program, the Cancer Accreditation program, the Trauma Verification program, the new Surgeon Specific Registry, and the American College of Surgeons National Surgical Quality Improvement Program (ACS NSQIP). He also serves as the Director of ACS NSQIP.

Dr. Ko’s work focuses on surgical quality of care, including quality measurement, process improvement, and quality maintenance. He has received millions of dollars in grant funding to study quality of care from sources that include the National Institutes of Health, the Centers for Disease Control and Prevention, the American Cancer Society, the Centers of Medicare and Medicaid Services, the Agency for Healthcare Research and Quality, and the Veterans Administration. He has published over 275 manuscripts and has written more than 20 book chapters. He is frequently invited to speak nationally and internationally and has served on numerous advisory panels.

Clinically, Dr. Ko is a double board-certified surgeon with a practice focusing on patients with colorectal cancer. At UCLA, he is the Robert and Kelly Day Professor of Surgery, has won the Faculty Teaching Award three times, and is recognized as one of the Best Doctors in America. He is also professor of health services at the UCLA School of Public Health.

Dr. Ko received his B.A (Biology), M.S. (Biological/Medical Ethics), and M.D. from the University of Chicago. He also received a Masters of Science Degree (Health Services/Outcomes Research) from the University of California, Los Angeles during his time as a Robert Wood Johnson Clinical Scholars Fellow at UCLA and RAND. Dr. Ko completed his General Surgery Residency at UCLA Medical Center, and obtained specialty training at the Lahey Clinic in Boston in Colon and Rectal Surgery.

MEDICAL COLLEGE OF WISCONSIN- STUART D. WILSON, M.D. HISTORICAL LECTURE AT RECENT MEETINGS

- 2009 **Edwin L. Kaplan, MD**, University of Chicago
Radiation Induced Thyroid Cancer – A Chicago Experience
- 2010 **Norman W. Thompson, MD**, University of Michigan
The Time Was Right
- 2011 **Jon A. van Heerden, MD**, Medical University of South Carolina
Pheochromocytoma Resection: Now and Then
- 2012 **Murray F. Brennan, MD**, Memorial Sloan-Kettering Cancer Center
Re-Operative Parathyroid Surgery Circa 1975
- 2013 **Orlo H. Clark, MD**, University of California, San Francisco
Recognition of Endocrine Glands and Abnormalities by Artists and Surgeons
Wen T. Shen, MD, MA, University of California, San Francisco
From 'Kindred Spirits' to the Social Network
- 2014 **Patricia J. Numann, MD**, SUNY Upstate Medical University
Ode to an Indian Rhinoceros
- 2015 **Robert Beazley, MD**, Boston University School of Medicine
The Glands of Owen...Who Was Owen?
- 2016 **Samuel A. Wells, Jr., MD**, National Cancer Institute
The Diagnosis and Treatment of Thyroid Cancer: A Historical Perspective
- 2017 **David L. Nahrwold, MD**, Northwestern University
Surgery, Surgeons and their College
- 2018 **John L. Cameron, MD**, John Hopkins Hospital
William Stewart Halsted; Our Surgical Heritage (Also an Endocrine Surgeon!)
- 2019 **James McClintock, MD**, University of Alabama at Birmingham
From Penguins to Plankton - the Dramatic Impacts of Climate Change on the Antarctic Peninsula

UCSF CAROL & ORLO H. CLARK LECTURESHIP



“Aberrant regulation of cortisol and aldosterone secretion in adrenal tumors and hyperplasias”

André Lacroix, M.D., FCAHS

Centre hospitalier de l'Université de Montréal (CHUM)

Sunday, April 25, 2021

10:15 AM – 11:00 AM CT

Pr. Lacroix completed M.D. degree in 1972 and specialization in endocrinology in 1977 at Université de Montréal. This was followed by Endocrine fellowship at Vanderbilt University in Nashville, TN from 1976-78 with Grant W Liddle, David N Orth, T.J McKenna, and at the National Institutes of Health in Bethesda, MD from 1978-80 with Marc E Lippman and during a sabbatical year of biotechnology in 1986 with MB Sporn and Anita Roberts.

He served as chief of Endocrine Division at Hôtel-Dieu hospital and as Director of the Endocrinology Training Program of Université de Montréal. He was Chairman of the Department of Medicine from 2002-2008 and Associate Director General for Medical and Academic Affairs at CHUM (2008-2012).

He was President of the Canadian Society of Endocrinology and Metabolism (2005- 2007) and Chair of the International Society of Endocrinology (2016-20). He is currently co-editor of the Adrenal Section of UpToDate (Boston, MA) and Encyclopedia of Endocrinology (Elsevier), Associate Editor of the European Journal of Endocrinology. He received the Robert Volpé 2010 award from CSEM in recognition for his contributions to Endocrinology in Canada. He was elected Fellow of the Canadian Academy of Health Sciences in 2008 and Foreign member of the National Academy of Medicine of France in 2016.

Major Areas of Research: Molecular and genetic mechanisms of adrenal tumors and hyperplasias leading to Cushing's syndrome, primary aldosteronism and adrenal tumorigenesis. Role of aberrant adrenal hormone receptors in adrenal overfunction. New drugs in the therapy of Cushing's disease and primary aldosteronism, of adrenocortical cancer and pheochromocytomas.

Pr Lacroix has published more than 225 articles (Including several in New England J Med, Lancet, Endocrine Reviews) or book chapters (h index: 59, 16559 citations, i10 index: 145), 305 scientific meeting abstracts and 315 invitations to conferences at national and international institutions or scientific meetings.

UCSF CAROL & ORLO CLARK LECTURESHIP AT RECENT MEETINGS

- | | | | |
|------|---|------|--|
| 1991 | Gregory B. Bulkley, MD
Johns Hopkins University,
Baltimore, Maryland

<i>Endothelial Xanthine Oxidase:
 a Radical Transducer of Signals
 and Injury</i> | 1999 | James Hurley, MD
Cornell University, New York,
New York

<i>Post-Operative Management of
 Differentiated Thyroid Cancer</i> |
| 1992 | Donald Coffey, PhD
Bethesda, Maryland

<i>New Concepts Concerning
 Cancer</i> | 2000 | James Shapiro, MD
University of Alberta, Edmonton,
Alberta

<i>Pancreatic Islet Cell
 Transplantation</i> |
| 1993 | John L. Doppman, MD
National Institutes of Health,
Bethesda, Maryland

<i>Recent Advances in
 Endocrinologic Imaging</i> | 2001 | Andrew F. Stewart, MD
University of Pittsburgh,
Pittsburgh, Pennsylvania

<i>Parathyroid Hormone-Related
 Protein: From Hypercalcemia
 of Malignancy to Gene Therapy
 from Diabetes</i> |
| 1994 | Gordon J. Strewler, MD
San Francisco, California

<i>The Parathyroid Hormone
 Related Protein: Clinical
 and Basic Studies of a
 Polyfunctional Protein</i> | 2002 | William F. Young Jr., MD
Mayo Clinic, Rochester,
Minnesota

<i>Adrenal-Dependent
 Hypertension: Diagnostic
 Testing Insights</i> |
| 1995 | Ivor M.D. Jackson, MD
Providence, Rhode Island

<i>Regulation of TSH Secretion:
 Implications for Disorders of the
 Thyroid Function</i> | 2003 | Sissy M. Jhiang, MD
The Ohio State University,
Columbus, Ohio

<i>Lessons From Thyroid Cancer:
 Genetics and Gene Therapy</i> |
| 1996 | Victor E. Gould, MD
Rush-Presbyterian-Medical
Center, Chicago, Illinois

<i>The Diffuse Neuroendocrine
 System: Evolution of the
 Concept and Impact on Surgery</i> | 2004 | Edward R. Laws Jr, MD
University of Virginia,
Charlottesville, Virginia

<i>The Diagnosis and Management
 of Cushing's Disease</i> |
| 1997 | Bertil Hamberger, MD, PhD
Karolinska Institute, Stockholm,
Sweden

<i>The Nobel Prize</i> | 2005 | David Duick, MD
Phoenix, Arizona

<i>Thyroid Nodules and Mild
 Primary Hyperparathyroidism:
 Examples of Clinical Perplexities
 or Unresolvable Conundrums</i> |
| 1998 | Susan Leeman, PhD
Boston University, Boston,
Massachusetts

<i>The NeuroPeptides: Substance
 P and Neurotensin</i> | | |

- 2006 **Michael Bliss, PhD**
University of Toronto, Ontario,
Canada
*Harvey Cushing and Endo-
Criminology*
- 2007 **Virginia A. Livolsi, MD**
University of Pennsylvania,
Philadelphia, Pennsylvania
*Thyroid Nodule FNA and Frozen
Section: Partners or Adversaries*
- 2008 **F. John Service, MD, PhD**
Mayo Clinic, Rochester,
Minnesota
*Hypoglycemia in Adults – 80th
Anniversary of Hyperinsulinism*
- 2009 **Jeffrey M. Trent, PhD**
Translation Genomics Research
Institute, Phoenix, Arizona
Integrating Genetics, Genomics,
and Biology Towards a More
Personalized Medicine
- 2010 **Alexander J.B. McEwan, MB**
University of Alberta, Edmonton,
Alberta, Canada
*The State of the Art of
Radionucleotide Imaging
and Therapy in Patients with
Neuroendocrine Tumors*
- 2011 **Allan H. (Bud) Selig**
9th Commissioner of Major
League Baseball
*Major League Baseball – 2011
Economic and Health Related
Issues*
- 2012 **Atul A. Gawande, MD, MPH**
Brigham and Women's Hospital
*Strategies for Improving Surgical
Performance*
- 2013 **Anders O.J. Bergenfelz, MD,
PhD**
Lund University Hospital
*Quality Control in Clinical
Practice and Postgraduate
Education in Endocrine Surgery*
- 2014 **Yuri E. Nikiforov, MD, PhD**
University of Pittsburgh
School of Medicine
*Progress in Genomic
Markers for Thyroid Cancer:
How Does it Affect Patient
Management?*
- 2015 **Gary Hammer, MD, PhD**
University of Michigan
*Translating Adrenal Stem
Cells: Implications for
Adrenal Disease*
- 2016 **Steven A. Rosenberg, MD,
PhD**
National Cancer Institute
and George Washington
University
*The Curative Potential
of T-cell Transfer
Immunotherapy for Patients
with Metastatic Cancer*
- 2017 **Jack A. Gilbert, PhD**
University of Chicago
*Thyroid Cancer and the
Microbiome*
- 2018 **Julie Freischlag, MD FRCS**
Wake Forest University
Breakthrough to Brave
- 2019 **Selwyn M. Vickers, MD,
FACS**
University of Alabama School
of Medicine, University of
Alabama at Birmingham
(UAB)
*Relationships and
Resilience: Lessons Learned
from Mentors and Heroes*



ANNUAL MEETING INFORMATION

ACCREDITATION



AMERICAN COLLEGE OF SURGEONS
DIVISION OF EDUCATION



PartnerCME
JOINT PROVIDERSHIP PROGRAM
ACS DIVISION OF EDUCATION

PROGRAM OBJECTIVES

This activity is designed for all endocrine surgeons seeking the latest developments in endocrine surgical technique and related research. The intent of the program is to improve the quality of patient care and improve overall patient safety. Audience participation and interaction will be encouraged. The content and format of the program have been determined based on evaluations and suggestions of attendees of previous programs.

At the completion of this activity, attendees will be able to:

1. Describe the most up to date innovations in endocrine surgical care to ensure providers are engaging in patient-centered care using the most valid, reliable and current information available to the specialty
2. Participate in discussions, and explain current developments in the science and clinical practice of endocrine surgery
3. Explain practical new approaches and solutions to relevant concepts and problems in endocrine surgical care.
4. Apply additional working knowledge to assist them with their existing and growing endocrine practice.
5. Possess new information and recent developments as they relate to recently established guidelines and procedures
6. Explain the new designation of Noninvasive Follicular thyroid cancer with Papillary-like nuclear features (NIFTP) and what it means for the management care plan of this subtype of thyroid cancer.
7. Apply new techniques to clinical practice to improve efficiency and reduce physician and allied provider burnout

CONTINUING MEDICAL EDUCATION CREDIT INFORMATION

Accreditation

This activity has been planned and implemented in accordance with the Essential Areas and Policies of the Accreditation Council for Continuing Medical Education (ACCME) through the joint providership of the American College of Surgeons and the American Association of Endocrine Surgeons. The American College of Surgeons is accredited by the ACCME to provide continuing medical education for physicians.

AMA PRA Category 1 Credits™

The American College of Surgeons designates this Other activity (hybrid format-live and enduring) for a maximum of **20.25 AMA PRA Category 1 Credits™**. Physicians should claim only the credit commensurate with the extent of their participation in the activity.

Of the *AMA PRA Category 1 Credits™* listed above, a maximum of 11.50 credits meets the requirements for Self-Assessment.



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CME CERTIFICATES AND EVALUATIONS

You may complete your attendance verification, meeting evaluation and self-assessment posttest online. You will receive your electronic CME certificate after completing the evaluation and posttests. Your final CME hours will be submitted to the ACS. Members of the ACS will have their credits posted to the ACS website around 30 days post-activity if your ACS number is provided.

The website to claim your CME credits will be emailed to all attendees.

Credit Summary	CME	Self-Assessment
AAES Opening Session	0.75	
Carol & Orlo H. Clark Distinguished Lecture	0.75	
Scientific Session I (Papers 1-4)	1.00	1.00
Scientific Session II (Papers 5-8, with DM)	1.25	1.25
How I Handle It: Tips and Tricks for Challenging Operative Scenarios	1.00	
Scientific Session III (Papers 9-13)	1.25	1.25
QuickShot Posters Happy Hour #1 (QS 1-8)	1.00	1.00
Ethical Issues Associated with Early Adoption of Innovative Surgical Techniques	1.00	
Presidential Address	1.00	
Scientific Session IV (Papers 14-17 with DM)	1.25	1.25
AAES Presidential Panel on Diversity, Equity and Inclusion	1.00	
Scientific Session V (Papers 18-20)	0.75	0.75
Medical College of Wisconsin Stuart D. Wilson, M.D. Historical Lecture	0.75	
Scientific Session VI (Papers 21-24)	1.00	1.00
Interesting Cases	1.50	
CESQIP Update	1.00	
Scientific Session VII (Papers 25-29)	1.25	1.25
Scientific Session VIII (Papers 30-35 with DM)	1.75	1.75
QuickShot Posters Happy Hour #2 (QS 9-16)	1.00	1.00
	20.25	11.50

DISCLOSURE INFORMATION

In accordance with the ACCME Accreditation Criteria, the American College of Surgeons must ensure that anyone in a position to control the content of the educational activity (planners and speakers/authors/discussants/moderators) has disclosed all financial relationships with any commercial interest (termed by the ACCME as “ineligible companies”, defined below) held in the last 24 months (see below for definitions). Please note that first authors were required to collect and submit disclosure information on behalf all other authors/contributors, if applicable.

Ineligible Company: The ACCME defines a “commercial interest” as any entity producing, marketing, re-selling, or distributing health care goods or services used on or consumed by patients. Providers of clinical services directly to patients are NOT included in this definition.

Financial Relationships: Relationships in which the individual benefits by receiving a salary, royalty, intellectual property rights, consulting fee, honoraria, ownership interest (e.g., stocks, stock options or other ownership interest, excluding diversified mutual funds), or other financial benefit. Financial benefits are usually associated with roles such as employment, management position, independent contractor (including contracted research), consulting, speaking and teaching, membership on advisory committees or review panels, board membership, and other activities from which remuneration is received, or expected. ACCME considers relationships of the person involved in the CME activity to include financial relationships of a spouse or partner.

Conflict of Interest: Circumstances create a conflict of interest when an individual has an opportunity to affect CME content about products or services of a commercial interest with which he/she has a financial relationship.

The ACCME also requires that ACS manage any reported conflict and eliminate the potential for bias during the educational activity. Any conflicts noted below have been managed to our satisfaction. The disclosure information is intended to identify any commercial relationships and allow learners to form their own judgments. However, if you perceive a bias during the educational activity, please report it on the evaluation.

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AGENDA

AGENDA

All times listed are Central Daylight Time.

SUNDAY, APRIL 25, 2021

9:30 am – 10:15 am	AAES Opening Session, Dr. Allan Siperstein
10:15 am – 11:00 am	UCSF Carol & Orlo Clark Lectureship, Dr. André Lacroix
11:00 am – 11:45 am	Break
11:00 am – 11:30 am	Innovation Showcase: Sonic Healthcare USA
11:45 am – 12:45 pm	Scientific Session 1 (Papers 1-4)
12:45 pm – 1:00 pm	Break
1:00 pm – 2:15 pm	Scientific Session 2 with Distinguished Moderator (papers 5-8)
2:15 pm – 3:15 pm	Break
2:15 pm – 2:45 pm	Innovation Showcase
2:15 pm – 3:15 pm	Yoga
3:15 pm – 4:15 pm	How I Handle It: Tips and Tricks for Challenging Operative Scenarios, Dr. Quan Duh
4:15 pm – 5:30 pm	Scientific Session 3 (Papers 9-13)
5:30 pm – 6:00 pm	Break
6:00 pm – 7:00 pm	QuickShot Poster Happy Hour #1 (posters 1-8)
7:30 pm – 8:30 pm	Fellowship Program Meet-Ups (advance registration)

MONDAY, APRIL 26, 2021

7:30 am – 9:00 am	Yoga
8:00 am – 8:45 am	New Member Welcome
9:00 am – 10:00 am	Ethical Issues Associated with Early Adoption of Innovative Surgical Techniques, Dr. Peter Angelos

10:00 am – 11:00 am	Presidential Address, Dr. Allan Siperstein
11:00 am – 12:15 pm	Scientific Session 4 with Distinguished Moderator (Papers 14-17)
12:15 pm – 12:45 pm	Break
12:45 pm – 1:45 pm	AAES Presidential Panel on Diversity Equity and Inclusion (DEI)
1:45 pm – 2:30 pm	Scientific Session 5 (Papers 18-20)
2:30 pm – 3:30 pm	NADF Patient Advocacy Session
3:45 pm – 4:30 pm	Medical College of Wisconsin-Stuart D. Wilson, M.D. Historical Lecture, Dr. Clifford Ko
4:30 pm – 5:30 pm	Scientific Session 6 (Papers 21-24)
5:30 pm – 6:30 pm	Presidential Happy Hour and Awards
7:30 pm – 8:30 pm	Fellowship Program Meet-Ups (advance registration)

TUESDAY, APRIL 27, 2021

9:30 am – 11:00 am	Interesting Cases Session, Dr. Richard Hodin
11:00 am – 11:45 am	AAES Business Meeting
11:45 am – 12:45 pm	CESQIP Update
11:45 am – 12:15 pm	Innovation Showcase
12:45 pm – 2:00 pm	Scientific Session 7 (Papers 25-29)
2:00 pm – 2:30pm	Break
2:30 pm – 4:15 pm	Scientific Session 8 with Distinguished Moderator (papers 30-35)
4:15 pm – 5:15 pm	QuickShot Poster Happy Hour #2 (posters 9-16)
5:45 pm – 6:15 pm	Final Awards, Leadership and Closing Comments



SCIENTIFIC PROGRAM

◆ Denotes Resident/Fellow Research Award
Competition Paper

NOTE: Author listed in **BOLD** is the presenting author

The Scientific Program includes all sessions that are eligible
for CME credit. Credit amounts for each session are listed
on page 36.

SCIENTIFIC PROGRAM

Sunday, April 25, 2021

9:30 – 10:15 AM

AAES OPENING SESSION, Allan Siperstein, MD

- Welcome – Allan Siperstein, MD
- In Memoriam – Allan Siperstein, MD
- Introduction of 2019 and 2020 New Members
- Introduction of 2019 Paul LoGerfo Award – Carrie Lubitz, MD, MPH
 - Naira Baregamian, MD – Vanderbilt University Medical Center
- Introduction to 2019 AAES-ThyCa Award – Carrie Lubitz, MD, MPH
 - Matthew Nehs, MD – Brigham and Women's Hospital

10:15 – 11:00 AM

UCSF CAROL & ORLO H. CLARK LECTURERSHIP

André Lacroix, M.D., FCAHS, MD – Centre hospitalier de l'Université de Montréal (CHUM)

“Aberrant regulation of cortisol and aldosterone secretion in adrenal tumors and hyperplasias”

11:45 AM – 12:45 PM

SCIENTIFIC SESSION 1: PAPERS 1-4

MODERATORS: Carrie Lubitz, MD, MPH – Massachusetts General Hospital, and Haggi Mazeh, MD – Hadassah-Hebrew University Medical Center, Mount Scopus

◆ **01. Is CT-scan identified necrosis a reliable single parameter for discerning between malignant and benign adrenocortical tumors?**
Daniel Garay Lechuga¹, Juan D Hernandez Acevedo², Rafael Humberto Perez Soto¹, David Butrón Hernández³, Mauricio Sierra Salazar¹, Juan P Pantoja Millán¹, Miguel F Herrera Hernández¹, David Velázquez Fernández¹
¹Endocrine surgery, National Institute for Medical Health Sciences and Nutrition, Salvador Zubirán, ²General surgery, National Institute for Medical Health Sciences and Nutrition, Salvador Zubirán, ³Radiology, National Institute for Medical Health Sciences and Nutrition, Salvador Zubirán

◆ **02. Clinical Features, Genotype-Phenotype Correlations, and Treatment Outcomes in Children and Adolescents with Multiple Endocrine Neoplasia Type 1: An International Cohort Study**
Omar A Shariq^{1,2}, Kate E Lines², Katherine A English², Bahram Jafar-

Mohammadi², Philippa Prentice³, Ruth Casey⁴, Benjamin G Challis⁴, Andreas Selberherr⁵, Fiona J Ryan², Ultan Healy², Tom R Kurzawinski⁶, Mehul T Dattani³, Irina Bancos⁷, Duncan Richards⁸, Benzon M Dy¹, Melanie L Lyden¹, William F Young, Jr.⁷, Travis J McKenzie¹, Rajesh V Thakker²

¹Department of Surgery, Mayo Clinic, ²Oxford Centre for Diabetes, Endocrinology and Metabolism, University of Oxford, ³Department of Paediatric Endocrinology, Great Ormond Street Hospital for Children, ⁴Department of Endocrinology, Cambridge University Hospitals NHS Foundation Trust, ⁵Department of Surgery, Medical University of Vienna, ⁶Centre for Endocrine Surgery, Great Ormond Street Hospital for Children, ⁷Division of Endocrinology, Diabetes, Metabolism, and Nutrition, Mayo Clinic, ⁸Oxford Clinical Trials Research Unit, University of Oxford

03. A multigenomic liquid biopsy biomarker for Neuroendocrine Tumor disease outperforms CgA and has diverse surgical and clinical utility

Irvin M Modlin¹, Massimo Falconi², Pier Luigi Filosso³, Andrea Frilling⁴, Anna Malczewska⁵, Christos Toumpanakis⁶, Ignat A Drozdov, Kjell Oberg⁷

¹Surgery, Yale University School of Medicine, ²Ospedale San Raffaele IRCCS, ³University of Turin, ⁴Imperial College London, ⁵Medical University of Silesia, ⁶University College of London, ⁷Uppsala University

◆ 04. A Prospective Study of Carcinoid Crisis with No Perioperative Octreotide

Sarah Wonn¹, Anna Ratzlaff¹, SuEllen Pommier¹, Belinda McCully¹, Rodney Pommier¹

¹Oregon Health & Science University

1:00 PM – 2:15 PM

Scientific Session 2: Papers 5-8 (with Distinguished Moderator)

MODERATORS: Rachel Kelz – University of Pennsylvania, and Mark Zafareo, MD – MD Anderson Cancer Center

◆ 05. Association of the Affordable Care Act with Access to Highest-Volume Centers for Patients with Thyroid Cancer

Jacques A Greenberg¹, Jessica W Thiesmeyer¹, Timothy M Ullman¹, Caitlin Egan¹, Maureen D Moore¹, Fernando Valle Reyes², Nikolay Ivanov³, Amanda M Laird⁴, Brendan M Finnerty¹, Thomas J Fahey III¹, Rasa Zarnegar¹, Toni Beninato⁴

¹Surgery, Weill Cornell Medical College / New York-Presbyterian Hospital,

²Surgery, Weill Cornell Medical College, ³Weill Cornell Medical College,

⁴Endocrine Surgery, Rutgers Cancer Institute of New Jersey, Rutgers Robert Wood Johnson Medical School

◆ 06. Insurance Type is Associated with Appropriate Use of Surgical and Adjuvant Care for Differentiated Thyroid Carcinoma.

Jessica W. Thiesmeyer¹, Jessica Limberg¹, Timothy M. Ullmann¹, Jacques Greenberg¹, Caitlin E. Egan¹, Maureen D. Moore¹, Brendan M. Finnerty¹,

Amanda M. Laird², Rasa Zarnegar¹, Thomas J. Fahey III¹, Toni Beninato²

¹*Surgery, New York-Presbyterian Hospital/Weill Cornell Medical Center,*

²*Endocrine Surgery, Rutgers Cancer Institute of New Jersey*

◆ **07. United Network for Organ Sharing Database Analysis: Pre-transplant thyroid cancer does not affect patient or graft survival after renal transplantation**

Aaron M Delman¹, Kevin M Turner², Alice Tang², David L Steward², Tammy M Holm³

¹*Surgery, University of Cincinnati College of Medicine,* ²*University of Cincinnati College of Medicine,* ³*Surgical Oncology, University of Cincinnati College of Medicine*

¹*Surgery, University of Cincinnati College of Medicine,* ²*University of Cincinnati College of Medicine,* ³*Surgical Oncology, University of Cincinnati College of Medicine*

◆ **08. Racial Disparities in the Utilization of Parathyroidectomy Among Patients with Primary Hyperparathyroidism: Evidence from a Nationwide Analysis of Medicare Claims**

Wilson M Alobuia¹, Tong Meng², Robin M Cisco¹, Dana T Lin¹, Insoo Suh³,

Manjula K Tamura^{4,5}, Amber Trickey⁶, Electron Kebebew¹, Carolyn D Seib^{1,6,7}

¹*Surgery, Stanford University School of Medicine,* ²*Emergency Medicine,*

Stanford University School of Medicine, ³*Surgery, University of California,*

San Francisco, ⁴*Geriatrics Research and Education Clinical Center (GRECC),*

Palo Alto Veterans Affairs Health Care System, ⁵*Nephrology, Stanford*

University School of Medicine, ⁶*Stanford–Surgery Policy Improvement*

Research and Education Center (S-SPIRE), Stanford University School of

Medicine, ⁷*General Surgery, Palo Alto Veterans Affairs Health Care System*

3:15 PM – 4:15 PM

How I Handle It: Tips and Tricks for Challenging Operative Scenarios

MODERATOR: Quan-Yang Duh, MD – University of California San Francisco

PANELISTS: Gerard Doherty, MD - Brigham and Women's Hospital; James Lee, MD - Columbia University Medical Center; Mira Milas, MD - University of Arizona College of Medicine - Phoenix and Banner Health; and Rebecca Sippel, MD - University of Wisconsin

4:15 PM – 5:45 PM

Scientific Session 3: Papers 9-13

MODERATORS: James Howe, MD – University of Iowa Hospitals & Clinics, and Juan Pablo Pantoja, MD – Instituto Nacional de Ciencias Medicas y Nutricion Salvador Zubiran

09. Identification of novel lipid metabolic biomarkers associated with poor adrenocortical carcinoma prognosis using integrated bioinformatics.

Chitra Subramanian¹, Mark S Cohen¹

¹*Surgery, University of Michigan*

◆ **10. Mast Cell Immunogenomic Computational Deconvolution of Adrenocortical Carcinoma Tumor Microenvironment**

Jordan J Baechle¹, David N Hanna², Raja S Konjeti³, Jeffrey C Rathmell⁴, Kimryn W Rathmell⁵, Naira Baregamian²

¹*Meharry Medical College*, ²*Surgery, Vanderbilt University Medical Center*,

³*Radiation Oncology, Vanderbilt University Medical Center*, ⁴*Pathology, Microbiology and Immunology, Vanderbilt University Medical Center*,

⁵*Hematology and Oncology, Vanderbilt University Medical Center*

◆ **11. Expression of Cancer Stem Cell Markers in Tall Cell Variant Papillary Thyroid Cancer Identifies a Molecular Profile Predictive of Recurrence in Classic Papillary Thyroid Cancer**

Anna C Beck¹, Anand Rajan², Shannon Landers³, Sarah Kelley¹, Andrew M Bellizzi², Geeta Lal¹, Sonia L Sugg¹, James R Howe¹, Carlos H Chan¹, Ronald J Weigel¹

¹*Surgery, University of Iowa Hospitals and Clinics*, ²*Pathology, University of Iowa Hospitals and Clinics*, ³*University of Iowa*

◆ **12. Glycolytic Inhibition with 3-Bromopyruvate Suppresses Tumor Growth and Improves Survival in a Murine Model of Anaplastic Thyroid Cancer**

Bixiao Zhao¹, Abha Aggarwal¹, Jessica Marshall¹, Matthew Nehs¹

¹*Surgery, Brigham and Women's Hospital*

13. Inhibition of autophagy mitigates cell migration and invasion in thyroid cancer

Tammy M Holm¹, Jun-Lin Guan², Z. Christine Bian²

¹*Surgical Oncology, University of Cincinnati College of Medicine*, ²*Cancer*

Biology, Unive10Carolina, ⁴*Department of Radiology, Boston University*

School of Medicine, ⁵*Department of Medicine, Boston University School of Medicine*

6:00 PM – 7:00 PM

QuickShot Poster Happy Hour #1 (Papers 1-8)

MODERATORS: Peter Czako, MD – William
Beaumont Hospital, and Lilah Morris-Wiseman, MD
– University of Arizona-Tucson

◆ **01. Long-term Voice Changes After Thyroidectomy: Results from a Validated Survey**

Chun Li¹, Scott Fligor¹, Sarah Duncan¹, Anthony Maeda¹, Hao Wei Chen¹, Anam Choudhary¹, Simran Budhwani¹, Per-Olof Hasselgren¹, Peter Mowschenson¹, Pavan Mallur¹, Benjamin James¹

¹*Beth Israel Deaconess Medical Center*

02. Out of Pocket Costs for Commercial Patients Undergoing Thyroidectomy

Feibi Zheng¹, Yongmei Huang², Jennifer Kuo³, Jason Wright⁴

¹*Houston Methodist Hospital*, ²*College of Physicians and Surgeons*,

Columbia University, ³*Division of GI/Endocrine Surgery, Columbia University*,

⁴*Herbert Irving Comprehensive Cancer Center, Columbia University*

03. Post-thyroidectomy hypocalcemia: is a routine preferable over a selective supplementation?

Luca Sessa¹, Carmela De Crea², Francesca Zotta³, Milena Pia Cerviere³, Pierpaolo Gallucci¹, Francesco Pennestri¹, Pietro Princi¹, Luca Revelli², Rocco Bellantone², Marco Raffaelli²

¹Fondazione Policlinico Universitario Agostino Gemelli IRCCS, ²Fondazione Policlinico Universitario Agostino Gemelli IRCCS - Università Cattolica del Sacro Cuore, ³Università Cattolica del Sacro Cuore

◆ 04. Impact of a Systemwide Adrenal Incidentaloma Quality Improvement Initiative – a Prospective Study

Alison P Woods^{1,2}, Timothy Feeney^{2,3}, Avneesh Gupta⁴, Philip E Knapp⁵, David McAneny², Frederick T Drake²

¹Department of Surgery, Johns Hopkins University School of Medicine, ²Department of Surgery, Boston University School of Medicine, ³Department of Epidemiology, University of North Carolina, ⁴Department of Radiology, Boston University School of Medicine, ⁵Department of Medicine, Boston University School of Medicine

◆ 05. Generation of an organoid model of adrenocortical carcinoma

Hemamylammal S SugavanamSivakumar¹, Kylie G Nairon¹, Xuguang G Zheng², Barbra S. Miller², John E Phay², Lawrence S Kirschner³, Aleksander G Skardal¹, Priya H Dedhia²

¹Biomedical Engineering, Ohio State University, ²Surgery, Ohio State University, ³Internal Medicine, Ohio State University

◆ 06. A prospective study comparing the midline and lateral trans-laryngeal ultrasonography approaches in the assessment of vocal cords before and after thyroid and neck surgeries

Man Him Matrix Fung¹, Wing Yan Chan¹, Ching Yiu Wong¹, Brian Hung-hin Lang¹

¹Surgery, Queen Mary Hospital, University of Hong Kong

◆ 07. Enhancing risk-stratification of indeterminate thyroid nodules using Artificial Neural Network-enabled image analysis.

Kelvin Memeh¹, Jelani Williams¹, Hui Li², Julian Conn Busch³, Li Lan², David Sarne⁴, Edwin Kaplan¹, Peter Angelos¹, Maryellen Giger², Xavier Keutgen¹

¹Section of Endocrine Surgery, Department of Surgery, The University of Chicago Medicine, ²Department of Radiology, The University of Chicago Medicine, ³Pritzker School of Medicine, The University of Chicago, Section of Endocrinology, Diabetes and Metabolism, Department of Medicine, The University of Chicago Medicine

◆ 08. Perception of Risk and Decision on Treatment in the Management of Differentiated Thyroid Cancer

Max A Schumm¹, Michelle Shu¹, Jiyeon Kim², Chi-Hong Tseng³, Masha J Livhits¹, Kyle A Zanoocco¹, Michael W Yeh¹, Greg D Sacks⁴, James X Wu¹

¹Surgery, UCLA, ²Biostatistics, UCLA, ³Medicine, UCLA, ⁴Surgery, Memorial Sloan Kettering Cancer Center

Monday, April 26, 2021

9:00 AM – 10:00 AM

Ethical Issues Associated with Early Adoption of Innovative Surgical Techniques

MODERATOR: Peter Angelos, MD, PhD – University of Chicago

FACULTY: Scott Grant, MD – Caremount; Megan Applewhite, MD – Albany Medical Center; Nancy Perrier, MD – MD Anderson Cancer Center; and Insoo Suh, MD – University of California San Francisco

10:00 AM – 11:00 AM

Presidential Address

Allan Siperstein, MD – Cleveland Clinic

“Endocrine Surgery: Great Accomplishments, Future Challenges”

11:00 AM – 12:15 PM

Scientific Session 4: Papers 14-17

MODERATORS: Janice Pasiaka, MD - University of Calgary, and Brenessa Lindeman, MD – University of Alabama at Birmingham

◆ 14. Perspectives on Virtual Interviews—A Follow-up Study of the Comprehensive Endocrine Surgery Fellowship Interview Process

Alaina D Geary¹, Tracy S Wang², Brenessa Lindeman³, Jennifer H Kuo⁴, Melanie L Lyden⁵, Wen T Shen⁶, Lilah F Morris-Wiseman⁷, Sally E Carty⁸, F. Thurston Drake¹

¹*Surgery, Boston University Medical Center*, ²*Surgery, Medical College of Wisconsin*, ³*Surgery, University of Alabama at Birmingham*, ⁴*Surgery, Columbia University Medical Center*, ⁵*Surgery, Mayo Clinic*, ⁶*Surgery, University of California, San Francisco Medical Center*, ⁷*Surgery, University of Arizona*, ⁸*Surgery, University of Pittsburgh Medical Center*

15. The Glass Podium: Gender Representation within the American Association of Endocrine Surgeons (AAES) from 2010-2019

Sean M Wrenn¹, Rajshri M Gartland², Lindsay E Kuo³, Nancy L Cho²

¹*Surgery, Rush University Medical Center*, ²*Surgery, Brigham and Women’s Hospital*, ³*Surgery, Temple University Hospital*

◆ 16. Optimal Surgeon-Volume Threshold for Neck Dissections in the Setting of Primary Thyroid Malignancies

Rahul K Sharma¹, Jihui Lee², Rachel Liou¹, Catherine McManus¹, James A Lee¹, Jennifer H Kuo¹

¹*Division of Endocrine Surgery, Columbia University Irving Medical Center*, ²*Department of Population Health Sciences, Weill Cornell Medicine*

◆ 17. Ambient Particulate Matter Air Pollution Increases Risk of Papillary Thyroid Cancer: a Case-Control Study

Shkala Karzai¹, Zhenyu Zhang², Whitney Sutton¹, Jason D Prescott¹, Murugappan Ramanathan Jr², Aarti Mathur¹

¹*Department of Surgery, Johns Hopkins University School of Medicine,*

²*Department of Otolaryngology- Head and Neck Surgery, Johns Hopkins University School of Medicine*

12:45 PM – 1:45 PM

AAES Presidential Panel on Diversity Equity and Inclusion (DEI). From Awareness to Action: Actionable Ways to Effect DEI Efforts in Surgery.

MODERATORS: Fiemu Nwariaku, MD – University of Texas Southwestern Medical Center, and Minerva Romero Arenas, MD, MPH – Weill Cornell Medicine – NYP Brooklyn Methodist

SPEAKERS: John Paul Sánchez, MD - University of New Mexico, Joan Reede, MD, MS, MPH, MBA - Harvard Medical School, and Herb Chen, MD - University of Alabama at Birmingham

1:45 PM – 2:30 PM

Scientific Session 5: Papers 18-20

MODERATORS: Tina Yen, MD – Medical College of Wisconsin, and Travis Cotton, MD – Brown University

◆ 18. Parathyroidectomy versus Cinacalcet for the Treatment of Secondary Hyperparathyroidism in Patients Receiving Dialysis. A Propensity Score Matched Analysis.

Nishtha Sharma¹, Luis Alvarado², Roxann Lerma¹, Alok K Dwivedi², Adeel Ahmad³, Aimee Hechanova³, Fernanda Payan-Schober³, Azikiwe Nwosu³, Eyas Alkhalili⁴

¹*Texas Tech Health Sciences Center Paul L Foster School of Medicine,*

²*Biostatistics and Epidemiology, Texas Tech Health Sciences Center Paul L Foster School of Medicine,* ³*Internal Medicine, Texas Tech Health Sciences Center Paul L Foster School of Medicine,* ⁴*Surgery, Texas Health Sciences Center Paul L Foster School of Medicine*

◆ 19. Prevalence and Risk Factors for Tertiary Hyperparathyroidism in Kidney Transplant Recipients

Whitney Sutton¹, Xiaomeng Chen¹, Palak Patel¹, Shkala Karzai¹, Jason D Prescott¹, Dorry L Segev^{1,2}, Mara McAdams-Demarco^{1,2}, Aarti Mathur¹

¹*Department of Surgery, Johns Hopkins University School of Medicine,*

²*Department of Epidemiology, Johns Hopkins University Bloomberg School of Public Health*

◆ 20. Data to Inform Counseling on Parathyroidectomy for Secondary Hyperparathyroidism of Renal Origin

Rebecca L Williams-Karnesky¹, Lauren Krumeich², Heather Wachtel², Douglas L Fraker², Chris Wirtalla², Frank Anthony Venuto², Pamela Sellers², Rachel R Kelz²

¹University of New Mexico, ²University of Pennsylvania

3:45 PM – 4:30 PM

Medical College of Wisconsin – Stuart D. Wilson, M.D. Historical Lecture

Clifford Y. Ko, MD, MS, MSHS, FACS, FASCRS – American College of Surgeons

“Evaluating and Achieving Surgical Quality in 2021”

4:30 PM – 5:30 PM

Scientific Session 6: Papers 21-24

MODERATORS: Michael Yeh, MD – University of California Los Angeles, and Rachel Slotcavage, MD – University of Arkansas

◆ **21. Screening for Primary Aldosteronism in the Hypertensive Obstructive Sleep Apnea Population is Cost-Saving**

Kathryn H Chomsky-Higgins¹, Sarah S Sims Pearlstein¹, Patricia C. Conroy¹, Wen T. Shen¹, Jessica Gosnell¹, Sanziana A. Roman¹, Julie A Sosa¹, Quan-Yang Duh¹, Insoo Suh¹

¹Endocrine Surgery, University of California, San Francisco

◆ **22. Cost Analysis of Reflexive vs. Selective Molecular Testing for Indeterminate Thyroid Nodules**

Q. Lina Hu¹, Max A. Schumm¹, Kyle A. Zanicco¹, Michael W. Yeh¹, Masha J. Livhits¹, James X. Wu¹

¹Surgery, University of California, Los Angeles

◆ **23. Thyroid lobectomy as a cost-effective approach in low-risk papillary thyroid cancer versus Active Surveillance**

Abdallah S Attia¹, Mohanad R Youssef¹, Mohamed Abouiesha¹, Mahmoud Omar¹, Deena Hadedeya¹, Mohammad R Hussein¹, Mohamed Shama¹, Emad Kandil¹

¹Tulane University

◆ **24. A cost-utility analysis of fluorocholine-PET imaging for primary hyperparathyroidism in the United States**

Ava Yap¹, Thomas Hope², Claire Graves³, Wouter Kluijfhout⁴, Wen Shen¹, Jessica Gosnell¹, Julie Ann Sosa¹, Sanziana Roman¹, Quan-Yang Duh¹, Insoo Suh¹

¹Department of Surgery, University of California San Francisco, ²Department of Radiology and Biomedical Imaging, University of California San Francisco, ³Department of Surgery, University of California Davis, ⁴Department of Surgery, University of Utrecht

Tuesday, April 27, 2021

9:30 AM – 11:00 AM **Interesting Cases Session**

MODERATOR: Richard Hodin, MD – Massachusetts General Hospital

1. TWO BIRDS...ONE MASS?

Ashley Alexander, MD – University of Alabama at Birmingham

2. WHAT DO WE REALLY KNOW ABOUT HYPERCALCEMIA AND PREGNANCY?

Panagiotis Bletsis, MD – University of Arizona College of Medicine – Phoenix and Banner Health

3. LIVING AT THE EXTREMES (OF CALCIUM)

Elizabeth M. Huffman, MD – Indiana University School of Medicine

4. THE “TAIL” OF TWO TUMORS

Alexia Stamatiou, MD – Department of Surgery, Weill Cornell Medical College, New York-Presbyterian Hospital

5. (ADRENALLY) INSUFFICIENT ELEVATIONS

Jessica Dahle, MD – Duke University

6. A CASE OF A RUPTURED ADRENAL MASS

Polina Zmijewski, MD – Brown University/ Rhode Island Hospital

7. OF RET AND MEN: THE CASE OF AN INCIDENTAL MODERATE RISK MUTATION

Taufiq Rajwani – Virginia Mason Medical Center

8. A 34-YEAR OLD MAN WITH A LARGE NECK MASS

Lindsay Kuo, MD – Temple University Lewis Katz School of Medicine

11:45 AM – 12:45 PM **CESQIP Update**

FACULTY: David Schneider, MD – University of Wisconsin School of Medicine and Public Health; Jennifer Rosen, MD – MedStar Georgetown University Medical Center and Washington Hospital Center; Sean Wrenn, MD – Massachusetts General Hospital and Brigham and Women’s Hospital

12:45 PM – 2:00 PM **Scientific Session 7: Papers 25-29**

MODERATORS: Tom Fahey, III, MD – New York Presbyterian-Weill Cornell Medicine, and Meredith Sorensen, MD, MD – Dartmouth Hitchcock Medical Center

◆ **25. Stones left unturned: missed opportunities to diagnose primary**

hyperparathyroidism in patients with nephrolithiasis

Michael S Lui¹, Jason C Fisher¹, Hunter J Underwood¹, Kepal N Patel¹, Jennifer B Ogilvie¹

¹*New York University School of Medicine*

◆ 26. Is a Routine 24-hour Urine Calcium Measurement Essential During the Evaluation of Primary Hyperparathyroidism?

Shimena R Li¹, Kelly L Mccoy¹, Meghan Kelley¹, Sally E Carty¹, Linwah Yip¹

¹*General Surgery, UPMC*

27. Long-term follow-up confirms utility of 18f-fluorocholine pet localization for primary hyperparathyroidism

Claire E. Graves¹, Thomas A. Hope², Jina Kim³, Miguel H. Pampaloni², Wouter Kluijfhout⁴, Carolyn D. Seib⁵, Jessica E. Gosnell⁶, Wen T. Shen⁶, Sanziana A. Roman⁶, Julie A. Sosa⁶, Quan-Yang Duh⁶, Insoo Suh⁶

¹*Surgery, University of California Davis*, ²*Radiology, University of California, San Francisco*, ³*Inova Schar Cancer Institute*, ⁴*Surgery, University of Utrecht*, ⁵*Surgery, Stanford University*, ⁶*Surgery, University of California, San Francisco*

◆ 28. Parathyroidectomy for nephrolithiasis in primary hyperparathyroidism: beneficial but not a panacea?

Siu-Yuan L Huang¹, Raoul Burchette², Joanie Chung², Philip Haigh³

¹*General Surgery, Kaiser Permanente Los Angeles Medical Center*,

²*Department of Research and Evaluation, Southern California Permanente Medical Group*, ³*Surgical Oncology, Kaiser Permanente Los Angeles Medical Center*

◆ 29. Recurrence after Successful Parathyroidectomy – Who Should We Worry About?

Aditya S Shirali¹, Si-Yuan Wu², Yi-Ju Chiang³, Paul H Graham¹, Elizabeth G Grubbs¹, Jeffrey E Lee¹, Nancy D Perrier¹, Sarah B Fisher¹

¹*Surgical Oncology, University of Texas MD Anderson Cancer Center*,

²*National Defense Medical Center*, ³*University of Texas MD Anderson Cancer Center*

2:30 PM – 4:15 PM

Scientific Session 8: Papers 30-35 (with Distinguished Moderator)

MODERATORS: Elizabeth Grubbs, MD - MD Anderson Cancer Center; and Kelly McCoy, MD - University of Pittsburgh

30. A Prospective Randomized Controlled Trial on the Efficacy and Safety of Prophylactic Central Compartment Lymph Node Dissection in Papillary Thyroid Carcinoma.

Jong-hyuk Ahn¹, Jung Hak Kwak¹, Keunchul Lee², Hyeong Won Yu², Hyungju Kwon³, Su-jin Kim¹, Young Jun Chai⁴, June Young Choi², Kyu Eun Lee¹

¹*Seoul National University Hospital*, ²*Seoul National University Bundang*

31. Rate of Occult Malignancy May Be A Deterrent to Radiofrequency Ablation for Benign Thyroid Disease

Jina Kim¹, Zhifei Sun², Marcus H Cummins³, Kevin C Donohue³, Robin Lea³, Claire E Graves⁴, Wen T Shen³, Jessica E Gosnell³, Sanziana A Roman³, Julie A Sosa³, Quan-Yang Duh³, Insoo Suh³

¹Inova Schar Cancer Institute, ²Washington University in St. Louis, ³University of California-San Francisco, ⁴University of California-Davis

◆ 32. Age determines treatment for T2N0M0 papillary thyroid cancer

Erin C MacKinney¹, Kristine Kuchta², David J Winchester³, Amna Khokar⁴, Tricia A Moo-Young¹, Richard A Prinz¹

¹Endocrine Surgery, NorthShore University HealthSystem, ²Biostatistics and Research Informatics, NorthShore University HealthSystem, ³NorthShore University HealthSystem, ⁴Endocrine Surgery, John H. Stroger Cook County Hospital

◆ 33. Radioactive iodine does not improve overall survival for patients with aggressive variants of papillary thyroid carcinoma less than 2 cm

Simon A Holoubek^{1,2}, Erin C MacKinney^{2,3}, Amna H Khokar^{2,3}, Kristine M Kuchta⁴, David J Winchester^{2,3}, Richard A Prinz^{2,3}, Tricia A Moo-Young^{2,3}

¹Department of Otolaryngology, Head and Neck Surgery, Augusta University, ²Department of Surgery, NorthShore University HealthSystem, ³Department of Surgery, University of Chicago, ⁴Bioinformatics and Research Core, NorthShore University HealthSystem

◆ 34. Intraoperative trans-laryngeal ultrasonography (LUSG) of the vocal cord is a novel method of confirming the recurrent laryngeal nerve (RLN) integrity during thyroid and neck surgery

Man Him Matrix Fung¹, Brian Hung-hin Lang²

¹Queen Mary Hospital, University of Hong Kong, ²Surgery, Queen Mary Hospital, University of Hong Kong

◆ 35. Medullary Thyroid Cancer: What is the optimal management of the lateral neck in a node negative patient at index operation?

Thomas Szabo Yamashita¹, Richard Rogers¹, Trenton Foster¹, Melanie Lyden¹, Geoffrey Thompson¹, John Morris¹, Travis McKenzie¹, Benzon Dy¹

¹Mayo Clinic

4:15 PM – 5:15 PM

QuickShot Poster Happy Hour #2 (Poster 9-16)

MODERATORS: John Lew, MD – University of Miami, and Adrienne Melck, MD – University of British Columbia

◆ 09. Molecular fluorescence-guided imaging of papillary thyroid cancer nodal metastasis using a fluorescent tracer targeting MET can

be used to detect lymph node metastasis

Madelon Metman¹, Pascal Jonker¹, Luc Sondorp^{2,3}, Mark Sywak⁴, Anthony Gill^{5,6,7}, Liesbeth Jansen², Paul van Dienst^{8,9}, Tessa van Ginhoven¹⁰, Clemens Löwik¹¹, Anh Nguyen¹², Go van Dam^{13,14}, Rob Coppes³, Bettien van Hemel¹⁵, Rudolf Fehrmann¹⁶, Schelto Kruijff¹

¹*Department of Surgical Oncology, University Medical Center Groningen,*
²*University Medical Center Groningen,* ³*Department of Biomedical Sciences of Cell & Systems – section molecular cell biology, University Medical Center Groningen,* ⁴*Department of Endocrine Surgery and Surgical Oncology, Royal North Shore Hospital,* ⁵*Royal North Shore Hospital, St Leonards,* ⁶*Sydney Medical School, University of Sydney,* ⁷*Cancer Diagnosis and Pathology Group Kolling Institute of Medical Research, Royal North Shore Hospital,* ⁸*Department of Pathology, University Medical Center Utrecht,* ⁹*Sidney Kimmel Comprehensive Cancer Center, Johns Hopkins,* ¹⁰*Department of Surgical Oncology and Gastrointestinal Surgery, Erasmus MC Cancer Institute,* ¹¹*Department of Radiology and Nuclear Medicine, Erasmus Medical Center Rotterdam,* ¹²*Department of Pathology, Erasmus Medical Center Rotterdam,* ¹³*Department of Nuclear Medicine and Molecular Imaging, University Medical Center Groningen,* ¹⁴*AxelaRx/TRACER B.V.,* ¹⁵*Department of Pathology, University Medical Center Groningen,* ¹⁶*Department of Medical Oncology, University Medical Center Groningen*

◆ 10. Surgical treatment of metastatic disease in the adrenal gland; how to inform the patient?

Madelon Metman¹, Charlotte Viëtor², Auke Seinen¹, Patrick Hemmer¹, Michiel Kerstens³, Richard Feelders⁴, Gaston Franssen², Tessa van Ginhoven², Schelto Kruijff¹

¹*Department of Surgical Oncology, University Medical Center Groningen,*
²*Department of Surgical Oncology and Gastrointestinal Surgery, Erasmus MC Cancer Institute,* ³*Department of Endocrinology, University Medical Center Groningen,* ⁴*Department of Endocrinology, Erasmus MC Cancer Institute*

◆ 11. Pre-Operative Blockade for Pheochromocytoma: Is it Time to Retire Phenoxybenzamine?

Jordan A George¹, Ruth N Obiarinze¹, John R Porterfield¹, Thomas N Wang¹, Herbert Chen¹, Brenessa M Lindeman¹, Jessica M Fazendin¹, Sushanth Reddy¹

¹*Surgery, University of Alabama at Birmingham*

12. Surgical Treatment of Hyperthyroidism Can Be Performed Safely Before a Euthyroid State is Achieved

Jessica M Fazendin¹, Kim Ramonell², Ammar Asban¹, Mary Smithson¹, John Porterfield¹, Herbert Chen¹, Brenessa Lindeman³

¹*University of Alabama at Birmingham,* ²*Surgery, University of Alabama at Birmingham,* ³*Surgeon*

◆ 13. Screening for Primary Hyperaldosteronism is Underutilized in Patients with Obstructive Sleep Apnea

Patricia C Conroy¹, Sophia Hernandez², Kate Chomsky-Higgins¹, Sarah Pearlstein¹, Wen T Shen¹, Jessica Gosnell¹, Julie A Sosa¹, Sanziana Roman¹, Quan-Yang Duh¹, Insoo Suh¹

¹*Department of Surgery, University of California, San Francisco*, ²*School of Medicine, University of California, San Francisco*

14. RNA-Sequencing Identifies Unique Molecular Features of Duodenal Neuroendocrine Tumors

Catherine G Tran¹, Scott K Sherman¹, Anna C Reisetter², Patrick J Breheny², Guiying Li¹, Aaron T Scott¹, Bartley J Brown³, Terry A Braun³, Xianlu Laura Peng⁴, Jen Jen Yeh⁵, Po Hien Ear¹, James R Howe¹

¹*Department of Surgery, University of Iowa Carver College of Medicine*,

²*Department of Biostatistics, University of Iowa College of Public Health*,

³*Center for Bioinformatics and Computational Biology, University of Iowa College of Engineering*,

⁴*Lineberger Comprehensive Cancer Center and Department of Pharmacology, University of North Carolina*, ⁵*Lineberger Comprehensive Cancer Center and Department of Surgery, University of North Carolina*

15. Circulating microRNA signatures in primary hyperparathyroidism

Heather Wachtel¹, Jae P Ermer¹, Douglas L Fraker¹, Rachel R Kelz¹, Matthias Hackl², Michael A Levine³

¹*Surgery, University of Pennsylvania*, ²*TAmiRNA*, ³*Endocrinology, Children's Hospital of Philadelphia*

16. Evaluating impact of near Infrared autofluorescence detection for identifying parathyroid glands during parathyroidectomies – a randomized single-center clinical trial.

Giju Thomas¹, Colleen M Kiernan², Melinda E Sanders³, Anita Mahadevan-Jansen¹, Carmen C Solorzano²

¹*Vanderbilt Biophotonics Center, Department of Biomedical Engineering,*

Vanderbilt University, ²*Division of Surgical Oncology and Endocrine Surgery,*

Vanderbilt University Medical Center, ³*Department of Pathology, Vanderbilt University Medical Center*



ABSTRACTS

◆ Denotes Resident/Fellow Competition Paper

NOTE: Author listed in **BOLD** is the presenting author

◆ **01. Is CT-scan identified necrosis a reliable single parameter for discerning between malignant and benign adrenocortical tumors?**

Daniel Garay Lechuga¹, Juan D Hernandez Acevedo², Rafael Humberto Perez Soto¹, David Butrón Hernández³, Mauricio Sierra Salazar¹, Juan P Pantoja Millán¹, Miguel F Herrera Hernández¹, David Velázquez Fernández¹

¹Endocrine surgery, National Institute for Medical Health Sciences and Nutrition, Salvador Zubirán, ²General surgery, National Institute for Medical Health Sciences and Nutrition, Salvador Zubirán, ³Radiology, National Institute for Medical Health Sciences and Nutrition, Salvador Zubirán

Background: Adrenocortical carcinoma (ACC) is a rare malignant tumor with a low incidence and a well-known poor prognosis. Preoperative diagnosis in the context of an adrenal mass identified by imaging studies is paramount for early surgical treatment. Recently, the presence of necrosis has been proposed as a single morphological parameter to differentiate benign from malignant adrenocortical tumors. The aim of this study was to analyze the measures of diagnostic efficiency of the different suspicious CT-scan features, including necrosis, for the diagnosis of ACC.

Methods: Case-control study of patients surgically treated for an adrenal mass with histopathological report consistent with ACC (cases) and benign adenoma (controls) between 1987 and 2019. Radiological features on CT-scan were retrospectively collected including size > 4 cm, simple-phase attenuation > 10 HU, necrosis, heterogeneity, local invasion and presence of metastases. Non-parametric bivariate statistical analysis and χ^2 test were performed for dimensional variables with non-normal distribution and categorical variables, respectively. Diagnostic efficiency measures of each feature for ACC diagnosis were performed. Furthermore, tumor size - necrosis volume correlation was calculated.

Results: Eighteen ACC patients and 41 patients with benign adenomas (BA) were included. Median (range) tumor size was 12.5 (2.4-16.7) cm and 2.8 (0.9-6.4) cm for ACC and BA, respectively ($p < 0.0001$). Differences between ACC and BA patients were found regarding tumor size > 4 cm (93.3% vs 26.3%, $p < 0.0001$), simple-phase attenuation > 10 HU (100% vs 53.3%, $p = 0.001$), necrosis (100% vs 2.8%, $p < 0.0001$), heterogeneity (93.3% vs 20.6%, $p < 0.0001$), local invasion (66.67% vs 0%, $p < 0.0001$) and presence of metastases (50% vs 0%, $p < 0.0001$). Presence of necrosis was the feature with the highest diagnostic accuracy (98%) with sensitivity, specificity, PPV and NPV of 100%, 97.14%, 93.75% and 100%, respectively. Cohen's Kappa coefficient between image-detected and histopathology finding of necrosis was 0.908 ($p < 0.0001$). Spearman's coefficient of 0.90 ($p < 0.0001$) was found for tumor size - necrosis volume correlation.

Conclusions: Presence of CT-scan detected necrosis is a reliable radiological feature to discern malignant from benign adrenal cortex tumors.

◆ 02. Clinical Features, Genotype-Phenotype Correlations, and Treatment Outcomes in Children and Adolescents with Multiple Endocrine Neoplasia Type 1: An International Cohort Study

Omaisr A Shariq^{1,2}, Kate E Lines², Katherine A English², Bahram Jafar-Mohammadi², Philippa Prentice³, Ruth Casey⁴, Benjamin G Challis⁴, Andreas Selberherr⁵, Fiona J Ryan², Ultan Healy², Tom R Kurzawinski⁶, Mehul T Dattani³, Irina Bancos⁷, Duncan Richards⁸, Benzon M Dy¹, Melanie L Lyden¹, William F Young, Jr.⁷, Travis J McKenzie¹, Rajesh V Thakker²

¹Department of Surgery, Mayo Clinic, ²Oxford Centre for Diabetes, Endocrinology and Metabolism, University of Oxford, ³Department of Paediatric Endocrinology, Great Ormond Street Hospital for Children, ⁴Department of Endocrinology, Cambridge University Hospitals NHS Foundation Trust, ⁵Department of Surgery, Medical University of Vienna, ⁶Centre for Endocrine Surgery, Great Ormond Street Hospital for Children, ⁷Division of Endocrinology, Diabetes, Metabolism, and Nutrition, Mayo Clinic, ⁸Oxford Clinical Trials Research Unit, University of Oxford

Background: Knowledge regarding manifestations and treatment outcomes in patients with multiple endocrine neoplasia type 1 (MEN1) is largely derived from adult cohorts. The objectives of this study were to investigate the occurrence and treatment of MEN1 manifestations during childhood and adolescence, and explore genotype-phenotype correlations in this age group.

Methods: A retrospective analysis was performed of patients with MEN1 who initiated surveillance in childhood or adolescence at 5 referral centers in the USA and Europe. Clinicopathological characteristics and treatment outcomes of manifestations detected before 19 years of age were recorded. Fisher's exact test, Wilcoxon rank-sum test, and Kaplan-Meier methods were used to analyse proportions, continuous variables, and recurrence-free survival, respectively.

Results: Eighty patients (50 females [62.5%]) from 60 families with complete surveillance data were identified. The median age of MEN1 diagnosis was 11.5 years (range: 0-18 years) and the median follow-up was 92.5 months (range: 7-306 months). Analysis revealed germline *MEN1* mutations in 75/80 cases (93.8%). Fifty-six patients (70%) developed an MEN1 manifestation before 19 years, at a median age of 14 years (range: 6-18 years). Primary hyperparathyroidism occurred in 46/56 patients (82.1%), 33 (72%) of whom underwent parathyroidectomy. Less-than-subtotal (<3-gland) resection resulted in worse recurrence/persistence-free survival vs. subtotal (3-3.5-gland) or total (4-gland) parathyroidectomy (median 27 months vs. not reached; $P=0.005$) and was not associated with lower rates of hypoparathyroidism. Twenty-one patients (37.5%) developed duodenopancreatic neuroendocrine tumors (DP-NETs; non-functioning [$n=15$], insulinomas [$n=8$], and gastrinoma [$n=1$]), 12 patients (57.1%) underwent surgery and 3 (14.3%) had metastases (hepatic [$n=2$] and lymph node [$n=1$]). Compared to patients without DP-NETs, those who developed DP-NETs at <19 years were more likely to harbor *MEN1* mutations affecting the menin-JunD interaction domain (80% vs 51.9%; $P=0.0459$). Pituitary tumors developed in 18/56 patients (32.1%) and were mostly dopamine agonist-responsive prolactinomas.

Conclusions: Morbidity from MEN1 manifestations may occur during childhood and adolescence in 70% of patients. Less-than-subtotal parathyroidectomy is associated with high failure rates and should be avoided. DP-NETs are the second most common manifestation in this age group and may be more frequent in patients with mutations disrupting menin-JunD interactions. Our findings underscore the importance of early MEN1 genetic testing and surveillance.

03. A multigenomic liquid biopsy biomarker for Neuroendocrine Tumor disease outperforms CgA and has diverse surgical and clinical utility

Irvin M Modlin¹, Massimo Falconi², Pier Luigi Filosso³, Andrea Frilling⁴, Anna Malczewska⁵, Christos Toumpanakis⁶, Ignat A Drozdov, Kjell Oberg⁷

¹Surgery, Yale University School of Medicine, ²Ospedale San Raffaele IRCCS,

³University of Turin, ⁴Imperial College London, ⁵Medical University of Silesia,

⁶University College of London, ⁷Uppsala University

Background: Chromogranin A (CgA) was previously accepted as the universal NET biomarker. Current guidelines consider it to be of minimal clinical utility. We report a multigenomic NET-specific blood biomarker test assessed over 5 years for diagnostic and surgical utility.

Methods: Cohort #1) NETest was evaluated in 2,383 subjects: 1,652 NETs, other cancers ($n=475$) and controls ($n=256$). In Cohort #2 we undertook a matched analysis using NETest and CgA ($n=1,260$) comprising NETs ($n=922$), cancers (232) and controls (106). Disease status by RECIST 1.1. NETest measurement by qPCR (0-100 scale, ULN: 20), CgA (EuroDiagnostica, ULN: 108ng/mL). Statistics: Mann-Whitney U-test, AUROC analysis, Chi² and McNemar's test.

Results: Cohort #1: NETest is an accurate biomarker (accuracy: 91%, AUC: 0.97, $p<0.0001$) and identifies all NET types: pheochromocytomas (80±24), small intestinal (50±27), pancreas (49±29), gastric (30±20), rectal (30±28), appendix (34±25). Typical lung carcinoids: 41±25 and atypical (50±26, $p<0.0001$). Levels correlate with grading (G1: 40±27 vs. G2/G3 mean NETest: 50-51). Metastatic disease levels (52±27) were higher than local (38±27, $p<0.0001$). NETest stratified disease negative (23±18) from stable disease (43±24) from progressive disease (62±26) ($p<0.0001$). Concordance with NET imaging (CT/MRI/ ⁶⁸Ga-DOTATOC) was 93%. Surgery (R0) ($n=102$) normalized NETest levels in 70%. Elevated levels at POD30 accurately predicted recurrence in 74% within 1 year. R1/R2 surgery failed to normalize levels (100%).

Cohort #2: NETest (87%) is a significantly more accurate diagnostic than CgA (54%, $p<0.0001$, McNemar: 254, Odd's ratio; 8.6). NETest correlated more accurately than CgA with grading (Chi²: 7.7, OR: 18.5) and identifying metastases (Chi²: 180, OR: 8.4). In progressive disease, NETest was positive (95%) compared to CgA (57%, $p<0.0001$). Image-detectable disease was NETest-positive (91%) vs. CgA (46%, Chi²=232, OR: 9.1). In the R0 surgical cohort, 19 of 69 (28%), had elevated post-operative NETest. All 19 (100%) recurred compared to 11% with elevated CgA ($p<0.0001$, Chi²=15.5).

Conclusions: NETest is a NET multigenomic blood biomarker that accurately diagnoses NET disease. In addition, it correlates with many clinical parameters (imaging, grade, metastases, disease status). It is significantly more accurate than CgA. Liquid biopsy with NETest provides an accurate, non-invasive strategy to real-time assess disease status and surgical treatment efficacy.

◆ 04. A Prospective Study of Carcinoid Crisis with No Perioperative Octreotide

Sarah Wonn¹, Anna Ratzlaff¹, SuEllen Pommier¹, Belinda McCully¹, Rodney Pommier¹

¹Oregon Health & Science University

Background: Carcinoid crises, defined as sudden onset of hemodynamic instability in patients with neuroendocrine tumors (NETs) undergoing operation, are associated with significantly increased risk of postoperative complications. Crises were theorized to be due sudden massive release of carcinoid hormones. Therefore, octreotide has been used prophylactically to reduce crisis rates as well as therapeutically to treat crises that still occur. However, multiple retrospective studies using prophylactic octreotide still report crisis rates of 27-42%. Average durations of crises when octreotide is used range from 9-19 minutes and 8-24% of crises last >10 minutes. A recent prospective study showed there is no massive release of hormones during crises, greatly weakening the argument for octreotide use. Before recommending cessation of perioperative octreotide, the incidence and duration of crises needs to be studied when it is not used at all.

Methods: Patients with NETs undergoing operation between 2017-2020 with no perioperative octreotide were prospectively studied. Carcinoid crisis was declared by agreement of the attending surgeon and anesthesiologist if sudden hemodynamic instability or flushing was observed with no plausible alternative explanation. Clinicopathologic data were compared by X^2 test for discrete variables and by Mann-Whitney U test for continuous variables.

Results: One hundred and seventy-one patients underwent 195 operations. Crisis was documented in 49 operations (25%). The median crisis duration was three minutes and no crises >10 minutes (0%) were observed. Crisis was more likely to occur in patients with small bowel primary tumors ($p=0.012$), grade 2 tumors ($p=0.015$), older age ($p=0.021$), and carcinoid syndrome ($p<0.0001$), but there was no significant difference in outpatient long acting somatostatin analog use. Patients who had crises were more likely to receive intraoperative transfusions ($p=0.006$), receive intraoperative vasopressors ($p=0.041$), and have major postoperative complications ($p=0.003$).

Conclusions: Completely eliminating perioperative octreotide resulted in neither increased rate nor duration of crisis compared to previous studies using octreotide. We conclude perioperative octreotide use may be safely stopped, due to inefficacy. Because crisis of even short duration is associated with increased risk of major complications, the search for an effective prophylactic agent should continue.

◆ 05. Association of the Affordable Care Act with Access to Highest-Volume Centers for Patients with Thyroid Cancer

Jacques A Greenberg¹, Jessica W Thiesmeyer¹, Timothy M Ullman¹, Caitlin Egan¹, Maureen D Moore¹, Fernando Valle Reyes², Nikolay Ivanov³, Amanda M Laird⁴, Brendan M Finnerty¹, Thomas J Fahey III¹, Rasa Zarnegar¹, Toni Beninato⁴
¹*Surgery, Weill Cornell Medical College / New York-Presbyterian Hospital*, ²*Surgery, Weill Cornell Medical College*, ³*Weill Cornell Medical College*, ⁴*Endocrine Surgery, Rutgers Cancer Institute of New Jersey, Rutgers Robert Wood Johnson Medical School*

Background: Disparities exist in access to high-volume surgeons, who have better patient outcomes following thyroidectomy. We aimed to determine the association of Medicaid expansion with access to high-volume thyroid cancer surgery centers by insurance status.

Methods: The National Cancer Database was queried for all adult thyroid cancer patients diagnosed 2010-2016. Quartiles of hospital volume (Q1, Q2, Q3, Q4) were generated dependent upon total operative volume during the study period. Clinicodemographic variables and odds ratios for treatment at each quartile were analyzed by insurance status. A difference-in-differences(DD) analysis examined the association of Medicaid expansion in 2013 with change in payer mix by hospital quartile.

Results: 241,448 patients who underwent surgery at 1,332 hospitals were included. Q1 had 48 hospitals (60,585 operations), Q2 120 (60,358), Q3 240 (60,637), and Q4 924 (59,868). Q1 hospitals had a higher proportion of privately-insured patients and were more likely to be academic centers ($p < 0.001$) compared to Q2-Q4 hospitals. Medicaid patients were more likely to be treated at a Q3-Q4 hospital (Q3 OR 1.05, $p < 0.02$, Q4 1.11, $p < 0.01$), while uninsured and Medicare patients were more likely to undergo surgery at Q2-Q4 hospitals [(uninsured: Q2 OR 2.82, Q3 2.34, Q4 2.07, $p < 0.01$) (Medicare: Q2 OR 1.16, Q3 1.30, Q4 1.44, $p < 0.01$)]. Following Medicaid expansion, the odds of Medicaid patients receiving surgery at a Q3 or Q4 compared to Q1 hospital were lower (2014-2016 OR Q3 0.82, Q4 0.85, $p < 0.01$) in eligible states. Medicaid patients in non-expansion states were at a higher-odds of receiving surgery at a Q3-Q4 hospital (2014-2016 OR Q3 2.23, Q4 1.86, $p < 0.01$). Medicaid expansion was associated with an increased proportion of Medicaid patients within each quartile in expansion states compared to non-expansion states, (Q1 adjusted DD 5.36%, Q2 5.29%, Q3 3.68%, Q4 3.26%, $p < 0.001$) and a decrease in uninsured patients treated at Q4 hospitals (adjusted DD -1.06%, $p = 0.001$).

Conclusions: Medicaid expansion was associated with an increased proportion of Medicaid patients undergoing thyroidectomy for thyroid cancer in all quartiles. Patients in expansion states were more likely to have surgery at high-volume centers following Medicaid expansion. The ACA was associated with greater access to high-volume centers for thyroid cancer.

◆ 06. Insurance Type is Associated with Appropriate Use of Surgical and Adjuvant Care for Differentiated Thyroid Carcinoma.

Jessica W. Thiesmeyer¹, Jessica Limberg¹, Timothy M. Ullmann¹, Jacques Greenberg¹, Caitlin E. Egan¹, Maureen D. Moore¹, Brendan M. Finnerty¹, Amanda M. Laird², Rasa Zarnegar¹, Thomas J. Fahey III¹, Toni Beninato²

¹*Surgery, NewYork-Presbyterian Hospital/Weill Cornell Medical Center*, ²*Endocrine Surgery, Rutgers Cancer Institute of New Jersey*

Background: Studies have described disparities in access to and appropriateness of care based on race and socioeconomic status for differentiated thyroid carcinoma (DTC) patients. However, the appropriateness of extent of thyroidectomy and radioactive iodine (RAI) treatment as it relates to insurance status has not been well-characterized.

Methods: The National Cancer Database was queried for adult DTC patients diagnosed 2010–2016. Clinicodemographic variables were compared by insurance type. Adjusted odds ratios (AOR) for appropriateness of therapy and hazard ratios (HR) for overall survival were calculated with multivariable regression modeling adjusted for age, sex, race, comorbidities, income, and hospital volume. A difference-in-differences (DD) analysis examined the association of Medicaid expansion with outcomes for low-income patients <65 years old.

Results: 224,500 patients were included. Demographic variables differed by insurance: Black and Hispanic patients represented a higher proportion of Medicaid and uninsured patients compared to Medicare and private patients (both $p < 0.001$). Medicaid patients had similar adjusted odds of undergoing inappropriate therapy to uninsured patients, including inappropriate lobectomy (Medicaid 1.36, 95%-CI [1.21-1.54]; uninsured 1.30, 95%-CI [1.05-1.60]), and under-treatment with RAI (Medicaid 1.20, 95%-CI [1.14-1.26]; uninsured 1.44, 95%-CI [1.33-1.55]). No insurance (HR 1.2, 95%-CI [1.1-1.4], $p = 0.008$) and Medicaid (HR 1.7, 95%-CI [1.5-1.8], $p < 0.001$) were associated with decreased overall survival compared to Medicare, whereas private insurance was associated with improved survival (HR 0.6, 95%-CI [0.6-0.7], $p < 0.001$). Inappropriate lobectomy and under-treatment with RAI also portended decreased survival, while appropriate surgery and over-treatment with RAI were associated with a survival benefit, regardless of insurance status ($p < 0.001$). There was no difference in appropriateness of treatment observed after Affordable Care Act (ACA) implementation in Medicaid expansion states versus non-expansion states: appropriate surgery overall (adjusted DD 0.5% [95% CI -0.9 to 2.0%], $p = 0.46$), over-treatment with RAI (adjusted DD 4.0% [95% CI -1.6 to 9.6%], $p = 0.16$), under-treatment with RAI (adjusted DD -0.4% [95% CI -4.1 to 3.3%], $p = 0.82$).

Conclusions: Medicaid patients, like uninsured patients, are at significantly increased odds of receiving inappropriate treatment for DTC; both groups are at a survival disadvantage compared to Medicare and those privately-insured. Correspondingly, states with Medicaid expansion did not see a change in the proportion of patients receiving appropriate care post-ACA.

◆ 07. United Network for Organ Sharing Database Analysis: Pre-transplant thyroid cancer does not affect patient or graft survival after renal transplantation

Aaron M Delman¹, Kevin M Turner², Alice Tang², David L Steward², Tammy M Holm³
¹*Surgery, University of Cincinnati College of Medicine,* ²*University of Cincinnati College of Medicine,* ³*Surgical Oncology, University of Cincinnati College of Medicine*

Background: Pre-transplant malignancy is associated with decreased patient and graft survival after renal transplant. Thyroid cancer is commonly identified in end-stage renal disease (ESRD) patients. Current US guidelines recommend a 2-5 year tumor-free waiting period before transplantation. No large database studies have examined the specific, modern day risk of pre-transplant thyroid malignancy (PTTM) on patient and graft survival after renal transplant.

Methods: The United Network for Organ Sharing (UNOS) database was queried for all adult primary renal transplant patients (n=385,641) with PTTM from January 2003–March 2019. Baseline patient characteristics, wait-list duration, and outcomes were compared in patients with and without PTTM.

Results: From January 2003–March 2019, 337 patients were identified with thyroid cancer prior to renal transplant listing. The PTTM cohort was more likely to be older at the time of transplant (56.14 vs 49.07, $p<0.01$) and female (62.91% vs 39.3%, $p<0.01$). On Kaplan-Meier analysis there was no significant difference in patient survival ($p=0.94$), and all-cause renal allograft survival was improved ($p=0.01$) after transplant in PTTM patients. Multivariable Cox-proportional hazards model did not show a significant risk associated with PTTM (HR: 0.86, 0.64–1.16). On bivariate analysis, the development of any post-transplant malignancy was not associated with PTTM (3.75% vs 2.94%, $p=0.44$). In patients diagnosed with thyroid malignancy after listing and prior to transplant (n=67), patient survival was improved ($p=0.02$) and graft survival unchanged ($p>0.05$). Wait-list duration for patients diagnosed with thyroid cancer after listing was significantly increased from baseline (1424.91 days vs 611.01 days, $p<0.01$). To account for potential practice changes over time, we isolated a modern cohort of PTTM patients from January 2016 – March 2019 (n=121), there were no changes in patient survival ($p=0.80$) or graft survival ($p=0.89$). Wait-list duration remained significantly increased (1403.62 days vs 735.42 days, $p<0.01$).

Conclusions: To our knowledge, this is the largest study to examine pre-transplantation thyroid cancer specific outcomes in renal transplantation patients. These findings suggest that PTTM patients are unnecessarily subjected to increased wait-list duration prior to transplant. PTTM diagnosed prior to or after listing is not associated with decreased patient or allograft survival and should not delay renal transplantation.

◆ 08. Racial Disparities in the Utilization of Parathyroidectomy Among Patients with Primary Hyperparathyroidism: Evidence from a Nationwide Analysis of Medicare Claims

Wilson M Alobuia¹, Tong Meng², Robin M Cisco¹, Dana T Lin¹, Insoo Suh³, Manjula K Tamura^{4,5}, Amber Trickey⁶, Electron Kebebew¹, Carolyn D Seib^{1,6,7}

¹*Surgery, Stanford University School of Medicine*, ²*Emergency Medicine, Stanford University School of Medicine*, ³*Surgery, University of California, San Francisco*, ⁴*Geriatrics Research and Education Clinical Center (GRECC), Palo Alto Veterans Affairs Health Care System*, ⁵*Nephrology, Stanford University School of Medicine*, ⁶*Stanford–Surgery Policy Improvement Research and Education Center (S-SPIRE), Stanford University School of Medicine*, ⁷*General Surgery, Palo Alto Veterans Affairs Health Care System*

Background: Among patients with primary hyperparathyroidism (PHPT), parathyroidectomy offers an excellent chance of cure and mitigation of disease-related complications. The impact of race and ethnicity on referral patterns and utilization of parathyroidectomy have not been well-characterized.

Methods: We performed a population-based, retrospective cohort study using 100% Medicare claims from beneficiaries with initial diagnosis of PHPT from 2006-2016. The frequency of PHPT-associated conditions and hospitalizations were evaluated according to race and ethnicity. The associations of race with surgeon evaluation and subsequent utilization of parathyroidectomy within 1 year of diagnosis were analyzed using multivariable logistic regression, adjusting for age, sex, PHPT-associated conditions, comorbidity, frailty, neighborhood disadvantage, and primary area of residence (urban/rural).

Results: Among 210,206 beneficiaries with PHPT, 63,136 (30.0%) underwent parathyroidectomy within 1 year of diagnosis. Black patients were more likely than White patients to have stage 3 chronic kidney disease (10.8% vs 8.1%, respectively) but had lower rates of osteoporosis and nephrolithiasis. Black and Hispanic patients were more likely to be hospitalized for PHPT-associated conditions in the 6 months before and after diagnosis compared to White patients (8.1% and 5.8% vs. 4.8%, respectively). Black race and Hispanic ethnicity were associated with decreased adjusted odds of being evaluated by a surgeon for parathyroidectomy (ORs 0.71 [95% CI 0.69-0.74] and 0.82 [95% CI 0.67-0.99] respectively) and undergoing parathyroidectomy after being evaluated by a surgeon (ORs 0.72 [95% CI 0.68-0.77], 0.82 [95% CI 0.67-0.99], respectively) compared to White race. Asian race was associated with decreased adjusted odds of being evaluated by a surgeon (OR 0.64 [95% CI 0.57-0.71]) and no difference in odds of undergoing parathyroidectomy after surgeon evaluation. Receiving endocrinologist care was associated with increased likelihood of being seen by a surgeon overall (OR 1.35 [95% CI 1.33 – 1.38]); however, analysis of interaction effects suggests this association was significantly decreased in Black, socioeconomically disadvantaged, and rural patients.

Conclusions: Among Medicare patients with PHPT, Black race and Hispanic ethnicity are associated with decreased rates of referral for surgical care and decreased likelihood of undergoing parathyroidectomy after surgeon evaluation. Urgent attention is needed to address racial and ethnic disparities in the management of patients with PHPT.

09. Identification of novel lipid metabolic biomarkers associated with poor adrenocortical carcinoma prognosis using integrated bioinformatics.

Chitra Subramanian¹, Mark S Cohen¹

¹*Surgery, University of Michigan*

Background: Adrenocortical carcinoma (ACC) while rare, often presents with advanced metastatic disease carrying a 5-year survival rate <10%. Currently, systemic therapy is mitotane alone or in combination with multidrug chemotherapy. ACC tumors have high avidity for cholesterol and lipid metabolic reprogramming plays an important role in metastasis and chemoresistance. As the role of lipids in ACC pathogenesis and therapy response has not yet been identified, we hypothesized that the integrated bioinformatic analysis of ACC will result in the identification of novel lipid biomarkers that are useful for diagnosing disease progression, therapy response, or the development of therapy resistance.

Methods: A bioinformatics approach was used to collate ACC studies from three different Gene Expression Omnibus (GEO) data (GSE12368, GSE19750, and GSE10927) from the Correlation engine. Meta-analysis of bio-group in correlation engine identified lipid metabolic genes differentially expressed between ACC and the normal adrenal tissue. Hub genes that are differentially expressed in all three data sets were selected for enrichment analysis by DAVID's. Protein-Protein interaction network (PPI) of hub genes was constructed using STRING. Survival analysis of hub genes was identified from the R2 genomic analysis platform using the TCGA data set.

Results: Examination of pathways by correlation engine identified 43 and 62 lipid metabolism-related genes that are positively and negatively regulated in ACC tumors vs. normal tissues ($p < 0.05$) in all three 3 GEO data. Enrichment analysis indicated that genes involved in sphingolipid, glycerophospholipid, and PPAR alpha metabolism are involving in upregulation of ACC whereas phospholipid, fatty acid, peroxisome, and steroid metabolism are involved in down-regulation of ACC. STRING protein network analysis further confirmed the involvement of the enriched lipid metabolism in ACC. Survival analysis of differentially regulated hub genes indicated that upregulation of genes involved in sphingolipid metabolism (SGPL1, SPTLC1) and steroid biosynthetic pathway (FDFT1, SQLE, COL4BP) and downregulation of genes in phosphatidylinositol (PIK3C2B, PIP4K2A, PIK3CD, SYNJ2, PIK3R5) and glycerophospholipid metabolism (DGAT1, PLA2G16, PLD1, CHPT1, PEMT, CDS2, GPD1, GPD1L) pathway are all significantly associated with poor overall survival ($p < 0.05$) in ACC patients.

Conclusions: Upregulation of sphingolipid and steroid synthesis genes and downregulation of phosphatidylinositol and glycerophospholipid metabolism are associated with worse survival in ACC patients.

◆ 10. IMast Cell Immunogenomic Computational Deconvolution of Adrenocortical Carcinoma Tumor Microenvironment

Jordan J Baechle¹, David N Hanna², Raja S Konjeti³, Jeffrey C Rathmell⁴, Kimryn W Rathmell⁵, Naira Baregamian²

¹Meharry Medical College, ²Surgery, Vanderbilt University Medical Center, ³Radiation Oncology, Vanderbilt University Medical Center, ⁴Pathology, Microbiology and Immunology, Vanderbilt University Medical Center, ⁵Hematology and Oncology, Vanderbilt University Medical Center

Background: Immunotherapeutic response failure of adrenocortical carcinomas (ACC), particularly cortisol-secreting ACC (CS-ACC), highlights a glucocorticoid-mediated immunosuppressive environment and the need for novel treatment strategies for this rare, aggressive cancer. Recent studies have only begun to characterize ACC tumor microenvironment (TME) and elude to a possible role for mast cell-mediated improved patient outcomes. Using immunogenomic computational analytics, we further dissect the role of mast cells and mast cell-mediated signaling gene expressions within TME and its intersection survival in patients with ACC.

Methods: The Cancer Genome Atlas (TCGA) human ACC tumor cohort (N=92) was used for comprehensive immunogenomic mRNA expression analysis of genes underlying mast cell signaling. CIBERSORT computational analytics were employed to deconvolute immunogenomic patterns of tumor immune infiltrating cell (TIIC) subtypes in ACC TME. R programming was used to assess the prognostic value of each gene's mRNA expression. Overall survival (OS) and disease-free survival (DFS) analysis was performed using Cox regression models.

Results: Immunogenomic TIIC subtype profiling of ACC tumors (33 CS-ACC, 59 nonCS-ACC) revealed significant differences between ACC groups with diminished mast cell infiltration in immunosuppressive TMEs. Mast cell tumor infiltration was associated with favorable OS when compared to other TIIC subtypes. Of the 25 prognostic mast cell-specific signaling genes analyzed, the mRNA expression of IL-16 and TPSAB1 were associated with favorable OS+DFS, whereas CXCL8, IL-4, and TPH2 were associated with poor OS+DFS in patients with ACC. ALOX5, HDC, and TNF mRNA expression were associated with favorable DFS only, whereas IL-13 was associated with poor DFS in patients with ACC. Notably, mRNA expression levels of the mast cell signaling genes HDC, IL-16, and TPSAB1 associated with favorable DFS and OS were significantly lower in CS-ACC tumors.

Conclusions: Our computational immunogenomic deconvolution analysis revealed a significant relationship between increased tumor mast cell infiltration and favorable prognosis and uncovered several prognostic genes associated with mast cell activation, signaling, and mast cell-mediated recruitment of other immune cell types in patients with ACC. Further studies investigating mast cell modulation are needed to develop novel or synergistic immunotherapeutic agents against the immunotherapeutic resistance of CS-ACC tumors.

◆ 11. Expression of Cancer Stem Cell Markers in Tall Cell Variant Papillary Thyroid Cancer Identifies a Molecular Profile Predictive of Recurrence in Classic Papillary Thyroid Cancer

Anna C Beck¹, Anand Rajan², Shannon Landers³, Sarah Kelley¹, Andrew M Bellizzi², Geeta Lal¹, Sonia L Sugg¹, James R Howe¹, Carlos H Chan¹, Ronald J Weigel¹
¹Surgery, University of Iowa Hospitals and Clinics, ²Pathology, University of Iowa Hospitals and Clinics, ³University of Iowa

Background: Tall cell variant (TCV) of papillary thyroid carcinoma (PTC) is an aggressive subtype of PTC. We sought to examine expression of the CD133 cancer stem cell marker in TCV compared to other well-differentiated thyroid cancers.

Methods: The expression of cancer stem cell markers was examined in 572 tumors of patients with classic PTC and TCV from the TCGA Thyroid Cancer database. To confirm these findings at the protein level, TCV and PTC tumors (n=14) were analyzed for CD133 protein expression by immunohistochemistry (IHC) using H-score (intensity x proportion of staining). ROC curve analysis was used to identify threshold cut-offs differentiating gene expression between thyroid cancer types.

Results: *CD133* RNA expression was elevated in TCV compared classic PTC in a large cohort of unmatched samples from the TCGA Thyroid Cancer database (5.9±1.8 vs 4.5±2.6, p=0.001). By IHC in age and stage matched samples, CD133 protein was confirmed to be significantly increased in TCV vs. classic PTC (H-score 115[102-132] vs. 7[6-28], p=0.006). Within the TCGA database, elevated *CD133* was associated with worse 12-year disease specific survival in all thyroid cancers (91% vs. 97%, p=0.04). *CD133* and *ALDH1A3* were more highly expressed in TCV and lower in follicular thyroid carcinoma (FTC) compared to classic PTC (p<0.001), while *CD24* and *ALDH1A1* were low in TCV and high in FTC (p<0.001). Post-hoc analysis of patients was performed using ROC curve analysis, which identified optimal cutoffs for RNA expression of *CD133*, *ALDH1A3* and *CD24* to identify TCV tumors. Classic PTC tumors were then examined using those cutoffs to identify tumors with a TCV-like gene signature characterized by high *CD133/ALDH1A3* and low *CD24* expression. Classic PTC with TCV-like gene signature had worse recurrence-free survival compared to classic PTC with a non-TCV signature (68% vs. 80% at 12 years, p=0.02).

Conclusions: TCV of PTC has increased expression of cancer stem cell markers compared to classic PTC and FTC. The TCV-like gene signature identified a molecular sub-type of classic PTC that has a significantly worse recurrence-free survival. This novel gene signature may be useful in tailoring therapy for PTC by identifying patients at high risk for recurrence.

◆ 12. Glycolytic Inhibition with 3-Bromopyruvate Suppresses Tumor Growth and Improves Survival in a Murine Model of Anaplastic Thyroid Cancer

Bixiao Zhao¹, Abha Aggarwal¹, Jessica Marshall¹, Matthew Nehs¹

¹Surgery, Brigham and Women's Hospital

Background: Anaplastic thyroid cancer (ATC) is a rare but devastating malignancy. ATC tumor cells exhibit the Warburg effect by preferentially undergoing glycolysis even in aerobic conditions and therefore have a high rate of glucose utilization. Our previous work has demonstrated that glucose restriction inhibits ATC cellular proliferation. Here, we hypothesize that targeted inhibition of the glycolytic enzyme hexokinase II can diminish tumor growth and improve outcomes in ATC using both *in vitro* and *in vivo* disease models.

Methods: The human ATC cell line 8505C was cultured in medium containing high (25mM) (HG) or low (3mM) (LG) glucose concentration with or without glycolytic inhibitor 3-bromopyruvate (200 μ M) (3-BP). Cellular proliferation and migration/ invasion were determined using BrdU and Boyden chamber assays, respectively. An orthotopic xenograft model of ATC was generated by injection of 8505C cells into the left thyroid lobes of nude immunocompromised mice. Animals were provided standard chow diet (SD) or ketogenic diet (KD) and given daily intraperitoneal injections of 3-BP (1.8mg/kg) or vehicle. Treatment groups were monitored weekly for body weight and blood levels of glucose and ketones for 9 weeks. Necropsies were performed to harvest tumors for analysis.

Results: Growth of 8505C *in vitro* in LG medium decreased cell proliferation by 33% ($P=0.01$), migration by 39% ($P<10^{-4}$), and invasion by 30% ($P=0.001$) when compared to the HG setting. Addition of 3-BP to LG produced even greater inhibition of proliferation by 89% ($P=10^{-4}$), migration by 44% ($P<0.001$), and invasion by 73% ($P<10^{-5}$). *In vivo*, concomitant administration of KD and 3-BP improved overall survival of animals compared to SD control ($P=0.006$) and KD alone ($P=0.009$) groups. Combined treatment also led to smaller tumor volumes (20.8mm³ vs 51.1mm³, $P=0.03$) and slower tumor growth rates (0.3mm³/day vs 1.0mm³/day, $P=0.01$) versus SD control. Treatment with KD or 3-BP alone did not increase survival over the SD control group.

Conclusions: Glycolytic inhibition with 3-BP inhibits tumor growth and extends survival in a murine model of ATC when combined with the ketogenic diet. This study demonstrates that metabolic and glycolytic inhibitors can exhibit context-specific utility and may only be effective alongside dietary restriction of glycolytic inputs.

13. Inhibition of autophagy mitigates cell migration and invasion in thyroid cancer

Tammy M Holm¹, Jun-Lin Guan², Z. Christine Bian²

¹*Surgical Oncology, University of Cincinnati College of Medicine*, ²*Cancer Biology, University of Cincinnati College of Medicine*

Background: Autophagy is a highly conserved cellular process for maintaining cellular homeostasis with both local and systemic effects. Upregulation of autophagy within tumor cells and the tumor microenvironment may promote metastasis vis-à-vis induction of tumor cell migration and invasion. The role of autophagy regulation in the progression of thyroid cancer is unknown. We hypothesized that autophagy upregulation would be critical for cellular migration and invasion in thyroid cancer, and tested this hypothesis utilizing a potent new and specific lysosomal autophagy inhibitor, Lys05.

Methods: Validated papillary (MDA-T32, MDA-T68) and follicular (FTC-133) human thyroid cancer cell lines in culture were first assessed for autophagic capacity by assessing accumulation of microtubule-associated protein light chain 3B (LC3B) after clamping autophagosome degradation with bafilomycin. We then performed both scratch migration and Matrigel invasion assays in the presence of known autophagy inhibitors: Lys05 and transfection of siRNA to FIP200, a critically necessary protein for autophagy.

Results: Up-regulation of autophagy was observed across all cell lines. In MDA-T32 cells, migration was reduced by 42% when transfected with siRNA against FIP200 and 78% in cells treated with 20uM of Lys05 ($p < 0.002$ vs controls). Similar results were seen in MDA-T68 cells with a migration reduction of 54% in siRNA FIP200 transfected cells and 67% in cells treated with Lys05 ($p < 0.002$ vs controls). Cell migration was reduced by 73% in FTC-133 cells transfected with FIP200 siRNA and 71% in Lys05 treated cells ($p < 0.002$ vs controls). Invasion assays demonstrated a 73%, 39%, and 75% reduction in the presence of Lys05 in MDA-T32, MDA-T68, and FTC-133 cells respectively ($p < 0.006, 0.02, 0.01$ vs controls). In the cells transfected with siRNA against FIP200, we observed similar reductions in invasion, 61%, 62%, and 55% in MDA-T32, MDA-T68, and FTC-133 cells ($p < 0.01, < 0.007, 0.002$ vs controls).

Conclusions: Autophagy is upregulated across multiple thyroid cancer subtypes. In thyroid cancer cell lines, inhibition of autophagy attenuates both cell migration and invasion suggesting a role for autophagy inhibition in the progression of thyroid cancer. Greater understanding of autophagy regulation in thyroid cancer will aid in the development of targeted therapeutics.

◆ **14. Perspectives on Virtual Interviews—A Follow-up Study of the Comprehensive Endocrine Surgery Fellowship Interview Process**

Alaina D Geary¹, Tracy S Wang², Brenessa Lindeman³, Jennifer H Kuo⁴, Melanie L Lyden⁵, Wen T Shen⁶, Lilah F Morris-Wiseman⁷, Sally E Carty⁸, F. Thurston Drake¹
¹*Surgery, Boston University Medical Center*, ²*Surgery, Medical College of Wisconsin*, ³*Surgery, University of Alabama at Birmingham*, ⁴*Surgery, Columbia University Medical Center*, ⁵*Surgery, Mayo Clinic*, ⁶*Surgery, University of California, San Francisco Medical Center*, ⁷*Surgery, University of Arizona*, ⁸*Surgery, University of Pittsburgh Medical Center*

Background: A 2018 survey on the interview process for the American Association of Endocrine Surgeons Comprehensive Endocrine Surgery Fellowship (CESF), found that both program directors (PDs) and fellows strongly favored in-person interviews, despite burdens of cost and time. In 2020, virtual interviews were mandated, and we designed this follow-up study to assess the virtual interview process.

Methods: Immediately after the 2020 CESF Match, anonymous surveys were distributed to applicants (n=37) and PDs (n=22). Mixed-methods analyses were used to evaluate survey responses. Ordinal data for ranking questions are presented as mean rank (MR) out of 10 (higher rank = better) and the percent whose response was ≥ 7 . Current results were compared to findings from our previous study.

Results: Response rates were 82% (PDs) and 60% (applicants). 61% of PDs invited the same or fewer applicants to interview than in previous years. Compared to the previous study, applicants attended a similar number of interviews (32% vs. 37% attended 1-10 interviews; $p=0.61$), fewer used vacation days (23% vs. 56%; $p=0.01$), and most reported no interview-related expenses (51% spent \$2500-7500 for in-person interviews). Applicant burdens in 2020 included inadequate interview spaces and lack of protected time for virtual interviews. Applicants did not believe the virtual format compromised their ability to meet faculty (MR 6.8/10; 68% ≥ 7) or make a good impression (MR 6.8/10; 60% ≥ 7). A similar proportion of applicants had a clear first choice prior to interviews (36% vs. 30%; $p=0.8$), and a similar proportion changed that first choice, regardless of virtual or in-person interviews (38% vs. 18% respectively [$p=0.5$]). Most PDs reported the virtual setting had no effect or improved their ability to assess applicants. Both PDs (72%) and applicants (77%) agreed that future interviews should be partially or completely virtual.

Conclusions: In a reversal from prior findings, 2020 CESF applicants and PDs reported strong interest in a virtual or hybrid virtual/in-person interview process. Virtual interviews were lower cost, more convenient, and mutually perceived to be effective. If a virtual component is incorporated into future interview processes, innovative strategies are necessary to optimize effectiveness, promote equitable access, and reduce redundancies.

15. The Glass Podium: Gender Representation within the American Association of Endocrine Surgeons (AAES) from 2010-2019

Sean M Wrenn¹, Rajshri M Gartland², Lindsay E Kuo³, Nancy L Cho²

¹*Surgery, Rush University Medical Center*, ²*Surgery, Brigham and Women's Hospital*,
³*Surgery, Temple University Hospital*

Background: Despite increasing numbers of women in academic surgery, female underrepresentation in surgical societies remains an ongoing issue, especially since society participation plays a key role in career development and success. We sought to determine the gender composition of presentations and awards at the American Association of Endocrine Surgery (AAES) annual meeting.

Methods: Utilizing public information and previous meeting data, we collected gender data for all first and senior authors for presentations from 2010-2019. The proportions of female to male presenters were compared for each presentation type. First/last authorship combinations were also determined: female/female, female/male, male/female, and male/male. Representation for awards and invited lectures was reviewed. Temporal trends were analyzed via linear regression for slope, p value, and goodness of fit.

Results: 56% of matched fellows and 36% of AAES active members are female. From 2010-2019, there were 354 podium and 477 poster presentations. For podium presentations, women were listed less often as first (42.7%, $p=0.007$) and senior authors (30.6%, $p<0.0001$). For posters, women were also listed less often as first (42.8%, $p=0.002$) and senior authors (29.8%, $p<0.0001$). The most common combination of first and senior authors was male-male (43.1%), followed by female-male (26.8%), female-female (16.1%), and male-female (14.0%). For awards and invited lectureships, women represented a minority in nearly all categories: meritorious achievement award (0%, $n=8$), historical lecturer (8.3%, $n=12$), President's invited lecturer (13.8%, $n=29$), honorary member (18.2%, $n=11$), resident/fellow research award (41.7%, $n=48$), and poster award (50.0%, $n=16$). While there was a positive trend in female representation, the percent of women first authors did not significantly change (slope=0.766, 95% CI 0.70 to 2.23, $p=0.26$) and there was no change observed in senior author demographics (slope=0.03348, 95% CI=-1.086 to 1.153).

Conclusions: Women are significantly underrepresented as presenters at AAES, especially in light of society demographics, and are less likely to receive awards or deliver invited lectures. As senior authors, women lag behind men as mentors to trainees and junior faculty. There was no trend toward improvement in disparities in senior authorship over the study period. Opportunities to improve gender representation among presenters, members, and award recipients should continue to be explored.

◆ 16. Optimal Surgeon-Volume Threshold for Neck Dissections in the Setting of Primary Thyroid Malignancies

Rahul K Sharma¹, Jihui Lee², Rachel Liou¹, Catherine McManus¹, James A Lee¹, Jennifer H Kuo¹

¹*Division of Endocrine Surgery, Columbia University Irving Medical Center,*

²*Department of Population Health Sciences, Weill Cornell Medicine*

Background: Thyroidectomy and neck dissections are used in the surgical management of thyroid cancer. Although the surgeon-volume relationship is well-documented for thyroidectomy, less is known about central neck (CND) and lateral neck dissections (LND). The aim of this study was to evaluate and determine the surgeon-volume threshold for CND and LND.

Methods: A retrospective analysis of the New York Statewide Planning and Research Cooperative System (SPARCS) was performed (2007-2017). Primary thyroid malignancy was identified by ICD code C73. Operations were identified based on CPT codes for CND (60252) and lateral neck-dissections (60254,38720,38724,38700,38752). Demographic variables included age, gender, race, and a modified Charlson-Comorbidity Score. 30-day complications were identified using ICD codes for central (vocal cord paralysis, hypocalcemia), lateral (diaphragm paralysis, winged scapula, tongue deviation) and other surgical complications. Optimal surgeon-volume threshold was determined using change-point logistic regression analysis. Using this threshold, surgeons were then classified to low vs. high volume surgeons (HVS). Logistic regression analysis was conducted to examine the effect of high-volume status on outcomes.

Results: A total of 3808 patients who underwent neck dissections (CND n=3485 and LND n=977) were identified with an average age of 47.1±14.4 years. Most patients were female (n=2804, 73.6%). Overall complication rate was 4.4%. 348 surgeons were represented in the database. The surgeon-volume threshold to distinguish HVSs for CNDs and LNDs was 7.0 (95% Bootstrap CI:1.3-7.5) and 3.3 (1.2-4.8) neck dissections/year, respectively. Using these criteria, 1,931 (55.4%) CND and 529 (54.2%) LND patients were operated on by a HVS. For CND, HVS were associated with a lower rate of vocal cord paralysis (OR 0.47, 0.25-0.85, p=0.01) hypocalcemia (OR 0.29, 0.13-0.63, p<0.01), and total complications (OR 0.41, 0.28-0.58, p<0.01). For LND, HVSs were associated with a lower odds of total complications (OR 0.42, 95% CI 0.23-0.74, p<0.01) but not lateral neck specific complications (OR 0.18, 0.02-1.53, p=0.12).

Conclusions: A threshold of ≥7.0 CNDs and ≥3.3 LNDs for thyroid cancer per year improves outcomes. Guidelines for training and centralization of care can be guided by these results to reduce complications.

◆ 17. Ambient Particulate Matter Air Pollution Increases Risk of Papillary Thyroid Cancer: a Case-Control Study

Shkala Karzai¹, Zhenyu Zhang², Whitney Sutton¹, Jason D Prescott¹, Murugappan Ramanathan Jr², Aarti Mathur¹

¹Department of Surgery, Johns Hopkins University School of Medicine, ²Department of Otolaryngology- Head and Neck Surgery, Johns Hopkins University School of Medicine

Background: In 2013, the International Agency for Research on Cancer Working Group classified air pollution as carcinogenic. However, the association between exposure to air pollution and papillary thyroid carcinoma (PTC), is unknown. We sought to estimate the relationship between long-term exposure to fine (diameter <2.5 µm) particulate matter (PM_{2.5}) in air pollution and risk of papillary thyroid cancer (PTC).

Methods: Under IRB approval, adult (age≥18) patients with newly diagnosed PTC between January 1, 2013 and December 31, 2016 across a single health system were identified using electronic medical records. Data from 2,032 patients with PTC were compared to 4,064 age and gender matched healthy controls without any evidence of thyroid disease or pathology. Cumulative PM_{2.5} exposure was estimated by a novel technique incorporating patients' residential zipcodes into a deep learning neural networks model, which utilizes both meteorological and satellite-based measurements. Conditional logistic regression was performed to assess for association between PTC and increasing average PM_{2.5} concentrations over one, two, and three years of cumulative exposure preceding PTC diagnosis. Additional analyses were performed to test whether these associations differed by patient characteristics.

Results: Within this cohort, mean age at diagnosis was 50 years and a majority of patients were female (75%). The majority of patients resided in the northeastern United States, followed by the South and Midwest. An increased odds of developing PTC was associated with a 5 µg/m³ increase of PM_{2.5} concentrations over two years (aOR=1.23, 95%CI: 1.05-1.45) and three years (aOR=1.28, 95% CI: 1.10-1.49) of exposure. Furthermore, this risk differed by smoking status ($p_{\text{interaction}}=0.05$). Among current smokers (n=517), the risk of developing PTC was highest (aOR=1.41, 95% CI: 1.18-1.69).

Conclusions: Rising concentrations of fine particulate matter in air pollution are significantly associated with the incidence of PTC with two and three years of exposure. Our novel findings provide additional insight into the potential pathophysiology of PTC, and warrant further investigation both nationally and internationally.

◆ 18. Parathyroidectomy versus Cinacalcet for the Treatment of Secondary Hyperparathyroidism in Patients Receiving Dialysis. A Propensity Score Matched Analysis.

Nishtha Sharma¹, Luis Alvarado², Roxann Lerma¹, Alok K Dwivedi², Adeel Ahmad³, Aimee Hechanova³, Fernanda Payan-Schober³, Azikiwe Nwosu³, Eyas Alkhalili⁴
¹Texas Tech Health Sciences Center Paul L Foster School of Medicine, ²Biostatistics and Epidemiology, Texas Tech Health Sciences Center Paul L Foster School of Medicine, ³Internal Medicine, Texas Tech Health Sciences Center Paul L Foster School of Medicine, ⁴Surgery, Texas Tech Health Sciences Center Paul L Foster School of Medicine

Background: Cinacalcet is a calcimimetic that is used for the treatment of hyperparathyroidism secondary to end stage renal disease. The goal of this study is to compare the long-term outcomes and survival between cinacalcet and parathyroidectomy in patients on hemodialysis.

Methods: We used the United States Renal Data System (USRDS) to identify adult patients on hemodialysis with Parathyroid hormone (PTH) levels higher than 1000 pg/ml. Patients who were treated with cinacalcet or parathyroidectomy between 2012 through 2014 with available long-term follow-up (5-year minimum) were included. The group treated with surgery (S) (n=2132) was compared using 1:1 propensity-score matching ratio to a cohort of patients treated with cinacalcet (C) (n=2132) accounting for clinical characteristics that might influence outcomes. A relative risk regression was conducted to assess the differences between the treatment groups. A Cox regression analysis was also conducted to compare the overall mortality and development of bone or cardiovascular morbidity after the initiation of each treatment and results were summarized with hazard ratios (HR) and 95% confidence interval (CI). Data analysis was conducted using Stata software Release 15.1 and SAS 9.4 software.

Results: The propensity score matching successfully created two groups with similar clinical characteristics. Patients in the surgery group had a higher mean peak PTH level prior to therapy (S 2081 vs C 1422 pg/ml, P<0.001). The 30-day postoperative mortality after surgery was 3.7%. There was no difference in the development of pathologic fractures between the two groups (S 27.7% vs C 25.3%, P=0.08). No difference was observed in the development of new-onset coronary artery disease (S 7.7% vs C 7.9%, P=0.8) but patients in the surgical group were less likely to develop cerebrovascular disease (S 4% vs C 5.7%, P=0.01). No difference in the rate of calciphylaxis was observed (S 2.2% vs C 1.5%, P=0.17). Survival analysis showed that patients undergoing surgery were less likely to die (HR:0.67, 95% CI 0.61-0.74, P<0.0001) and had a better 5-year survival rate (S 65.9% vs C 54.4%, P<0.0001).

Conclusions: Patients on dialysis undergoing parathyroidectomy for the treatment of secondary hyperparathyroidism have a better overall survival than those treated with cinacalcet.

◆ 19. Prevalence and Risk Factors for Tertiary Hyperparathyroidism in Kidney Transplant Recipients

Whitney Sutton¹, Xiaomeng Chen¹, Palak Patel¹, Shkala Karzai¹, Jason D Prescott¹, Dorry L Segev^{1,2}, Mara McAdams-Demarco^{1,2}, Aarti Mathur¹

¹*Department of Surgery, Johns Hopkins University School of Medicine*, ²*Department of Epidemiology, Johns Hopkins University Bloomberg School of Public Health*

Background: Tertiary hyperparathyroidism (tHPT) after kidney transplantation (KT) has been associated with graft dysfunction, cardiovascular morbidity, and osteopenia when left untreated. The true prevalence of tHPT is unclear due to variability in definitions and evolution in treatment modalities of hyperparathyroidism. Therefore, our primary objectives were to evaluate the prevalence of tHPT and to identify risk factors associated with its development.

Methods: Under IRB approval, data from a prospective cohort study of adults (≥18 years) who underwent KT between 12/2008-6/2019 at a tertiary care referral center was collected. Patient and clinical characteristics, including treatment of secondary hyperparathyroidism (sHPT) prior to KT, were recorded. The diagnosis of tHPT was defined as hypercalcemia and hyperparathyroidism 1 year post-KT. Treatment with calcimimetics, calcium/Vitamin D supplementation, and/or parathyroidectomy was recorded. A modified Poisson regression model was utilized to evaluate for risk factors associated with the development of tHPT.

Results: Among 849 KT recipients, 522 (61.5%) had persistently elevated PTH 1 year post-KT and 179 (21.1%) had tHPT. Of those with tHPT, only 69 (38.6%) received treatment, which included calcimimetics in 58 (84.1%) patients, parathyroidectomy in 5 (7.2%), and both in 6 (8.7%). The development of tHPT was associated with male sex (aPR=1.33, 95% CI: 1.01-1.78), the use of calcimimetics to treat sHPT prior to KT (aPR=1.70, 95%CI: 1.14-2.54), and elevated pre-KT PTH level ≥300pg/ml (aPR=2.66, 95%CI: 1.45-4.87).

Conclusions: Tertiary hyperparathyroidism affects greater than 1 in 5 KT recipients and is under-recognized and undertreated in 61% of patients. Pre-KT PTH levels ≥300pg/ml and use of calcimimetics are associated with the development of tHPT. These findings encourage the re-evaluation of recommended pre-KT PTH thresholds and the consideration of pre-KT parathyroidectomy to avoid the adverse sequelae of tHPT in KT recipients.

◆ 20. Data to Inform Counseling on Parathyroidectomy for Secondary Hyperparathyroidism of Renal Origin

Rebecca L Williams-Karnesky¹, Lauren Krumeich², Heather Wachtel², Douglas L Fraker², Chris Wirtalla², Frank Anthony Venuto², Pamela Sellers², Rachel R Kelz²
¹University of New Mexico, ²University of Pennsylvania

Background: Parathyroidectomy for secondary hyperparathyroidism of renal origin (SHRO) necessitates a different care paradigm than that used for the more common indication of primary hyperparathyroidism. Although post-operative hungry bone syndrome (HBS) is a well-documented phenomenon leading to electrolyte disturbances, the impacts on hospital length of stay and readmission rates are uncharacterized in this clinical context. We sought to examine the association between HBS and outcomes following parathyroidectomy for SHRO to inform patient counseling.

Methods: Patients ages 18y+ who underwent a parathyroidectomy for SHRO were identified in a geographically diverse, state dataset (AR, FL, IA, MA, MD, NE, UT, VT, WA, WI) (2013-2016) and, classified based on the diagnosis of HBS. Covariates included demographics, payer status, 31 comorbidities, parathyroid autotransplantation, thymectomy, and hospital characteristics such as system affiliation and endocrine surgery volume. The primary outcome of interest was hospital length of stay (LOS). Secondary outcomes were complications and 30-day readmissions. Univariate analyses were performed using parametric and nonparametric testing, as appropriate.

Results: Among 796 patients studied, we identified 164 HBS patients (20.6%). The median age was 49 years (interquartile interval [IQI]: [37, 60]), and the median number of comorbidities was 4 (IQI: [3, 5]). There were no differences in the rates of HBS by race or number of comorbidities. The median age of HBS patients (43y, IQI: [34, 54]) was younger than that of nonHBS patients (51y, IQI: [39, 61]; $p < 0.001$). HBS was more common among obese patients than nonobese patients (25% *versus* 15.8%; $p < 0.001$). Parathyroid autotransplant was performed at similar rates in HBS and nonHBS patients (23.8% *versus* 23.1%; $p = 0.821$). Median LOS was significantly longer for HBS patients (6 days, IQI: [4, 8] *versus* 3 d, IQI: [2, 6]; $p < 0.001$). There were no differences in nerve injury, voice disturbance, or tracheostomy rates by HBS diagnosis. Similar 30-day readmission rates were observed (HBS: 41(25%) *versus* nonHBS: 147(23%); $p = 0.640$).

Conclusions: HBS occurs in one of five patients following parathyroidectomy for SHRO, regardless of the use of parathyroid autotransplantation. Patients should be informed of the possibility of a relatively long (6 days) LOS following surgery, as well as the moderate possibility (>20%) of another hospitalization within the 30-day post-discharge period.

◆ 21. Screening for Primary Aldosteronism in the Hypertensive Obstructive Sleep Apnea Population is Cost-Saving

Kathryn H Chomsky-Higgins¹, Sarah S Sims Pearlstein¹, Patricia C. Conroy¹, Wen T. Shen¹, Jessica Gosnell¹, Sanziana A. Roman¹, Julie A Sosa¹, Quan-Yang Duh¹, Insoo Suh¹

¹*Endocrine Surgery, University of California, San Francisco*

Background: Guidelines recommend screening for primary aldosteronism (PA) in patients diagnosed with hypertension and obstructive sleep apnea (OSA). Recent studies have shown that adherence to these recommendations is extremely low. It has been suggested that cost is a barrier to implementation. No analysis has been done to rigorously evaluate the cost-effectiveness of widespread implementation of these guidelines.

Methods: We constructed a decision-analytic model to evaluate screening of the hypertensive OSA population for PA as per guideline recommendations in comparison with the status quo. Probabilities, utility values, and costs were identified in the literature. Threshold and sensitivity analyses assessed robustness of the model. Costs were represented in 2020 US dollars and health outcomes in quality-adjusted life-years. The model assumed a societal perspective with a lifetime time horizon.

Results: Screening per guideline recommendations had an expected cost of \$46723 and 35.4 quality-adjusted life years. Continuing at the status quo had an expected cost of \$48311 and 34.9 quality-adjusted life years. Screening was dominant, as it was both less costly and more effective. These results were robust to sensitivity analysis of disease prevalence, test sensitivity, patient age, and expected outcome of medical or surgical treatment of primary aldosteronism. The screening strategy remained cost-effective even if screening were conservatively presumed to identify only 4% of new PA cases.

Conclusions: For patients with hypertension and OSA, screening for PA is cost-saving due to cardiovascular risk averted. Cost should not be a barrier to improving PA screening adherence.

◆ 22. Cost Analysis of Reflexive vs. Selective Molecular Testing for Indeterminate Thyroid Nodules

Q. Lina Hu¹, Max A. Schumm¹, Kyle A. Zanocco¹, Michael W. Yeh¹, Masha J. Livhits¹, James X. Wu¹

¹*Surgery, University of California, Los Angeles*

Background: An estimated 600,000 fine needle aspiration (FNA) biopsies of thyroid nodules are performed annually, with up to 30% resulting in indeterminate cytology. Molecular testing is now commonly used to refine the diagnosis of indeterminate thyroid nodules. The purpose of this study is to compare the costs of a reflexive molecular testing strategy to a selective molecular testing strategy for indeterminate thyroid nodules.

Methods: A Markov model was constructed using data from a randomized clinical trial incorporating reflexive molecular testing for patients with indeterminate thyroid nodules categorized as Bethesda III or IV. This was compared to a simulated selective molecular testing strategy with patients undergoing either diagnostic thyroidectomy or repeat FNA after initial indeterminate cytology, with molecular testing reserved for instances of two consecutive indeterminate cytology results. Model variables were abstracted from institutional trial data, literature review, and the Medicare physician fee schedule. Sensitivity analysis was employed to account for uncertainty in the model's assumptions.

Results: The average cost per patient in the reflexive testing strategy was \$8132, compared to \$5993 in the selective testing strategy. In 10,000 Monte Carlo simulations, potentially avoidable diagnostic thyroidectomy for benign underlying pathology was performed in 2356 patients in the reflexive testing arm, compared to 3632 patients in the selective testing arm. In other words, a reflexive testing strategy costs an additional \$21.4M to allow 1276 patients avoid diagnostic surgery, at an incremental cost of \$16,763 per operation avoided. In this model, 471 patients in the reflexive testing arm underwent unintentional observation for missed underlying malignant pathology, compared to 664 patients in the selective testing arm. The cost of molecular testing (set at \$3750 for this model) had the greatest impact on overall costs, with \$1211 representing the cost below which the reflexive testing strategy was cost-saving compared to the selective testing strategy.

Conclusions: In this cost-modeling study, reflexive molecular testing for indeterminate thyroid nodules enabled patients to avoid unnecessary diagnostic lobectomy at an estimated cost of \$16,000 per surgery avoided. Additional studies are indicated to determinate the actual cost per unnecessary surgery avoided, as well as to determine the true value of avoiding thyroid resection.

◆ 23. Thyroid lobectomy as a cost-effective approach in low-risk papillary thyroid cancer versus Active Surveillance

Abdallah S Attia¹, Mohanad R Youssef¹, Mohamed Abouiesha¹, Mahmoud Omar¹, Deena Hadedeya¹, Mohammad R Hussein¹, Mohamed Shama¹, Emad Kandil¹
¹Tulane University

Background: Current debate exists over the optimal management of low-risk papillary thyroid cancer. The American Thyroid Association (ATA) supports the concept of active surveillance (AS) to manage low-risk papillary thyroid cancer (PTC); however, the cost effectiveness has not been well-studied yet. We sought to perform a cost-effectiveness analysis comparing AS versus surgical intervention for patients in USA.

Methods: A Markov decision tree model was developed to compare AS and thyroid lobectomy. Our reference case is a 40-year-old female who was diagnosed with unifocal (15mm), low-risk PTC. Probabilistic outcomes, costs, and health utilities were determined using an extensive literature review. The willingness-to-pay threshold was set at a \$50,000/quality-adjusted life year (QALY) gained. Sensitivity analyses were performed to account for uncertainty in the model's variables.

Results: Lobectomy provided a final effectiveness of 11.7/QALYs, compared to 11/QALYs for AS. Compared to AS, ICER for lobectomy was \$25894.67 /QALY (< Willing-To-Pay threshold of \$50,000/QALY) and thus surgical intervention is proved to be cost-effective. In the sensitivity analysis, surgical intervention remained cost-effective regardless of the patient's age, associated complications, rates of progression, and discount rates.

Conclusions: Lobectomy is a cost-effective strategy compared to AS in USA for low-risk PTC. Identifying key factors can help physicians and patients determine the best, individualized management strategy in the long term for low-risk papillary thyroid cancer. Patients in whom the diagnosis of low-risk papillary thyroid cancer is associated with even a modest decrement in quality of life may benefit from early lobectomy as a cost-effective strategy.

◆ 24. A cost-utility analysis of fluorocholine-PET imaging for primary hyperparathyroidism in the United States

Ava Yap¹, Thomas Hope², Claire Graves³, Wouter Kluijfhout⁴, Wen Shen¹, Jessica Gosnell¹, Julie Ann Sosa¹, Sanziana Roman¹, Quan-Yang Duh¹, Insoo Suh¹

¹Department of Surgery, University of California San Francisco, ²Department of Radiology and Biomedical Imaging, University of California San Francisco,

³Department of Surgery, University of California Davis, ⁴Department of Surgery, University of Utrecht

Background: Primary hyperparathyroidism (pHPT) is the most common cause of hypercalcemia, with 80% of cases caused by a single adenoma. Historically, pHPT necessitated bilateral neck exploration (BNE), but improved imaging localization now allows for minimally invasive parathyroidectomy (MIP) with lower complication risks. Recently, positron emission tomography using radiolabeled fluorocholine (FCH-PET) demonstrated high accuracy in detecting these lesions. However, the potential cost-effectiveness of FCH-PET in the U.S. has not been studied.

Methods: We constructed a decision tree model of patients undergoing parathyroidectomy for pHPT. Patient scenarios involved four pre-operative imaging modalities: (1) FCH-PET, (2) 4-dimensional computed tomography (4DCT), (3) ultrasound, and (4) sestamibi-single photon emission computed tomography (SPECT). All patients subsequently underwent surgical resection (MIP vs BNE), with associated cost (\$) and clinical outcomes (as measured by health utilities). Model parameters were informed by literature review and Medicare cost data. Incremental cost-utility ratios (ICURs) were calculated in dollars per quality-adjusted life year (\$/QALY), with a willingness-to-pay (WTP) threshold in the U.S. set at \$100,000/QALY. Two-way and threshold sensitivity analyses were performed.

Results: In the base case scenario, FCH-PET led to the most QALYs gained at 23.94 but was the most expensive imaging modality at \$2,096 per study, with a treatment cost of \$6,390 or \$267/QALY. 4DCT led to the least expensive treatment costs of \$4,968 and 23.88 QALYs gained, or \$208/QALY. On a cost-effectiveness plane, sestamibi-SPECT was dominated by other imaging modalities and therefore excluded from further cost-utility analysis. Using 4DCT as the reference, the ICUR for ultrasound was \$3,691/QALY, and for FCH-PET was \$39,017/QALY, which are both below the WTP threshold. FCH-PET's ICUR surpassed the WTP threshold when its price increased to \$4,199, with a treatment cost of \$8,493 or \$355/QALY. Sensitivity analysis demonstrated that FCH-PET became the dominant strategy when its price was reduced to \$685.

Conclusions: This economic analysis investigated whether FCH-PET is cost-effective compared to other established imaging modalities. In our model, FCH-PET is an economically viable pre-operative imaging modality for pHPT when compared to existing localization techniques, with superior clinical outcomes. Depending on the price, FCH-PET can be either a cost-effective or dominant option.

◆ **25. Stones left unturned: missed opportunities to diagnose primary hyperparathyroidism in patients with nephrolithiasis**

Michael S Lui¹, Jason C Fisher¹, Hunter J Underwood¹, Kopal N Patel¹, Jennifer B Ogilvie¹

¹*New York University School of Medicine*

Background: Nephrolithiasis is a well-described sequela of primary hyperparathyroidism (PHPT) and an indication for parathyroidectomy in those with biochemical evidence of disease. The prevalence of PHPT in patients who present with nephrolithiasis has been described as 3-5%, however recent studies have demonstrated that a majority of patients presenting with renal colic and hypercalcemia are never screened for hyperparathyroidism.

Methods: We retrospectively reviewed 15,725 patients at a tertiary, academic medical center who presented with nephrolithiasis between 2012 and 2020. Patients who had calcium levels measured within 6 months of presentation were identified. Of the patients with hypercalcemia (≥ 10.3 mg/dL), we examined those with a parathyroid hormone (PTH) level within 6 months before to 9 months after presentation. Patients were excluded if they had PTH levels measured greater than 6 months before presentation. Those with a biochemical diagnosis of PHPT (PTH ≥ 65 pg/mL) were evaluated to see if they were referred to a specialist for treatment.

Results: Of 15,725 patients presenting with nephrolithiasis, 12,420 (79%) had a calcium level measured. 630 (5%) patients were found to be hypercalcemic. Of the hypercalcemic patients, only 207 (33%) had a PTH level measured. Patients were more likely to have PTH levels sent if they were older or if they had higher calcium levels ($p=0.025$, $p<0.001$). Patients were also more likely to have PTH levels sent if they presented to an outpatient clinic rather than the emergency room ($p<0.001$). Of the 89 patients identified to have classical PHPT, 35 (39.3%) were referred for treatment. There were no significant differences in demographics or insurance status associated with referral to a specialist.

Conclusions: Only 89 (0.57%) patients with nephrolithiasis were ultimately diagnosed with PHPT, which is significantly lower than the expected prevalence. We found several areas for diagnostic improvement: 3305 (21%) of all patients presenting with nephrolithiasis were not screened for hypercalcemia and 423 (67%) patients with hypercalcemia did not have PTH levels measured. These missed opportunities for diagnosis are critical as early definitive management of PHPT could prevent recurrent kidney stones and other PHPT-related end organ effects.

◆ **26. Is a Routine 24-hour Urine Calcium Measurement Essential During the Evaluation of Primary Hyperparathyroidism?**

Shimena R Li¹, Kelly L Mccoy¹, Meghan Kelley¹, Sally E Carty¹, Linwah Yip¹

¹General Surgery, UPMC

Background: Primary hyperparathyroidism (pHPT) can have a biochemical profile similar to familial hypocalciuric hypercalcemia (FHH), and calcium-to-creatinine-clearance ratio (CCCR) <0.01 helps distinguish the two. Additionally, 24-hr urinary calcium (24UCa) >400 mg/day indicates surgery and current guidelines recommend obtaining 24UCa preoperatively. The study aim was to assess how often 24UCa altered patient care in the evaluation of suspected pHPT.

Methods: After QI-IRB approval, consecutive patients assessed for suspected sporadic pHPT at a multidisciplinary clinic from 2019-2020 were reviewed. pHPT was diagnosed by 2016 AAES Parathyroidectomy Guidelines criteria and 24UCa ordered for all patients. A 24UCa-directed change in care was defined as confirmation of FHH, deferment of surgery for additional testing, or 24UCa >400 mg/day as the sole indication for surgery.

Results: 320/356 patients (90%) completed 24UCa and 271 (76%) had concurrent biochemical testing to calculate CCCR. 24UCa was <100 mg/day in 9% (29/320) and CCCR <0.01 in 14% (39/271). No patient had confirmed FHH and when CCCR <0.01, FHH was excluded by 24UCa >100 mg/day (54%), prior normal serum calcium (13%), chronic renal insufficiency (10%), absence of familial hypercalcemia (5%), normal repeat 24UCa (5%), or interfering diuretic contributing to abnormal results (3%). Genetic testing was needed for 4 (10%) patients, and was negative in 2 and pending for 2. Overall, a 24UCa-directed change in care occurred in 12/320 patients (4%) including 2 who had negative FHH gene testing, 2 who are awaiting gene testing, 2 patients with 24UCa >400 mg/day as the sole indication for surgery, and 6 patients who had repeat 24UCa testing which was then normal. pHPT due to 4-gland hyperplasia was more common in patients with CCCR <0.01 than those with CCCR >0.01 (21% v. 5%, p=0.004) but surgical failure rates (hypercalcemia >6 months postoperatively) were equivalently low (p=1).

Conclusions: Compliance with 24UCa testing was high (90%) and results affected initial management in 4%, including productive identification of hypercalciuria as the sole indication for surgery in 2 patients. When CCCR <0.01, clinical assessment was often sufficient to exclude FHH and genetic testing was required in only 5%. A 24UCa should be ordered judiciously during assessment for pHPT surgery.

27. Long-term follow-up confirms utility of 18f-fluorocholine pet localization for primary hyperparathyroidism

Claire E. Graves¹, Thomas A. Hope², Jina Kim³, Miguel H. Pampaloni², Wouter Kluijfhout⁴, Carolyn D. Seib⁵, Jessica E. Gosnell⁶, Wen T. Shen⁶, Sanziana A. Roman⁶, Julie A. Sosa⁶, Quan-Yang Duh⁶, Insoo Suh⁶

¹*Surgery, University of California Davis*, ²*Radiology, University of California, San Francisco*, ³*Inova Schar Cancer Institute*, ⁴*Surgery, University of Utrecht*, ⁵*Surgery, Stanford University*, ⁶*Surgery, University of California, San Francisco*

Background: Parathyroid imaging aids surgeons performing parathyroidectomy for primary hyperparathyroidism (PHPT). ¹⁸F-fluorocholine positron emission tomography (FCH PET) has demonstrated accuracy in parathyroid localization in Europe and is currently under Food and Drug Administration (FDA) investigation in the United States (U.S.). The purpose of this study was to evaluate the utility of FCH PET for preoperative parathyroid localization in patients with long-term follow-up.

Methods: We retrospectively reviewed patients enrolled in a clinical trial of FCH PET parathyroid imaging at our institution. Patients who had PHPT with indications for parathyroidectomy were imaged with simultaneous FCH PET/magnetic resonance imaging (MRI). The effect of FCH PET imaging on surgical planning was evaluated with a pre-operative clinical decision algorithm. Surgical cure after parathyroidectomy was determined based on normal serum calcium at least six months after surgery. Location-based sensitivity and specificity of FCH PET imaging was assessed using three anatomic locations (left neck, right neck, and mediastinum) with surgery as gold standard in patients with confirmed surgical cure.

Results: In our cohort of 102 patients, mean age was 63 years, and 73% of patients were female. Thirty-nine patients (38%) had previous parathyroid surgery, and 78 patients (76%) had at least one prior negative imaging result. FCH PET localized at least one candidate lesion in 93% of patients and led to a change in pre-operative strategy in 65 patients (65%). Of the 77 patients who had surgery, 75 (97%) had at least one hypercellular parathyroid confirmed on pathology; 2 patients had negative explorations. Fifty-eight patients (77%) had laboratory data at least 6 months post-operatively, with 55/58 patients (95%) demonstrating cure. In our patient-based analysis, FCH PET successfully guided surgery in 48/60 (80%) of patients. Among patients with confirmed cure, it had a location-based sensitivity of 95% and specificity of 93%.

Conclusions: In this first U.S. clinical trial of FCH PET for parathyroid localization, long-term results confirm that FCH PET frequently changed pre-operative surgical planning and had a high success rate in guiding intra-operative resection in a challenging cohort. FCH PET is a promising parathyroid imaging modality that may be particularly useful in patients undergoing re-operations, or those with previous negative imaging.

◆ 28. Parathyroidectomy for nephrolithiasis in primary hyperparathyroidism: beneficial but not a panacea?

Siu-Yuan L Huang¹, Raoul Burchette², Joanie Chung², Philip Haigh³

¹General Surgery, Kaiser Permanente Los Angeles Medical Center, ²Department of Research and Evaluation, Southern California Permanente Medical Group, ³Surgical Oncology, Kaiser Permanente Los Angeles Medical Center

Background: Nephrolithiasis is a classic indication for parathyroidectomy in patients with primary hyperparathyroidism (PHPT), however, the effects of parathyroidectomy on nephrolithiasis recurrence are not well studied. The aim was to determine effect of parathyroidectomy on time to first nephrolithiasis recurrence and recurrence rate per patient-years.

Methods: A retrospective cohort study of patients diagnosed with biochemically confirmed PHPT between 1995 and 2014 and had at least one episode of nephrolithiasis was performed. The patients were divided into three groups: observation, presurgery, and postsurgery. Endpoints were time to first recurrence of nephrolithiasis and recurrence rate per patient-years, as analyzed by Cox proportional hazard and Poisson regression.

Results: The cohort was comprised of 1252 patients. Mean follow-up was 8 years. There were 334 (27%) patients who underwent parathyroidectomy and 918 (73%) were observed. Mean age was 60 years, 47.8% had a Charlson Co –Morbidity Index Score of 0, mean baseline calcium and PTH levels were 11 mg/dl and 92 pg/ml, respectively. The surgical and nonsurgical groups differed significantly in age, gender, Charlson, calcium, and PTH level. Overall recurrence rate was 23.3%. The 5, 10, and 15-year recurrence-free survival was 74.4%, 56.3%, 49.5%, respectively, in the presurgery group and 82.4%, 70.9%, 62.8%, respectively, in the postsurgery group ($p < 0.0001$ for each time period). The 5, 10, and 15-year recurrence-free survival in the observation group was 86.3%, 77.7%, and 70.6%, respectively. Among the parathyroidectomy patients, 141 had one or more recurrences; 55 were presurgery, 54 were postsurgery, and 32 patients were both pre and postsurgery. The recurrence rates presurgery versus postsurgery were 1 event per 6.3 patient-years versus 1 event per 9.4 patient-years ($p = 0.0007$). The average time to recurrence was 4.6 years for both the 87 who recurred before surgery and the 86 who recurred after surgery.

Conclusions: Recurrent nephrolithiasis occurs in about ¼ of patients. Parathyroidectomy appears to prolong the time to first recurrence as well as decrease the number of recurrences over time, but it does not eliminate recurrences. In patients with recurrences before and after parathyroidectomy, the operation does not appear to significantly increase time between recurrences.

◆ 29. Recurrence after Successful Parathyroidectomy – Who Should We Worry About?

Aditya S Shirali¹, Si-Yuan Wu², Yi-Ju Chiang³, Paul H Graham¹, Elizabeth G Grubbs¹, Jeffrey E Lee¹, Nancy D Perrier¹, Sarah B Fisher¹

¹*Surgical Oncology, University of Texas MD Anderson Cancer Center*, ²*National Defense Medical Center*, ³*University of Texas MD Anderson Cancer Center*

Background: In the last 20 years a paradigm shift towards minimally invasive parathyroidectomy (MIP) has occurred with an accepted recurrence rate of 2%. Recent studies have demonstrated a higher long-term recurrence rate, raising the question of how best to follow these patients. We sought to examine recurrence of primary hyperparathyroidism (PHPT) after surgical cure and evaluate early predictors of recurrence to inform follow-up strategies.

Methods: Adult patients with sporadic PHPT treated between 9/1/1997-9/1/2019 with normocalcemia at 6 months postoperatively and follow-up > 9 months were identified. Recurrence was defined as hypercalcemia (>10.2 mg/dL) with an inappropriately elevated parathyroid hormone level (PTH).

Results: Parathyroidectomy for sporadic PHPT was performed in 563 patients (median age 62.4 years, 77.1% female) with the majority undergoing a MIP (82.6%, n= 465). During a median follow up of 31.5 months (IQR 14.1–67.5 months), 20 patients (3.6%) recurred with a median time to recurrence of 43.9 months (IQR 21.0-73.8 months). Preoperative calcium (Ca) and PTH, gender, and operative approach (MIP vs. four-gland exploration) did not impact recurrence (p>0.05). Recurrence was more common in older patients (68 vs. 62 years, p=0.007) and those with higher Ca (although still normocalcemic) and PTH values at 6 months (Ca 10.0 vs. 9.3 mg/dL, p<0.001; PTH 64 vs. 46 pg/mL, p<0.001). The percent drop in intraoperative PTH was less among those with recurrence (65.5% vs. 82%, p=0.004). On multivariate analysis, higher 6-month Ca and PTH were associated with increased risk of recurrence (OR 23.1, p<0.001 for Ca, OR 1.02, p<0.001 for PTH). Recursive partitioning identified a 6-month serum Ca \geq 9.8 mg/dL as the optimal cutpoint to risk stratify, with these patients 7.7 times more likely to develop recurrence (p <0.001). This relationship persisted in patients undergoing planned MIP (n=465), with 2.3% patients recurring with a 6-month serum Ca < 9.8 versus 10.5% patients with a 6-month Ca \geq 9.8 (p=0.002).

Conclusions: Recurrence of sporadic primary hyperparathyroidism after surgical cure in the era of MIP is infrequent but may occur late. A serum calcium \geq 9.8 mg/dL at 6 months may be an early risk factor for recurrence and could inform future surveillance strategies.

30. A Prospective Randomized Controlled Trial on the Efficacy and Safety of Prophylactic Central Compartment Lymph Node Dissection in Papillary Thyroid Carcinoma.

Jong-hyuk Ahn¹, Jung Hak Kwak¹, Keunchul Lee², Hyeong Won Yu², Hyungju Kwon³, Su-jin Kim¹, Young Jun Chai⁴, June Young Choi², Kyu Eun Lee¹

¹*Seoul National University Hospital*, ²*Seoul National University Bundang Hospital*,

³*Ewha Womans University Medical Center*, ⁴*Seoul National University Boramae Medical Center*

Background: The efficacy of prophylactic central compartment lymph node dissection (pCND) for papillary thyroid carcinoma (PTC) is still debated. Since there are few prospective randomized controlled trials (RCTs) to compare the pros and cons of pCND, recommendations in many guidelines are often based on retrospective studies, meta-analysis and systematic reviews, or expert opinions. We performed prospective RCT to evaluate oncological efficacy and surgical safety of pCND.

Methods: A total of 101 patients with PTC without evidence of metastatic lymph nodes (LNs) before and during surgery were enrolled. Patients were randomly assigned to 'TTx' group (n=50) who underwent total thyroidectomy (TTx) only and 'pCND' group (n=51) who underwent TTx+pCND. The surgical outcomes, complications and recurrence rates were compared between both groups.

Results: 'pCND' group harvested significantly more LNs (2.1 ± 2.4 in TTx vs. 5.2 ± 3.5 in pCND, $p < 0.05$). The number of patients upstaged from cN0 to pN1a was significantly higher in 'pCND' group (6.0% in TTx vs. 27.5% in pCND, $p < 0.05$). However, there were no significant differences in the number of patients received RAI treatment, the number of RAI treatments, and total RAI dose ($p = 1.000$, 0.484, and 0.409, respectively). The number of patients with stimulated thyroglobulin levels less than 1 ng/mL before the first RAI treatment was similar in two groups (54.5% in TTx vs. 45.5% in pCND, $p = 1.000$). Both groups showed similar adverse outcomes with transient vocal cord palsy ($p = 0.734$) and transient hypoparathyroidism ($p = 0.194$). Permanent vocal cord palsy and hypoparathyroidism were not present in both groups. After 46.6 month follow-up period, no patients showed recurrence upon regular ultrasound examination ($p = 1.000$).

Conclusions: This study showed 'pCND' group harvested higher number of LNs and upstaged more cN0 patients to pN1a. Despite the differences on numbers of pN1a, both groups underwent RAI treatments without differences. And there was no difference in complications and recurrence rates in both groups. In conclusion, pCND has no clinical benefit in PTC cN0 patients who will undergo total thyroidectomy.

31. Rate of Occult Malignancy May Be A Deterrent to Radiofrequency Ablation for Benign Thyroid Disease

Jina Kim¹, Zhifei Sun², Marcus H Cummins³, Kevin C Donohue³, Robin Lea³, Claire E Graves⁴, Wen T Shen³, Jessica E Gosnell³, Sanziana A Roman³, Julie A Sosa³, Quan-Yang Duh³, Insoo Suh³

¹*Inova Schar Cancer Institute*, ²*Washington University in St. Louis*, ³*University of California-San Francisco*, ⁴*University of California-Davis*

Background: Radiofrequency ablation (RFA) has been proposed as an alternative strategy for the management of benign thyroid conditions. We analyzed the proportion of patients who underwent thyroid surgery for benign diseases at our institution who would be potentially eligible for RFA.

Methods: We identified patients who underwent thyroid surgery from 2015 to 2019 at our institution for Bethesda II cytopathology on initial fine needle aspiration or autonomously functioning thyroid nodule (AFTN). Patients were considered potentially eligible for RFA if they met any of the following conditions: dominant nodule >2 cm with or without compression symptoms, dominant nodule <1 cm with compression symptoms, or AFTN. Baseline characteristics between RFA-eligible and RFA non-eligible groups were compared. We then performed a subgroup analysis of patients with Bethesda II cytopathology who had malignancy diagnosed on final pathology.

Results: Of 414 patients in total, 347 (83.8%) would be eligible to consider RFA as an alternative to thyroid surgery based on preoperative characteristics. The RFA-eligible group was younger than the RFA non-eligible group (49 vs. 53 years respectively, $p=0.05$). More patients in the RFA-eligible group underwent thyroid lobectomy, compared to the RFA non-eligible group (67.1% vs. 50.7%, $p=0.02$). Postoperatively, in the RFA-eligible group, 25 (7.2%) experienced voice change after surgery; 13 (3.7%) had an abnormal postoperative laryngoscopy, and 3 (0.9%) were dissatisfied or concerned about their scar.

In a subsequent analysis of 406 patients with Bethesda II cytopathology, 95 (23.3%) had malignancy diagnosed on final surgical pathology. Thirty patients (7.4%) had malignancy in the dominant, biopsied nodule, while the other 65 tumors were incidentally found. The thyroid cancer subtypes included 73 papillary, 20 follicular, 2 noninvasive follicular thyroid neoplasm with papillary-like nuclear features, and 1 lymphoma. Among the 65 incidental tumors, 8 (12.3%) were tumors >1 cm.

Conclusions: Many patients who undergo surgery for benign thyroid disease could be considered for RFA as an alternative treatment modality. However, the rate of occult malignancy is not insignificant and should be further studied before broad implementation of RFA.

◆ 32. Age determines treatment for T2N0M0 papillary thyroid cancer

Erin C MacKinney¹, Kristine Kuchta², David J Winchester³, Amna Khokar⁴, Tricia A Moo-Young¹, Richard A Prinz¹

¹Endocrine Surgery, NorthShore University HealthSystem, ²Biostatistics and Research Informatics, NorthShore University HealthSystem, ³NorthShore University HealthSystem, ⁴Endocrine Surgery, John H. Stroger Cook County Hospital

Background: Age is important in the staging and treatment of conventional papillary thyroid cancer (cPTC). We examine if the extent of surgery and use of radioactive iodine affect overall survival (OS) for patients with cPTC T2 tumors (2cm-3.9cm) according to age.

Methods: 32,147 patients in the National Cancer Data Base from 2004 to 2016 had cT2N0M0 cPTC tumors. Multivariable Cox regression analysis compared 1189 patients with lobectomy to 9,314 patients with total thyroidectomy (TT) and 21,644 patients with total thyroidectomy plus radiation (TT+R) for three age ranges (18-45, 46-55, and 56-90+). 1:1 propensity score matching for age groups, gender, race, Carlson Comorbidity Index, insurance status, income, facility type, tumor size, tumor focality, extrathyroidal extension, and surgical margins was performed on 1,189 patients per treatment group. Kaplan-Meier curves with 10-year OS estimates and log-rank test stratified by age were used to determine if extent of surgery affected OS on propensity score matched analysis.

Results: Lobectomy had equivalent OS to TT and TT+R for patients aged 18-45 and 46-55 on multivariable Cox regression (p=NS). Those older than 55 had reduced OS with lobectomy (HR 1.95, 95%CI 1.46-2.60, p<0.001) compared to TT+R. Similarly, there were no significant OS differences in patients aged 18-45 and 46-55 who had either lobectomy, TT, or TT+R, but there was a significant survival advantage in patients aged >55 who had TT+R compared to lobectomy (10-year OS 79.2% vs 70.3%; p=0.007) on propensity score matched analysis.

Conclusions: Thyroid lobectomy has equivalent 10Y-OS to TT and TT+R in patients aged 18 to 55 with cT2N0 cPTC. TT+R has improved 10Y-OS for patients age >55 with cT2N0 cPTC compared to lobectomy.

◆ **33. Radioactive iodine does not improve overall survival for patients with aggressive variants of papillary thyroid carcinoma less than 2 cm**

Simon A Holoubek^{1,2}, Erin C MacKinney^{2,3}, Amna H Khokar^{2,3}, Kristine M Kuchta⁴, David J Winchester^{2,3}, Richard A Prinz^{2,3}, Tricia A Moo-Young^{2,3}

¹*Department of Otolaryngology, Head and Neck Surgery, Augusta University,*

²*Department of Surgery, NorthShore University HealthSystem,* ³*Department of Surgery, University of Chicago,* ⁴*Bioinformatics and Research Core, NorthShore University HealthSystem*

Background: Tall Cell and Diffuse Sclerosing variants of papillary thyroid cancer (PTC) are associated with more aggressive clinicopathologic variables. The use of adjuvant radioactive iodine (RAI) following thyroidectomy has not been well studied in this patient population.

Methods: Patients ≥ 18 years in National Cancer Data Base 2004-2016 with classic (cPTC), tall cell (TC), or diffuse sclerosing (DS) PTC subtypes 1mm-40mm were identified. Multivariable logistic regression was used to identify factors associated with aggressive features. Overall survival (OS) was assessed using the Kaplan-Meier method with 10-year survival estimates (10YOS) and log-rank tests, after propensity score matching for clinicopathological and treatment variables.

Results: 115,940 classic PTC (cPTC) patients, 4,011 TC, and 507 DS were identified as having tumor sizes 1mm-40mm. Extrathyroidal extension (ETE) and nodal involvement were more frequent for all tumor sizes of TC and DS when compared to cPTC ($p < 0.01$). TC patients had more distant metastases than cPTC patients ($p < 0.01$). Total thyroidectomy (TT) with RAI was more frequently done in TC and DS patients when compared to cPTC patients (62.4%, 59.0% vs 42.6%, $p < 0.001$). When aggressive variant patients undergoing TT alone vs. TT with RAI were propensity matched across clinicopathologic variables there was no difference in OS between the two treatment groups for tumors < 2 cm (01-1.0 cm 92.2% vs 84.8%, $p = 0.98$); (1.0-2.0 cm 72.7% vs 88.1%, $p = 0.82$). However, OS was improved for the TT+RAI propensity score matched patients with tumor sizes 21-40mm vs. those undergoing TT alone (83.4% vs 70.0%, $p = 0.004$).

Conclusions: TC and DS patients present with more aggressive pathological features compared to cPTC and are more likely to undergo total thyroidectomy with RAI. For aggressive variant tumors ≤ 2 cm, there is no overall survival advantage provided by the addition of RAI. This suggests that surgical resection alone may be sufficient treatment for these patients.

◆ **34. Intraoperative trans-laryngeal ultrasonography (LUSG) of the vocal cord is a novel method of confirming the recurrent laryngeal nerve (RLN) integrity during thyroid and neck surgery**

Man Him Matrix Fung¹, Brian Hung-hin Lang²

¹*Queen Mary Hospital, University of Hong Kong*, ²*Surgery, Queen Mary Hospital, University of Hong Kong*

Background: Eliciting a normal electromyography (EMG) signal has been the usual method to confirm the functional integrity of the recurrent laryngeal nerve (RLN) during intraoperative nerve monitoring (IONM). Given that oscillations of the vocal cord (VC) can be detected with trans-laryngeal ultrasonography (LUSG) when the ipsilateral RLN is stimulated with the endotracheal tube (ETT) in-situ, we aimed to compare the accuracy and cost of this novel detection method with the conventional EMG method.

Methods: Consecutive patients who underwent an elective thyroid or neck procedure were included. In all cases, the NIM-Neuro 3.0 system was used. ETT-based surface electrodes were utilized for EMG signal recording. Standard anaesthetic technique was adopted. Towards the end of the surgery, the integrity of the RLN was confirmed by both detection methods (namely, LUSG and EMG) independently. In LUSG examination, in addition to observing for VC oscillations, color doppler was used to detect VC movements on RLN stimulation. VC function was later validated by direct laryngoscopy (DL). If either method concurred with the DL finding, it was defined as a “true-positive” or “true-negative”, based on the presence or absence of VC paresis. Accuracy was calculated as the sum of all true-positives and negatives divided by the total of nerves-at-risk. The cost of each method was calculated.

Results: One-hundred and seven patients with eligible. Total number of nerves-at-risk was 158. Based on the DL findings, the test sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) of LUSG as a detection method were 66.7%, 99.3%, 85.7% and 98.0%, respectively while the test sensitivity, specificity, PPV and NPV of the conventional EMG signals as a detection method were 88.9%, 97.9%, 72.7% and 99.3%, respectively. The prognostic accuracy in both methods was equal (97.4%). The cost of the LUSG method was much less than the EMG method (USD 82.44 vs. USD 454.97).

Conclusions: LUSG has a similar detection accuracy to EMG method during IONM. Apart from being a cheaper alternative, LUSG may be useful when there is an unexplained loss of EMG signals during surgery and may play a future role in the IONM troubleshooting algorithm.

◆ **35. Medullary Thyroid Cancer: What is the optimal management of the lateral neck in a node negative patient at index operation?**

Thomas Szabo Yamashita¹, Richard Rogers¹, Trenton Foster¹, Melanie Lyden¹, Geoffrey Thompson¹, John Morris¹, Travis McKenzie¹, Benzon Dy¹

¹*Mayo Clinic*

Background: Medullary Thyroid Cancer (MTC) is a rare neuroendocrine malignancy that occurs sporadically as well the result of genomic RET mutations in MEN2A/B. MTC can be confined to the thyroid but also has higher rates of metastasis than well-differentiated thyroid cancer. Prophylactic lateral neck dissection (LND) is often performed but its use is controversial.

Methods: Single-center retrospective review (2000-2017) of patients undergoing surgical treatment for MTC. Demographics, genetic associations, clinical, and imaging findings were analyzed. Loco-regional recurrence (LR), overall recurrence (OR), and overall survival (OS) were examined.

Results: There were 214 patients identified, 86 men and 128 women. Mean age at diagnosis was 50±18 years. 26% (55) were associated with genetic syndromes, MEN 2A being the most common (95%). Median value for calcitonin at diagnosis was 890pg/mL (IQR 0.3-3484). 23% (50) presented with lateral node-positive disease at diagnosis, 3 familial vs 47 from the sporadic form, (P<0.0001). All patients underwent central neck dissection. 39% (85) patients underwent LND at initial surgery, of which 26 were prophylactic with 31% (8) being node positive. OR was 26% (72) in all patients.

Of the 26 patients undergoing prophylactic LND, 11% (3) presented with LR vs 16% (14) of those that did not undergo prophylactic LND, P=0.71. OS at 5 years was 47% for patients with clinically node negative disease at diagnosis and no prophylactic LND vs 46% for those undergoing prophylactic LND, P=0.11

11% (24) of patients presented with only LR, and 3.5% (6) of patients presented with biochemical recurrence with no identifiable lesion. 16% (7) of patients with syndrome-associated disease presented with recurrence compared to 34% (66) from the sporadic cohort, P<0.001. One patient of the RET-associated node negative group had prophylactic LND, and one patient presented LR vs two from the node positive group.

Conclusions: MTC often presents with loco-regional metastasis with false negative imaging in the lateral neck. However, there is no significant difference in LR and OS following prophylactic lateral neck dissection, limiting its role in patients with MTC with no evidence of loco-regional disease beyond the thyroid and central neck.



QUICKSHOT POSTERS

◆ Denotes Resident/Fellow Competition QuickShot

NOTE: Author listed in **BOLD** is the presenting author

◆ 01. Long-term Voice Changes After Thyroidectomy: Results from a Validated Survey

Chun Li¹, Scott Fligor¹, Sarah Duncan¹, Anthony Maeda¹, Hao Wei Chen¹, Anam Choudhary¹, Simran Budhwani¹, Per-Olof Hasselgren¹, Peter Mowschenson¹, Pavan Mallur¹, Benjamin James¹

¹*Beth Israel Deaconess Medical Center*

Background: Although thyroid surgery is complicated by nerve injury in fewer than 1% of cases, long-term dysphonia may persist postoperatively even in the absence of overt nerve injury. Therefore, we evaluated long-term dysphonia following thyroidectomy using a validated survey.

Methods: We identified patients undergoing thyroidectomy at our high-volume institution from 1990 to 2018 with a known RLN injury rate under 1%. Patients were surveyed via telephone to complete the Voice Handicap Index-10 Survey (VHI-10), a validated instrument that quantifies patient-reported dysphonia via the 10 most statistically robust complaints of perceived voice handicap adapted from the full VHI survey. Individual metrics for physical symptoms, functional impact, and emotional responses are scored from 0–4 with an aggregate score >11 considered abnormal. Medical records were reviewed for patient demographics, diagnosis, and time since surgery.

Results: 308 patients met study criteria and successfully completed the survey (mean age 51 ± 14 years (standard deviation), 241 (78%) female). Median time since surgery was 10.7 (interquartile range 2.3–17.5) years. The mean VHI-10 score was 2.6 ± 5.2 , with 195 (63%) patients reporting no voice complaints. Of the 113 (37%) patients who reported subjective dysphonia, the mean VHI-10 score was 7.1 ± 6.5 (range 1–37). Twenty-two (7.1%) patients had VHI-10 score above the empiric normative cutoff of 11, with a mean score of 17.6 ± 6.8 . The most frequent complaints included “The clarity of my voice is unpredictable” (N=71, 23%), “People have difficulty understanding me in a noisy room” (N=70, 23%), and “I feel as though I have to strain to produce voice” (N=65, 21%).

Conclusions: Long-term follow up of patients following thyroidectomy suggests that over 30% report subjective dysphonia, with 7% reporting significant functional limitations. Research to further assess the etiology and impact of these changes on long-term measured quality of life is needed.

02. Out of Pocket Costs for Commercial Patients Undergoing Thyroidectomy

Feibi Zheng¹, Yongmei Huang², Jennifer Kuo³, Jason Wright⁴

¹*Houston Methodist Hospital*, ²*College of Physicians and Surgeons, Columbia University*, ³*Division of GI/Endocrine Surgery, Columbia University*, ⁴*Herbert Irving Comprehensive Cancer Center, Columbia University*

Background: Little is known about pocket costs (OOPC) for patients with thyroid conditions requiring thyroidectomy in the United States.

Methods: We performed a retrospective cohort study of patients who underwent thyroidectomy from 2008 to 2016 using the IBM Watson MarketScan database. Claims data were divided into three time periods: 90 days prior to surgery to 30 days after surgery, 31 days to 180 days after surgery, and 181-360 days after surgery. In addition to total costs, payments were stratified into OOPC and insurer payment. Payments were further divided into expenditures for inpatient care, outpatient care and outpatient drug costs.

Results: A total of 65,996 patients aged 18-95 who underwent thyroidectomy were identified after excluding patients who changed coverage and patients on capitated plans. Among these patients, substernal thyroidectomy accounted for 4.3%, complete thyroidectomy 36.2%, and partial thyroidectomy 59.5%. Patients diagnosed with malignant disease accounted for 24.5%. The gender ratio was 85 to 15 for female;male, and 10.4% of patients were aged 65 or above. Over 40% of patients had a comorbidity. The median total medical expenditures per patient in the study period of 90 days prior to surgery to 360 days after surgery was \$19,334 (IQR \$11,010 - \$34,300), the median OOPC was \$2,285 (IQR \$1,127 - \$4,082), the median insurance reimbursement was \$14,983 (IQR \$7,212 - \$28,167). 25.1% of patients received inpatient services with a median OOPC of \$497 (IQR \$0 - \$1,439), 99% of patients received outpatient services with a median OOPC of \$1626 (IQR \$701 - \$3,206), and 80.6% of patients required outpatient medications with median OOPC of \$300 (IQR \$119 - \$642).

Conclusions: The median OOPC for health expenditures for patients with commercial insurance coverage requiring thyroidectomy from 90 days prior to 360 days after surgery is \$2,285, approximately 11.8% of total costs, a substantial financial burden for many American households despite their insured status.

03. Post-thyroidectomy hypocalcemia: is a routine preferable over a selective supplementation?

Luca Sessa¹, Carmela De Crea², Francesca Zotta³, Milena Pia Cerviere³, Pierpaolo Gallucci¹, Francesco Pennestri¹, Pietro Princi¹, Luca Revelli², Rocco Bellantone², Marco Raffaelli²

¹Fondazione Policlinico Universitario Agostino Gemelli IRCCS, ²Fondazione Policlinico Universitario Agostino Gemelli IRCCS - Università Cattolica del Sacro Cuore, ³Università Cattolica del Sacro Cuore

Background: Protocols for the management of post-thyroidectomy hypocalcemia are based on routine or selective supplementation of calcium and/or vitamin D, aiming to safely reduce the length of hospitalization and to prevent the risk of readmission for symptoms. Comparative studies among different protocols are lacking. We compared the effectiveness of PTH-driven selective supplementation (PD-SS) and routine calcium and vitamin D supplementation in preventing symptomatic hypocalcemia and readmission.

Methods: Between February and July 2020, 300 consecutive consenting patients undergoing total thyroidectomy (TT) were assigned to 3 different arms: the PD-SS group (100 patients, operated on between February-March 2020), the high-dose routine supplementation (HD-RS) group (100 patients, April- May 2020) and the low-dose routine supplementation (LD-RS) group (100 patients, June-July 2020). PD-SS included oral calcium (OC) 3 g and calcitriol 1 mcg per day in patients with PTH 4 hours after surgery (4hrs-PTH) <15 pg/mL, OC 3 g per day in patients with 4hrs-PTH ≥15 pg/mL but a percent decrease >50% with respect to the preoperative levels and no treatment in all the other patients. Routine supplementation included administration in all the patients of calcitriol 0.5 mcg (LD-RS) or 1 mcg (HD-RS) the day before and 4-hour after TT and OC 3 g and calcitriol 1 mcg per day postoperatively starting from the first postoperative day.

Results: No significant difference was observed among the three groups regarding age, sex, pre-operative diagnosis, extent of surgery (TT+/- central+/-lateral neck dissection), post-operative 4hrs-PTH (P=NS). Mean post-operative stay was shorter in HD-RS patients when compared to PD-SS and LD-RS (1.1 Vs 2.0 Vs 1.4, respectively - P<0.001). Significantly more patients in the PD-SS group experienced symptomatic hypocalcemia (5/100 Vs 1/100 Vs 1/100 - P<0.05), but the rate of post-operative hypocalcemia was not significantly different among the 3 groups (14/100 Vs 11/100 Vs 6/100 - PD-SS Vs LD-RS Vs HD-RS, respectively) (P=NS). No readmission for symptomatic hypocalcemia or hypercalcemia was necessary.

Conclusions: HD-RS emerged as the most effective treatment to prevent hypocalcemia and symptoms, without increasing the risk of readmission for calcitriol-related hypercalcemia. Basing on the present results, HD-RS should be recommended as the preferable protocol.

◆ 04. Impact of a Systemwide Adrenal Incidentaloma Quality Improvement Initiative – a Prospective Study

Alison P Woods^{1,2}, Timothy Feeney^{2,3}, Avneesh Gupta⁴, Philip E Knapp⁵, David McAneny², Frederick T Drake²

¹Department of Surgery, Johns Hopkins University School of Medicine,

²Department of Surgery, Boston University School of Medicine, ³Department of Epidemiology, University of North Carolina, ⁴Department of Radiology, Boston University School of Medicine, ⁵Department of Medicine, Boston University School of Medicine

Background: Appropriate follow-up of incidental adrenal masses (IAMs) is infrequent. We implemented a quality improvement (QI) program to improve the management of IAMs.

Methods: This systemwide initiative targeted primary care providers (PCPs) after IAM detection. It incorporated (1) chart-based messages and emails to PCPs, (2) an evidence-based algorithm for IAM workup, and (3) standardized recommendations in radiology reports. Data were prospectively collected in 2019 (the “QI cohort”) and compared to a cohort diagnosed with IAMs in 2016 (prior to the intervention). The primary outcome was the initiation of an IAM workup by the PCP, defined as relevant clinical history-taking, laboratory screening, follow-up imaging, or sub-specialist referral.

Results: The QI cohort included 206 patients, versus 225 in the historical cohort. Patients who died during admission or had severe life-limiting conditions were excluded. All patients had ≥ 6 months of follow-up. In the QI cohort, 37.4% (77/206) met the primary endpoint for PCP-initiated workup, compared to 25.8% (58/225) in the historical cohort ($p=0.013$). Implementation of the standardized radiology template was not universal. Among those whose radiology reports included standardized IAM recommendations, 55.8% (29/52) received IAM follow-up. More patients in the QI cohort underwent follow-up imaging (26.7% vs. 17.8%; $p=0.028$) and more QI cohort patients completed a biochemical evaluation (21.8% vs. 14.2%; $p=0.044$). After adjusting for insurance status and initial imaging setting (e.g., inpatient, outpatient, emergency department), patients in the QI cohort had 1.84 times higher odds (95%CI 1.12-3.03) of PCP-initiated IAM workup. Time to initial PCP follow-up visit was shorter in the QI cohort compared to the historical cohort (24.5 days vs. 42 days, $p=0.022$). Of 159 patients with a final diagnosis listed in the medical record, 125 (78.6%) had presumed or confirmed non-functional adenomas, 20 (12.6%) had metastatic tumors, and 4 (2.5%) had biochemically functional masses; no adrenocortical carcinomas were diagnosed.

Conclusions: This QI intervention was associated with increased IAM evaluation and decreased time to follow-up. While 25.8% of patients historically underwent IAM workup, 37.4% of patients underwent workup in the QI cohort overall. Furthermore, in the subset receiving all 3 components of the QI initiative, a majority (55.8%) of patients underwent IAM evaluation.

◆ 05. Generation of an organoid model of adrenocortical carcinoma

Hemamylammal S SugavanamSivakumar¹, Kylie G Nairon¹, Xuguang G Zheng², Barbra S. Miller², John E Phay², Lawrence S Kirschner³, Aleksander G Skardal¹, Priya H Dedhia²

¹Biomedical Engineering, Ohio State University, ²Surgery, Ohio State University, ³Internal Medicine, Ohio State University

Background: Adrenocortical carcinoma (ACC) has a poor prognosis, with a 5-year survival of less than 35%. Current treatment options are limited in effectiveness, and lack of research models has significantly hindered drug development. Patient-derived tumor organoids (PTOs) are patient-specific 3-dimensional *in vitro* cultures that are generated from a clinical biospecimen. PTOs can provide advantages over traditional 2D cell culture and animal models because they demonstrate fidelity to the primary human tumor and offer patient specificity for high-throughput drug screening. The purpose of this study was to determine the feasibility of ACC PTOs as a research model for ACC.

Methods: Three tumor biospecimens were obtained from patients and processed into a tumor cell suspension, while maintaining the heterogeneity of the biospecimens. 100,000 cells were encapsulated in 10 μ L volumes of a hyaluronic acid and gelatin-based hydrogel system to create PTOs. PTOs were assessed for viability with ATP proliferation assays and live/dead staining. Media was collected from PTOs at 4 days and secreted cortisol was quantified by ELISA. PTOs were cultured for 7 days and then treated with mitotane with or without etoposide, doxorubicin and cisplatin (EDP) for 72 hours.

Results: PTOs of high initial viability were fabricated from all samples, with 1g of biospecimen resulting in 6 to 28x10⁶ cells. PTOs remained viable for three weeks in culture and demonstrated up to 2.5-fold proliferation as evidenced by ATP proliferation assays with relative luminescence units ranging from 2x10⁵ to 7x10⁶. Cortisol production was 12 ng/mL in PTOs derived from cortisol-producing ACC. Two of the three sets of PTOs demonstrated significant cell death in response to high dose EDP, but not to low dose EDP or mitotane alone. No difference in cell death was seen with the addition of mitotane.

Conclusions: Our model is the first successful biofabrication of ACC PTOs *in vitro*. Moreover, we demonstrate the ability to perform drug screens and assess hormone production using ACC PTOs. This work suggests that ACC PTOs are a powerful research model that can be used to study oncogenic signaling pathways and develop effective personalized treatments.

◆ **06. A prospective study comparing the midline and lateral trans-laryngeal ultrasonography approaches in the assessment of vocal cords before and after thyroid and neck surgeries**

Man Him Matrix Fung¹, Wing Yan Chan¹, Ching Yiu Wong¹, Brian Hung-hin Lang¹

¹Surgery, Queen Mary Hospital, University of Hong Kong

Background: Trans-laryngeal ultrasonography (TLUSG) is a good non-invasive alternative to direct laryngoscopy in the assessment of the vocal cords (VCs) for thyroid and neck surgery. In order to clearly image the symmetrical movement of the VCs, the ultrasound probe is normally placed in the middle of the thyroid cartilage (the so-called “the midline approach”). However, recent studies have found that approaching the VCs laterally (i.e. placing the ultrasound probe parallel to the lateral surface of the thyroid cartilage or “the lateral approach”) might be more favourable. We aimed to compare the success rate of VC visualisation and diagnostic accuracy between the two different TLUSG approaches.

Methods: Consecutive patients undergoing an elective thyroid or neck surgery were subjected to TLUSG assessment of the VCs via the two approaches by two independent, experienced assessors. Each assessor was responsible of conducting one of the two approaches and during assessment, each was unaware of the findings of the other approach. The VC function was subsequently validated by direct laryngoscopy. Diagnostic accuracy was calculated as the sum of all true-positives and negatives divided by the total of VCs assessed.

Results: Eight-seven patients were eligible. Of these, 46 were conducted preoperatively while 41 were conducted postoperatively. The total number of VCs assessed was 174. The overall success rate of VC visualisation was significantly higher with the lateral approach than the midline approach (97.7% vs. 81.6%, $p=0.001$). Both the preoperative and postoperative success rates of VC visualisation were significantly higher with the lateral approach than the midline approach (95.6% vs. 80.4%, $p=0.05$ and 100% vs. 82.9%, $p=0.012$, respectively). However, the findings from the midline approach were completely concordant with those from the lateral approach. Both approaches achieved a diagnostic accuracy of 97.9% relative to direct laryngoscopy. There were no patients with a false-negative finding in both approaches.

Conclusions: Although both approaches were highly accurate and reliable at VC assessment, the lateral approach achieved a significantly better success at VC visualisation than the midline approach in both the preoperative and postoperative settings. The lateral approach should be the preferred initial technique in peri-operative VC assessment by TLUSG.

◆ 07. Enhancing risk-stratification of indeterminate thyroid nodules using Artificial Neural Network-enabled image analysis.

Kelvin Memeh¹, Jelani Williams¹, Hui Li², Julian Conn Busch³, Li Lan², David Sarne⁴, Edwin Kaplan¹, Peter Angelos¹, Maryellen Giger², Xavier Keutgen¹
¹*Section of Endocrine Surgery, Department of Surgery, The University of Chicago Medicine,* ²*Department of Radiology, The University of Chicago Medicine,* ³*Pritzker School of Medicine, The University of Chicago,* ⁴*Section of Endocrinology, Diabetes and Metabolism, Department of Medicine, The University of Chicago Medicine*

Background: Ultrasound-guided fine needle aspiration cytology (FNAC) is the gold standard for the evaluation of thyroid nodules. However, up to 30% of FNAC results are indeterminate, requiring further testing. Molecular testing was introduced to improve cancer detection rate with FNAC; however, studies have reported mixed result on their value. Machine learning algorithms, has had increasing success in cancer detection but little is known about their utility in risk-stratification of thyroid nodules. In this study, we evaluated the use of a Bayesian Artificial Neural Network (BANN) in improving cancer detection in thyroid nodules using ultrasound features.

Methods: Ultrasound images were labeled according to their FNAC and surgical pathology diagnosis-MM: malignant on both, BB: benign on both, IM: indeterminate(FNAC) and malignant(pathology), IB: indeterminate(FNAC) and benign(pathology).The margins of the nodules were annotated and used as truth for segmentation. Texture analysis was conducted within the tumor contours using quantitative radiomics. A two-class BANN-classifier was utilized in two ways: 1) round-robin-by-lesion with stepwise feature selection using leave-one-out cross-validation (LOOCV) for MM vs. BB, and IM vs. IB; and 2) training the BANN using the combined MM/BB set with subsequent independent testing on the FNAC-indeterminate image set (IM vs. IB). Performance was examined using receiver operating characteristic(ROC) analysis with area under the ROC curve (AUC) as a metric.

Results: Ultrasound images of 263 thyroid nodules were reviewed. 146 nodules were benign on surgical pathology. Subgroup breakdown included: 90 BB, 56 IB(Bethesda III [39], IV [15], V [2]), 47 IM(Bethesda III [15], IV [9], V [23]), and 70 MM thyroid lesions. Round-robin-by-lesion BANN using LOOCV yielded an AUC of 0.76 ± 0.038 and 0.70 ± 0.052 for the classification task of MM vs. BB, and IM vs IB, respectively ($P < 0.001$). BANN training on MM/BB images with independent testing of IB vs. IM yielded an AUC of 0.65 ± 0.053 ($P = 0.0050$). The model performed best with Bethesda-IV nodules (AUC of 0.725003 0.105865 , [$p = 0.0336$])

Conclusions: The application of Quantitative Radiomics and BANN on thyroid ultrasound images can improve the cancer detection rate for indeterminate thyroid nodules. Further studies are needed to refine this classifier and confirm its utility in a clinical setting, especially in combination with molecular testing.

◆ 08. Perception of Risk and Decision on Treatment in the Management of Differentiated Thyroid Cancer

Max A Schumm¹, Michelle Shu¹, Jiyeon Kim², Chi-Hong Tseng³, Masha J Livhits¹, Kyle A Zanicco¹, Michael W Yeh¹, Greg D Sacks⁴, James X Wu¹

¹*Surgery, UCLA*, ²*Biostatistics, UCLA*, ³*Medicine, UCLA*, ⁴*Surgery, Memorial Sloan Kettering Cancer Center*

Background: The landscape of differentiated thyroid cancer (DTC) management has been evolving rapidly. As a result, there is variation in recommended treatment for thyroid nodules and DTC. In this study we examine the association between physicians' perception of risk and their management of DTC.

Methods: In this survey study, we presented thyroid specialists with four clinical vignettes: 1) classic papillary thyroid cancer (PTC), 2) indeterminate thyroid nodule with BRAF mutation, 3) papillary thyroid microcarcinoma (mPTC), 4) tall cell variant PTC. Participants were asked to judge the operative risks and likelihood of cancer recurrence of conservative vs. aggressive treatment. Risk reduction was defined as the difference between conservative and aggressive treatment. The risk reduction was standardized between cases and used in a linear mixed effect model to predict choice of treatment.

Results: Of 183 respondents (31% adjusted response rate), 39% were surgical and 61% were medical thyroid specialists. Respondents identified themselves as conservative (30%), moderate (61%) and aggressive (9%), relative to their local practice pattern. Physicians varied markedly in their assessments of risks. For example, estimated risk of 10-year cancer recurrence after lobectomy for a 2.0 cm PTC ranged from 1%-53% (IQR, 3%-12%), with 66% choosing lobectomy and 34% choosing total thyroidectomy (TT). Estimated malignancy risk in a 1.5 cm indeterminate nodule with BRAF V600E mutation, ranged from 5%-100% (IQR, 50%-98%), with 70% choosing lobectomy and 30% TT. Estimated risk of 5-year cervical metastases during active surveillance of a 0.8 cm mPTC ranged from 0-95% (IQR, 4%-15%), with 36% choosing active surveillance, 56% lobectomy and 8% TT. Pooled analysis demonstrated physicians who perceived the greatest risk reduction were 13.2% (95% CI 6.7%-19.6%) more likely to choose the more aggressive treatment compared to physicians who perceived the least risk reduction (1.0 standard deviation above vs below the mean). However, differences in risk reduction explained only 11.6% of the observed variation in decision-making. Estimated operative risk had no significant effect on choice of treatment.

Conclusions: In four common clinical scenarios, there is wide variation in risk estimates and choice of treatment. Perceived differences in likelihood of cancer recurrence only explains a small proportion of variation in decision-making.

◆ 09. Molecular fluorescence-guided imaging of papillary thyroid cancer nodal metastasis using a fluorescent tracer targeting MET can be used to detect lymph node metastasis

Madelon Metman¹, Pascal Jonker¹, Luc Sondorp^{2,3}, Mark Sywak⁴, Anthony Gill^{5,6,7}, Liesbeth Jansen², Paul van Dienst^{8,9}, Tessa van Ginhoven¹⁰, Clemens Löwik¹¹, Anh Nguyen¹², Go van Dam^{13,14}, Rob Coppes³, Bettien van Hemel¹⁵, Rudolf Fehrmann¹⁶, Schelto Kruijff¹

¹Department of Surgical Oncology, University Medical Center Groningen, ²University Medical Center Groningen, ³Department of Biomedical Sciences of Cell & Systems – section molecular cell biology, University Medical Center Groningen, ⁴Department of Endocrine Surgery and Surgical Oncology, Royal North Shore Hospital, ⁵Royal North Shore Hospital, St Leonards, ⁶Sydney Medical School, University of Sydney, ⁷Cancer Diagnosis and Pathology Group Kolling Institute of Medical Research, Royal North Shore Hospital, ⁸Department of Pathology, University Medical Center Utrecht, ⁹Sidney Kimmel Comprehensive Cancer Center, Johns Hopkins, ¹⁰Department of Surgical Oncology and Gastrointestinal Surgery, Erasmus MC Cancer Institute, ¹¹Department of Radiology and Nuclear Medicine, Erasmus Medical Center Rotterdam, ¹²Department of Pathology, Erasmus Medical Center Rotterdam, ¹³Department of Nuclear Medicine and Molecular Imaging, University Medical Center Groningen, ¹⁴AxelaRx/TRACER B.V., ¹⁵Department of Pathology, University Medical Center Groningen, ¹⁶Department of Medical Oncology, University Medical Center Groningen

Background: Prophylactic central compartment lymph node dissection (CLND) or watchful waiting are two currently used strategies in papillary thyroid cancer (PTC) treatment. Choosing between both strategies for an individual patient is difficult due to low specificity of preoperative imaging modalities for central compartment nodal metastases. This study aims to assess the safety and feasibility of molecular fluorescence-guided imaging (MFGI) of PTC nodal metastases (NM) with EMI-137 (targeting MET, overexpressed in PTC) to improve patient selection for a prophylactic CLND.

Methods: Patients with primary or recurrent PTC undergoing a lymph node dissection were included in a multicenter phase 1 dose-escalation study (NCT0347025) to evaluate EMI-137 tracer safety and optimal dosage. Adverse events during admission were registered. Fresh and grossed formalin-fixed lymph nodes were imaged *ex vivo* (IVIS Spectrum/Lumina 2, PerkinElmer) and correlated to histopathology. Median fluorescence intensities (MFI in p/sec/cm²/sr, Interquartile Range (IQR)) were determined and compared (Mann–Whitney U-test) between NM and normal lymph nodes (NLN). A cut-off MFI with optimal specificity for the detection of NM was determined in the optimal dosage cohort.

Results: 19 patients received 0.09 mg/kg (n=3), 0.13 mg/kg (n=10) or 0.18 mg/kg (n=6) EMI-137. Patients were treated with a CLND (n=8), uni- or bilateral lymph node dissection including CLND (n=7) or selective lymph node dissection (n=4). A total of 70 NM and 336 NLN were yielded and assessed. No serious adverse events related to the administration of EMI-137 occurred. After dose extension, only patients receiving 0.13 mg/kg had a significant difference (p<0.0001) in MFI between 24 NM (3.74x10⁷ p/sec/cm²/sr, IQR 8.54x10⁷ p/sec/cm²/sr) and 128 NLN (9.67x10⁶ p/sec/cm²/sr, IQR 1.71x10⁷ p/sec/cm²/sr). With a cutoff-MFI of 4,09x10⁷ p/sec/cm²/sr, a sensitivity, specificity and negative predictive value for the detection of NM of 74%, 76% and 95% respectively was calculated in the 0.13 mg/kg dosage cohort (n=10, 43 NM, 251 NLN).

Conclusions: The administration of EMI-137 is safe. 0.13 mg/kg EMI-137 is the optimal dosage for the detection of PTC nodal metastasis with MFGI and may be useful to improve the selection of patients that might benefit from a prophylactic CLND, ultimately reducing treatment-associated morbidity.

◆ 10. Surgical treatment of metastatic disease in the adrenal gland; how to inform the patient?

Madelon Metman¹, Charlotte Viëtor², Auke Seinen¹, Patrick Hemmer¹, Michiel Kerstens³, Richard Feelders⁴, Gaston Franssen², Tessa van Ginhoven², Schelto Kruijff¹

¹*Department of Surgical Oncology, University Medical Center Groningen,* ²*Department of Surgical Oncology and Gastrointestinal Surgery, Erasmus MC Cancer Institute,* ³*Department of Endocrinology, University Medical Center Groningen,* ⁴*Department of Endocrinology, Erasmus MC Cancer Institute*

Background: The rapid development of systemic therapies for various cancers has driven a trend towards more surgical treatments of (oligo) metastatic disease. Patients and clinicians are faced with the challenge to assess whether the surgical risks are outweighed by the oncological advantages. It is of paramount importance to assess surgical risks of metastasectomies. We, therefore, assessed the surgical outcome of patients who underwent adrenalectomy for metastatic disease. Does metastatic adrenalectomy (MA) add to the well-being of patients with cancer who are often in the last phases of their lives? We here present clinical characteristics and short-term and long-term outcomes of patients undergoing MA.

Methods: A retrospective, multicenter study was performed between September 2001 and September 2020 at two endocrine surgical units in the Netherlands. We collected patient characteristics (age, gender), tumor-related data (primary tumor), perioperative outcomes (type of surgery, complications, length of hospital stay, conversion) and oncological outcomes (date of death, cause of death) from electronic medical records. Postoperative complications that occurred within 30 days were scored according to the Clavien Dindo classification.

Results: MA was performed in 98 patients. We observed an increase from an average of 3 MAs per year between 2001-2005 to 10 between 2015-2019. The most frequent underlying malignancies were colorectal cancer (n=17) and lung cancer (25.5%) followed by melanoma (16.3%). The cohort was predominantly male (63.3%) and median age at surgery was 63 years. In 56.1%, minimal invasive MA (41 LTA and 14 RPA) was performed (7 converted). The median hospital stay was 6 days and 36.7% had postoperative complications. The most frequent complication was pneumonia (n=6). Mortality rate was 55.1% (n=54). Median survival after MA for all the deceased patients was 19.8 months; colorectal cancer 30.0 months (n=17) and lung cancer 8.5 months (n=17).

Conclusions: Improved systemic treatments have led to an increased demand for metastatic adrenalectomy over the past years. Complication rates of 36.7% are significant and cannot be neglected. Therefore, multidisciplinary teams should weigh the decision to perform metastatic adrenalectomy for each patient on an individual basis.

◆ 11. Pre-Operative Blockade for Pheochromocytoma: Is it Time to Retire Phenoxybenzamine?

Jordan A George¹, Ruth N Obiarinze¹, John R Porterfield¹, Thomas N Wang¹, Herbert Chen¹, Brenessa M Lindeman¹, Jessica M Fazendin¹, Sushanth Reddy¹

¹*Surgery, University of Alabama at Birmingham*

Background: Pheochromocytomas (PC) are adrenal tumors that produce catecholamines. Historically, PC were managed with pre-operative phenoxybenzamine (associated with great morbidity and cost) to mitigate intra-operative hemodynamic changes and post-operative myocardial infarction (MI). Some have advocated calcium channel antagonists (CCA), selective alpha-1 antagonists (SAA), and beta blockers (BB) with little data supporting one approach over another. We evaluated different treatment strategies and their effects on intra-operative hemodynamics in PC patients.

Methods: A retrospective, single-institution review of resected PC patients from 2010 through 2020 was performed. Clinicopathological characteristics and pre-operative blood pressure medications were analyzed over time to predict intra-operative hemodynamics. All hemodynamic measurements are reported as means.

Results: Ninety-seven patients underwent PC resection, 54% female (N=52) and 70% Caucasian (N=68). Pre-operative phenoxybenzamine was used most (N=43, 44%), followed by SAA (N=32, 33%), CCA (N=29, 30%), and BB (N=29, 30%). No agent was used in 8 (8%) patients. Post-operative MI occurred in 3 (3%) patients, with no mortality. The data were dichotomized into early and late time periods (2010-2015, N=54 and 2016-2020, N=43). All MIs occurred in early period patients taking phenoxybenzamine. The two time periods were similar in age (p=0.11), race (p=0.55), and sex (p=1.0). Early period patients were more likely to get phenoxybenzamine (67% vs. 16%, p<0.0001) and less likely to get SAA (17% vs. 53%, p=0.002) with similar usage of CCA (p=0.38), BB (p=0.82), and no preoperative agent (p=1.0). No differences were observed in initial operative hemodynamics (heart rate p=0.43, systolic BP p=0.51, mean BP p=0.81). The late period group had a lower maximum heart rate (117.5 vs. 145.9 bpm, p=0.0016), maximum systolic BP (170.3 vs. 210.1 mm Hg, p=0.008), and mean BP (166.4 vs. 188.7 mm Hg, p=0.003), while early period patients experienced more hypotension (minimum systolic BP 63.7 vs. 110.8 mm Hg, p=0.0001; minimum mean BP 41.0 vs. 96.2 mm Hg, p<0.0001).

Conclusions: Post-operative MIs occur rarely after PC surgery. Anesthesia advancements and decreased phenoxybenzamine use over time are associated with improved intra-operative hemodynamic stability. Further studies should focus on the necessity of preoperative phenoxybenzamine use in PC patients.

12. Surgical Treatment of Hyperthyroidism Can Be Performed Safely Before a Euthyroid State is Achieved

Jessica M Fazendin¹, Kim Ramonell², Ammar Asban¹, Mary Smithson¹, John Porterfield¹, Herbert Chen¹, BRENESSA LINDEMAN³

¹University of Alabama at Birmingham, ²Surgery, University of Alabama at Birmingham, ³SURGEON

Background: The 2016 American Thyroid Association guidelines state that hyperthyroid patients should be rendered euthyroid prior to surgery to prevent thyroid storm. This strong recommendation, however, carries only low-quality evidence to support it. While achieving the euthyroid state prior to thyroidectomy is ideal, patient-related factors can often preclude a preoperative euthyroid state. We compared peri- and post-operative outcomes of hyperthyroidism patients who were controlled versus uncontrolled at the time of surgery.

Methods: A retrospective review was performed of 208 consecutive hyperthyroidism patients at one institution from January 2016 to September 2020. Patients were defined as hyperthyroid if they had at least one suppressed TSH, and uncontrolled if T3 or T4 was elevated immediately prior to surgery (normal=2.8-4.4pg/mL, 0.58-1.64ng/dL, respectively). Patient demographics, pathology, reason for surgery, preoperative medication, operation length, blood loss, and postoperative outcomes were compared with Chi-square and t-tests, as appropriate.

Results: Of the 208 patients, 81.2% were women and 55.8% were uncontrolled at time of surgery. Controlled patients had higher TSH [0.149 (IQR 0.01-1.853) v. 0.01(IQR 0.008-0.01) mi-U] and lower free T4 [0.92 (IQR 0.77-1.20) v. 3.05 (IQR 1.89-4.3) ng/dL], respectively. Uncontrolled patients were more likely to be diagnosed with Grave's disease (84.5 v. 63%, $p<0.001$), to undergo surgery due to medication intolerance or allergies (19 v. 9.8%, $p=0.014$), and take more preoperative medications (2.12 v. 1.48, $p<0.001$). No patient in either group experienced thyroid storm precipitated by surgery. Controlled patients had shorter operative times (62 v. 51.7% <2 hrs, $p=0.001$) and decreased estimated blood loss (21.6 v. 54.1 mL, $p=0.002$). Both groups experienced similar low-rate postoperative complications, apart from an increase in temporary hypocalcemia in the uncontrolled group (14.7% vs 2.1%, $p=0.001$).

Conclusions: To our knowledge, this is the largest reported cohort of uncontrolled hyperthyroidism patients undergoing surgery. These results suggest that thyroidectomy can be performed safely, and without precipitating thyroid storm, in actively hyperthyroid patients.

◆ 13. Screening for Primary Hyperaldosteronism is Underutilized in Patients with Obstructive Sleep Apnea

Patricia C Conroy¹, Sophia Hernandez², Kate Chomsky-Higgins¹, Sarah Pearlstein¹, Wen T Shen¹, Jessica Gosnell¹, Julie A Sosa¹, Sanziana Roman¹, Quan-Yang Duh¹, Insoo Suh¹

¹Department of Surgery, University of California, San Francisco, ²School of Medicine, University of California, San Francisco

Background: Primary hyperaldosteronism (PA) is hypothesized to be one causal link between obstructive sleep apnea (OSA) and hypertension. Surgical treatment of PA is one of few effective, long-term therapies for OSA. Despite 2016 Endocrine Society guidelines' inclusion of OSA and hypertension co-diagnosis as a recommended indication for screening for PA, the state of PA-screening implementation in this population is unknown.

Methods: We identified all adult patients with polysomnography-confirmed OSA at one academic institution between 2012-2020 through electronic medical record query. We compared the prevalence of PA diagnoses, risk factors, and screening to a control cohort of primary care patients without prior polysomnogram or OSA diagnoses. Patients were considered to have screening for PA if they had a PA diagnosis or laboratory evaluation of serum aldosterone or plasma renin activity.

Results: 8,163 patients with OSA were compared to a control cohort of 391,781. Patients with OSA were older, had higher body-mass index (BMI), and were predominantly male. On multivariate logistic regression analysis, patients with OSA were at increased odds of having hypertension (58.2% v. 30.1%; OR 2.92, p<0.001), drug-resistant hypertension (20.8% v. 6.1%; OR 3.96, p<0.001), hypertension and hypokalemia co-diagnosis (8.01% v. 2.54%; OR 3.55, p<0.001), and PA (0.3% v. 0.1%; OR 2.97, p<0.001), independently of BMI and sex. From 2012-2020, patients with at least one indication for PA-screening (n=1873 OSA patients, n=28,811 control patients) were at increased odds of having been screened for PA if they had OSA (OR 1.86, p<0.001); however, the vast majority of eligible patients did not undergo screening regardless of whether they had OSA or not (92.37% v. 95.59%, respectively). The prevalence of PA-screening among OSA patients with screening indications remained low both pre- and post-2016, after new guideline implementation (4.57% v. 3.36%, respectively).

Conclusions: OSA is associated with PA diagnosis as well as PA risk factors without formal diagnosis, suggesting underdiagnosis. Screening for PA in OSA patients remains underutilized despite national guideline recommendations. Strategies are needed to increase PA-screening adherence in OSA patients, as patients may benefit from surgical treatment of concomitant PA to reduce their OSA severity and its associated cardiopulmonary morbidity and mortality.

◆ 14. RNA-Sequencing Identifies Unique Molecular Features of Duodenal Neuroendocrine Tumors

Catherine G Tran¹, Scott K Sherman¹, Anna C Reisetter², Patrick J Breheny², Guiying Li¹, Aaron T Scott¹, Bartley J Brown³, Terry A Braun³, Xianlu Laura Peng⁴, Jen Jen Yeh⁵, Po Hien Ear¹, James R Howe¹

¹Department of Surgery, University of Iowa Carver College of Medicine,

²Department of Biostatistics, University of Iowa College of Public Health,

³Center for Bioinformatics and Computational Biology, University of Iowa

College of Engineering, ⁴Lineberger Comprehensive Cancer Center and

Department of Pharmacology, University of North Carolina, ⁵Lineberger Comprehensive Cancer Center and Department of Surgery, University of North Carolina

Background: Although duodenal neuroendocrine tumors (DNETs) derive embryologically from the foregut, whether they more closely resemble midgut NETs at the transcriptional level remains unknown. We performed RNA-sequencing (RNA-seq) on DNETs and compared differential gene expression with foregut (pancreatic NETs; PNETs) and midgut NETs (jejunoileal NETs; SBNETs).

Methods: RNA-seq was performed on primary NETs and normal tissue from patients with DNETs (n = 16), PNETs (n = 41), and SBNETs (n = 37). DESeq2 in R determined differential gene expression and Ingenuity Pathway Analysis (IPA) identified enriched pathways. Gene expression changes were plotted by principal component analysis (PCA), and median pairwise distance (MPD) compared differences between tumor type.

Results: PCA and MPD demonstrated that DNETs are transcriptionally distinct from both SBNETs and PNETs (tests of difference $p < 0.01$). Genes were filtered by uniqueness to tumor type, resulting in 355 differentially-expressed-versus-normal genes common to DNETs, PNETs, and SBNETs. These genes included CHGA, CHGB, SYP, NEUROD1, TPH1, and WNT4. Common upregulated pathways were associated with synaptogenesis, CREB signaling in neurons, and insulin secretion. In comparison, 170 genes were specific to DNETs, with upregulation of glycoprotein VI and cAMP-mediated signaling.

Overall DNET gene expression not significantly more similar to PNETs or SBNETs (MPD 98.5 vs 91.7, $p = 0.3$). When considering genes in pathways upregulated in SBNETs or PNETs, DNET expression more closely approximated SBNETs in pathways associated with melatonin degradation (MPD 2.5 vs. 3.4, $P < 0.01$), FXR/RXR activation (MPD 4.1 vs. 5, $P = 0.04$), and SPINK1-associated pancreatic cancer (MPD 3.5 vs. 5.5, $P = 0.001$). DNET expression was more similar to PNET expression in genes related to GABA receptor signaling (MPD 5.3 vs. 3.6, $P = 0.001$). When analysis was limited to genes important to PNETs or SBNETs, the SBNET set showed DNETs more closely resembled SBNETs (MPD 2.52 vs. 4.96, $P = 0.001$).

Conclusions: Although NETs from several sites share common differentially expressed genes, DNETs have unique upregulation of glycoprotein VI and cAMP-mediated signaling. PCA and median pairwise distance demonstrate DNETs have distinct gene expression, with some transcriptional similarity to SBNETs when considering genes important to SBNETs and PNETs.

15. Circulating microRNA signatures in primary hyperparathyroidism

Heather Wachtel¹, Jae P Ermer¹, Douglas L Fraker¹, Rachel R Kelz¹, Matthias Hackl², Michael A Levine³

¹Surgery, University of Pennsylvania, ²TAmiRNA, ³Endocrinology, Children's Hospital of Philadelphia

Background: Primary hyperparathyroidism (PHPT) is associated with increased bone remodeling and loss of bone mineral density (BMD). miRNAs are short, non-coding RNAs that play important roles in regulating gene expression. Because changes in specific miRNAs have been described in patients with osteoporosis, we analyzed the expression levels of circulating miRNAs in patients with PHPT, and correlated with biochemical markers of bone remodeling and bone density.

Methods: A prospective case-control study of post-menopausal females 60-80 years of age with PHPT and controls without PHPT matched by race, age (± 2.5 years), and lowest T-score on DXA scan (± 0.5). Biochemical indices of bone turnover and serum levels of 27 miRNAs were evaluated. The correlation between miRNA levels and markers of bone remodeling was examined using linear regression. Heat map and principal component analysis was performed.

Results: The study cohort included 49 PHPT and 47 controls. The median age was 67 years, and the majority of subjects were Caucasian (88%). Based on T-scores, BMD was normal in 12%, osteopenic in 66%, and osteoporotic in 21%. PHPT subjects had significantly higher median calcium (10.7 versus 9.4 mg/dl, $p < 0.001$), parathyroid hormone (PTH) levels (77.7 versus 36.7 pg/ml, $p < 0.001$), bone-specific alkaline phosphatase (22.8 versus 19.6 mcg/L, $p = 0.004$), CTX (0.81 versus 0.43 pg/ml, $p < 0.001$) and osteocalcin (29.5 versus 17.8 ng/mL, $p < 0.001$) but lower phosphate (3.1 versus 3.6 mg/dl, $p < 0.001$) and P1NP (47.3 versus 61.3 mcg/L, $p = 0.026$) compared with controls. Fourteen miRNAs were differentially expressed in PHPT subjects compared to controls. Eleven of the fourteen miRNAs significantly correlated with both calcium and PTH, and two additional miRNAs correlated with PTH only. Within BMD matched subgroups, PHPT patients had differential expression of 9 miRNAs, primarily in osteoporotic subjects.

Conclusions: This is the first study to evaluate miRNAs in PHPT. Fourteen miRNAs were differentially expressed in subjects with PHPT compared with matched controls; 6 of these have been previously implicated in bone homeostasis. Differential miRNA levels correlated most consistently with serum levels of PTH, suggesting that PTH may regulate expression. miRNAs show promise as potential biomarkers in PHPT. Our ongoing follow-up study examines the effect of parathyroidectomy on miRNA levels and BMD.

16. Evaluating impact of near Infrared autofluorescence detection for identifying parathyroid glands during parathyroidectomies – a randomized single-center clinical trial.

Giju Thomas¹, Colleen M Kiernan², Melinda E Sanders³, Anita Mahadevan-Jansen¹, Carmen C Solorzano²

¹Vanderbilt Biophotonics Center, Department of Biomedical Engineering, Vanderbilt University, ²Division of Surgical Oncology and Endocrine Surgery, Vanderbilt University Medical Center, ³Department of Pathology, Vanderbilt University Medical Center

Background: Difficulty in identifying parathyroid glands (PGs) intraoperatively during parathyroidectomy leads to time-consuming and costly frozen section analyses (FSA). Near-infrared autofluorescence (NIRAF) detection has been demonstrated to be a reliable non-invasive technique for real-time label-free PG identification. This study is the first randomized clinical trial to assess the impact of NIRAF detection in patients undergoing parathyroidectomy, using the FDA-cleared probe-based NIRAF detection device called PTeye.

Methods: Patients undergoing parathyroidectomy for primary/persistent hyperparathyroidism were prospectively enrolled under two endocrine surgeons and randomly allocated to the test (PTeye) or control (no PTeye) group. Routine radiologic localization and intraoperative parathyroid hormone assay were utilized. Data were collected from both groups, which included (i) number of PGs identified with 'high' confidence by the attending surgeon and by the assisting resident/trainee, (ii) number of FSA performed, (iii) operative time, and (iv) number of operative failures at the first post-operative visit. Furthermore, quantitative parameters recorded with PTeye were analyzed to determine the PG detection rate and performance accuracy.

Results: Fifty-five patients were randomly recruited to the PTeye (n=32) and control group (n=23), with 172 PGs visualized by both surgeons over 7 focused and 48 bilateral explorations. For tissues assessed in the PTeye group, the device demonstrated a PG detection rate of 100% and an overall accuracy of 93.9%. Using plain visual examination, the attending surgeons identified 3.0 and 2.9 PGs per patient with 'high' confidence in the PTeye and control group respectively (p=0.78). Upon utilizing NIRAF detection in the PTeye group, PG identification rate of the attending surgeons notably improved to 3.2 PGs per patient (p=0.03), while that of the residents/trainees rose significantly from 1.0 to 3.1 PGs per patient (p<0.001). More importantly, there was a significant reduction in FSAs in the PTeye group as compared to the control (0.09 vs 0.74 FSA per patient, p=0.02). There was no significant difference between the groups for operative time (p=0.15) and number of operative failures at the first postoperative visit (p=1.0).

Conclusions: NIRAF detection with PTeye can be a valuable intraoperative adjunct and educative tool for improving a surgeon's confidence in PG identification, while potentially reducing FSA performed during parathyroidectomy.



POSTERS

◆ Denotes Resident/Fellow Competition Poster

NOTE: Author listed in **BOLD** is the presenting author

◆ 01. Preoperative Imaging Findings Predictive of Pheochromocytoma among Nonfunctional Adrenal Tumors

Shkala Karzai¹, Whitney Sutton¹, Joseph K Canner¹, Palak P Patel¹, Aarti Mathur¹, Jason D Prescott¹

¹Department of Surgery, Johns Hopkins University School of Medicine

Background: Pheochromocytomas are radiographically enhancing, catecholamine-secreting adrenal tumors for which adrenalectomy is indicated. Rarely, a pheochromocytoma will be hormonally inactive ('silent') and associated biochemical testing will be negative. Nonfunctional enhancing adrenal tumors may thus merit resection on the basis of pheochromocytoma risk. We hypothesize that preoperative adrenal tumor imaging features correlate with pheochromocytoma risk and that characterization of this correlation will inform preoperative decision making for nonfunctional adrenal tumors.

Methods: Under IRB approval, we performed a retrospective review of adults who underwent adrenalectomy at a high volume center between 01/2009 and 05/2020. Inclusion required any of the following preoperative CT findings: noncontrast Hounsfield units (HU) >10, contrast HU >100, phased absolute contrast washout <50%, or phased relative contrast washout <40%. Biochemical testing results >4X the normal upper limit were considered diagnostic of pheochromocytoma. Values between 1 and 4X the upper normal limit were equivocal. Multivariable logistic regression was used to evaluate associations between histologically-proven pheochromocytomas and patient factors, biochemical data and imaging findings.

Results: 148 patients having 152 adrenal tumors were included. Surgical pathology revealed 85 (55.9%) pheochromocytomas, 26 (17.1%) adenomas, 9 (5.9%) metastases, 3 (2.0%) adrenocortical carcinomas, 1 lipoma (0.7%), and 28 (18.4%) other lesions. 59 (68.4%) pheochromocytomas met preoperative diagnostic biochemical criteria, 24 (28.2%) were equivocal and 2 (2.3%) were 'silent' (p<0.001). 3.3% were <20 HU (p=0.003) on noncontrast CT imaging, while 40.8% were <100 HU (p=0.001) on contrast imaging. Pheochromocytoma was significantly associated with diagnostic biochemistry (aOR=1842.6, 95%CI: 123.7-27450.0, p<0.001), equivocal biochemistry (aOR=40.1, 95%CI: 8.3-193.6, p<0.001), noncontrast CT density ≥40 HU (aOR=21.2, 95%CI: 2.9-154.5, p=0.003), contrast CT enhancement >100 HU (aOR=8.8, 95%CI: 2.5-31.2, p=0.001). Contrast washout and noncontrast CT HU 20-<40 were not associated with pheochromocytoma.

Conclusions: Biochemical marker elevation >1X the normal upper limit in the setting of an adrenal tumor should raise concern for pheochromocytoma, as should CT density ≥40 HU (noncontrast) and >100 HU (contrast). Compared to previous studies, these findings support a lower threshold of suspicion based on biochemistry and contrast-enhanced HU, and a higher threshold based on noncontrast HU. Adrenalectomy should be strongly considered when any of these preoperative findings are identified.

02. Thyroid Ultrasound Proficiency Metric Designed Through a Multidisciplinary Delphi Process

Yinin Hu¹, Alex Michaels², Rachita Khot³, Worthington Schenk⁴, John B Hanks⁴, Philip W Smith⁴

¹*Surgery, University of Maryland Baltimore*, ²*Surgery, Wake Forest University School of Medicine*, ³*Radiology, University of Virginia School of Medicine*, ⁴*Surgery, University of Virginia School of Medicine*

Background: Surgeon-performed thyroid ultrasounds can impact patient counseling and operative decision-making. The purpose of this study was to design a proficiency metric to facilitate instruction of surgical residents in thyroid ultrasound. We hypothesized that a multidisciplinary faculty team would arrive at a consensus proficiency metric through a modified Delphi approach, and that this metric would illustrate the learning curve among trainees.

Methods: Diagnostic radiology and surgery faculty experienced in thyroid ultrasound participated in a Delphi panel to design a thyroid ultrasound proficiency scale (UPS-Thyroid). Categorized free-response for metric content was elicited in Round 1. Subsequent panel rounds used a 70% consensus threshold to retain, revise, or exclude each metric item until all items had >70% consensus for retention. The UPS-Thyroid was then piloted in preoperative settings among five surgery residents (clinical years 3-5) with ultrasound experience. Feedback using UPS-Thyroid was provided after every attempt. Learning curves were depicted using cumulative sum.

Results: Three surgeons and four radiologists participated in metric design. Round 1 (free-response) generated 24 metric items. Following three iterative Delphi rounds, the panel arrived at >70% consensus to retain 14 items without further revisions or additions. The metric included the following items on a 3-point proficiency scale for a maximum score of 42 points: Positioning (1 item), Technique (4 items), Image Capture (2 items), Measurement (2 items), and Interpretation (5 items). A pilot group of five residents were scored against a proficiency threshold of 36 points. Learning curve inflection points were noted between 1 to 7 repetitions.

Conclusions: A multidisciplinary, modified Delphi approach generated rapid consensus for a novel thyroid ultrasound proficiency metric (UPS-Thyroid). Among surgery residents with moderate ultrasound experience, basic proficiency at thyroid ultrasound is feasible within 10 repetitions.

◆ 03. Localization and Characterization of Single Gland Parathyroid Adenomas with SPECT-CECT

Elizabeth M Huffman¹, Alexa J Loncharich¹, Rodica I Muraru¹, Mark Tann², Lava R Timsina¹, Hadley E Ritter¹, Alexandria D McDow¹

¹Surgery, Indiana University, ²Radiology, Indiana University

Background: Minimally invasive parathyroidectomy requires accurate preoperative localization. Single-photon emission computed tomography hybridized with contrast enhanced CT imaging (SPECT-CECT) has demonstrated increased sensitivity over SPECT alone, but little is known regarding SPECT-CECT's lateralization and quadrant localization rates. Assessment of SPECT-CECT's correlation with a pathological gold standard allows for a better understanding of the predictive ability of SPECT-CECT to characterize and localize adenomas when planning for minimally invasive approaches.

Methods: A retrospective analysis of patients with pathologically confirmed, single gland primary hyperparathyroidism who received preoperative localization using SPECT-CECT between 2015-2018 at a single institution was performed. SPECT-CECT longest dimension was compared to longest pathology dimension, and SPECT-CECT volume was compared to both pathology volume and pathology mass using a Pearson correlation. SPECT-CECT location (left vs. right, superior vs. inferior, and quadrant) was compared to the surgically confirmed pathological location using percent agreement and Kappa score (k). The sensitivity of SPECT-CECT localization from ROC analysis using pathologically confirmed location as gold standard was calculated. A p-value of <0.05 was considered statistically significant.

Results: A cohort of 250 patients with SPECT-CECT predicted and pathology confirmed single gland adenomas was identified. Statistically significant correlations were found between the longest pathology length and longest SPECT-CECT length (Pearson $r=0.16$, $p=0.01$), pathology volume and SPECT-CECT volume ($r=0.68$, $p<0.001$), and pathology mass and SPECT-CECT volume ($r=0.45$, $p<0.001$). SPECT-CECT accurately localized parathyroid adenomas based on laterality with left vs. right parathyroid glands having a sensitivity of 97.5% vs. 95.8% (agreement=96.6%, AUC=0.97, $k=0.93$, $p<0.001$). SPECT-CECT accurately localized superior vs. inferior parathyroid glands with a sensitivity of 63.5% vs. 93.4% (agreement=81.0%, AUC=0.78, $k=0.59$, $p<0.001$). SPECT-CECT accurately localized parathyroid adenomas by quadrant with right superior (sensitivity 48.8%, AUC=0.74, $k=0.58$), right inferior (sensitivity 95.7%, AUC=0.91, $k=0.77$, left superior (sensitivity 71.7%, AUC=0.83, $k=0.69$), and left inferior (sensitivity 86.4%, AUC=0.88, $k=0.73$) with 89.7% agreement ($p<0.001$).

Conclusions: SPECT-CECT accurately localized surgically resected single gland parathyroid adenomas, and SPECT-CECT dimensions significantly correlated with pathology confirmed measurements. SPECT-CECT results can be used with confidence to guide preoperative decision making regarding initial surgical approach for minimally invasive parathyroidectomies in primary hyperparathyroidism.

04. Ethanol Ablation for the Treatment of Benign Thyroid Nodules

Gabrielle K Steinl¹, Catherine McManus², James A Lee², Jennifer H Kuo²

¹*Columbia University College of Physicians & Surgeons*, ²*Surgery, Division of GI/Endocrine Surgery, Columbia University Medical Center*

Background: Though not routinely performed in the United States, percutaneous ethanol injection, also known as ethanol ablation (EA), has been described as a safe and effective alternative to surgery for the treatment of benign, cystic thyroid nodules. This study summarizes our preliminary single-institution experience with the efficacy and safety of EA.

Methods: An IRB-approved, retrospective analysis of patients who had undergone EA at our institution was performed. EA candidates included patients with symptomatic, benign, predominantly cystic ($\geq 75\%$) thyroid nodules. Under ultrasound guidance, the cyst fluid was aspirated using a 16-gauge needle then irrigated with saline followed by a small amount of 100% ethanol (approximately 1/3 original cyst volume). At the time of EA and in post-procedure visits, nodule volume was calculated based on ultrasound measurements using the ellipsoid formula. Volume reduction ratio (VRR) was calculated as $(\text{initial volume} - \text{current volume}) / \text{initial volume}$. Compressive symptoms were assessed using a 1– 10 scale and cosmetic symptoms with a 0-3 scale.

Results: 16 patients underwent EA for a single cystic thyroid nodule between 9/2019—10/2020. Average pre-procedure cyst volume was 17.2 ± 12.3 cc. Prior to the procedure, 12/16 patients had FNA confirming benign pathology, 4 had simple cysts on sonogram. All tolerated the procedure well, and there were no complications. In-person follow-up was limited by the COVID-19 pandemic. However, average nodule VRR was $70\% \pm 13\%$ at 1-month post-procedure ($n=7$) and $75\% \pm 13\%$ at 6 months ($n=3$). One patient had complete 12-month follow-up with a VRR of 99%. The mean symptom score decreased from 5.6 ± 2.4 pre-procedure to 1.7 ± 1.1 at 1 month ($p<0.001$, $n=7$). Mean cosmetic score decreased from 2.3 ± 0.9 pre-procedure to 1.1 ± 1.2 at 1 month ($p=0.02$, $n=7$). The 4 patients with follow-up data 6-12 post-procedure all reported a symptom score of 1 and a cosmetic score of 0-1.

Conclusions: EA appears to be a safe and effective option for cystic thyroid nodules. Follow-up studies are warranted to evaluate long-term efficacy.

◆ 05. Incidence of Reoperation in Primary Hyperparathyroidism in a Statewide Database.

Rahul K Sharma¹, Rachel Liou¹, Catherine McManus¹, James A Lee¹, Jennifer H Kuo¹

¹*Division of Endocrine Surgery, Columbia University Irving Medical Center*

Background: Single institution studies have suggested that 5-10% of patients with primary hyperparathyroidism do not achieve long-term cure after parathyroidectomy (PTX). The aim of this study was to evaluate the rate of re-operative PTX in a large, statewide insurance database.

Methods: An IRB approved, cross-sectional analysis of the New York Statewide Planning and Research Cooperative System (SPARCS) between 2007-2017 was performed. Patients were identified based on CPT codes for a parathyroidectomy (60500) and re-operative parathyroidectomy (60502). The first insurance claim for PTX was considered the index operation. Patients with a subsequent claim for 60502 or a second 60500 >180 days from the index operation were considered to have a re-operative PTX for recurrence. Surgeons were considered high-volume if they performed >50 PTX/year. A proportional hazards model was used to analyze re-operative PTX regressed on age, gender, and surgeon volume. Patients were censored at the end of the database collection period (1/2018). Predicted re-operative rates at 2, 5 and 10 years were based on Kaplan Meier (KM) models.

Results: A total of 20,424 PTX patients were identified with a mean age of 59±12.8 years. Most patients were female (n = 15,516, 76.0%). Most patients had their index PTX performed by a high-volume surgeon (52.6%). Only 117 patients underwent a re-operative PTX (0.60%), with the average time to re-operative PTX of 2.2 years. Predicted mean rates of re-operative PTX based on KM models were 0.4% (95% CI 0.3-0.4%) at 2 years, 0.7% (0.5-0.8%) at 5 years, and 1.2% at 10 years (0.8-1.4%). Index PTX by a high-volume surgeon was significantly associated with a lower risk of re-operative PTX (HR: 0.46, 95% CI 0.32-0.67). Of those receiving a re-operative PTX, 25.5% of the operations were performed by a different surgeon.

Conclusions: The rate of re-operative PTX in New York State is lower than the reported late recurrence rate for patients undergoing PTX for primary hyperparathyroidism. Index PTX performed by a high-volume surgeon is associated with lower risk for re-operative PTX.

◆ 06. The Rate and Extent of Malignancy in Patients with Thyroid Nodules Differ Across Race and Ethnicity

Hui Zheng¹, Victoria Lai¹, Jana Lu², Jin K Kang³, Erin A Felger¹, Nancy M Carroll⁴, Kenneth D Burman⁵, Leonard Wartofsky⁵, Jennifer E Rosen⁴

¹Section of Endocrine Surgery, Department of General Surgery, Medstar Washington Hospital Center/Georgetown University Hospital, ²Georgetown University School of Medicine, ³Department of General Surgery, Medstar Washington Hospital Center/Georgetown University Hospital, ⁴Section of Endocrine Surgery, Department of General Surgery, Medstar Washington Hospital Center, ⁵Section of Endocrinology, Department of Internal Medicine, Medstar Washington Hospital Center

Background: Assessing the risk of malignancy in thyroid nodules with indeterminate fine needle aspiration (FNA) cytology remains a challenge. The difference between racial and ethnic groups in the prevalence of thyroid cancer has been well examined in population studies. This study aimed to evaluate the frequency and extent of malignancy in patients with thyroid nodules who undergo surgery across race and ethnicity.

Methods: We conducted a retrospective chart review of consecutive patients at our institution between March 2013 and March 2020 who underwent thyroid surgery and had available surgical pathology. We assessed the frequency of Bethesda classification categories and rates of malignancy across race and ethnicity, which were self-reported. We compared the frequency of multifocal disease and nodal involvement across race and ethnicity in patients with thyroid cancer in final pathology.

Results: A total of 1640 patients were included in this analysis. Eighty-one percent were women and 89% underwent pre-operative FNA. The average age was 51.1 years. Whites accounted for 52%, Blacks 35%, Hispanics 5%, Asians 4% and Other 4%. Blacks had significantly more Category II nodules than other groups (Blacks 51.3%, Whites 26.5%, Hispanics 17.44%, Asians 15.87%, and Other 22.7%, $p < 0.0001$) and fewer Category VI nodules (Blacks 5.8%, Whites 27.6%, Hispanics 38.4%, Asians 33.3% and Others 31.8%, $p < 0.0001$). Overall thyroid cancer prevalence was 45.8%. Blacks with indeterminate nodules (Bethesda Categories III and IV) were less likely to have malignancy than Whites with indeterminate nodules (36.6% vs 48.2%, $p = 0.03$). Thyroid cancer in Blacks was less likely to be multifocal compared to Hispanics and Asians (Blacks 35.5%, Hispanics 54.2%, Asians 54.3%, respectively, $p < 0.05$). Black patients with thyroid cancer were also less likely to have nodal disease than other racial groups (Blacks 11.3%, Whites 30.7%, Hispanics 37.7%, Asians 37.1%, $p < 0.0001$).

Conclusions: Race and ethnicity may play an important role in influencing the rate of malignancy in thyroid nodules as well as the extent of thyroid cancer. Confirmation of these findings could contribute to further risk stratification of suspicious thyroid nodules.

◆ 07. High-rates of Work-Related Musculoskeletal (MSK) Injury and Symptoms in Head and Neck Endocrine Surgeons – A Plea for Early Intervention

Megan Jensen¹, Sonia Sugg¹, Nitin Pageder¹, Geeta Lal¹

¹University of Iowa

Background: Work-related injury and musculoskeletal (MSK) symptoms are common among surgeons, and can affect their health, quality of life and career length. However, data pertaining to head and neck endocrine surgeons (HNES) is lacking. The objectives of this study were to determine the prevalence of MSK symptoms among HNES and the relationship of these symptoms to demographic and practice-related variables. In addition, we were interested in the strategies employed by surgeons to manage symptoms and their awareness of surgical ergonomics principles.

Methods: A 43-question electronic survey was distributed using Qualtrics to all members of the American Association of Endocrine Surgeons (AAES) and the members of the Endocrine section of the American Head and Neck Society (AHNS). Statistical analysis was performed with SAS 9.4 (Cary, NC).

Results: 220 surgeons (49% AAES and 51% AHNS) completed the survey. Mean age of the cohort was 48.2 (+/-10.1) years, and 33% were women. MSK symptoms were reported by 199 (90%), the most frequent being pain (91%) and stiffness (81%). The most common locations were the neck (87%) and shoulders (55%). Female surgeons were significantly more likely to have symptoms relative to male surgeons (98.6% versus 86.4%, $p=0.004$). Each additional inch in height was protective for symptoms (OR = 0.89, $p=0.067$). Among the symptomatic surgeons, 24% developed them during training, and the cumulative frequency was almost 80% by 10 years in practice. A total of 55% reported taking pain medication, and 53% reported seeking other treatments, including massage (70%), exercise (58%), physical therapy (55%), and surgery (7%) for their symptoms. Despite the high frequency of symptoms, they were rarely reported (10%), even though 18% of individuals had considered early retirement due to them. Additionally, although 67% of respondents reported awareness of ergonomic principles, only 19% had learned about them during residency/fellowship. The most common ergonomic adjustments were stretching, use of microbreaks and headlight/loupe adjustments.

Conclusions: The vast majority of HNES surgeons, especially women, suffer MSK symptoms that could potentially impact their quality of life and career length. Effective strategies to protect this highly trained workforce need to be developed, studied, and implemented, probably early during training.

◆ **08. Persistence and recurrence of hypercalcemia after parathyroidectomy over five decades (1965-2010) in a community-based cohort**

Thomas Szabo Yamashita¹, Maxwell Mirande¹, Chieh-Ting Huang¹, Ann Kearns¹, Geoffrey Thompson¹, Trenton Foster¹, Melanie Lyden¹, Travis McKenzie¹, Robert Wermers¹, Benzon Dy¹

¹*Mayo Clinic*

Background: There is limited long term follow up of patients undergoing successful parathyroidectomy. Recurrence is thought to be uncommon, 4-10% in current literature. This study sought to evaluate persistence and recurrence of hypercalcemia in primary hyperparathyroidism (PHPT) after parathyroidectomy utilizing over 50 years of data from a community based cohort.

Methods: Single-institution retrospective (1965-2010) population-based cohort from Olmsted County (MN) of patients undergoing surgery for PHPT. Patients' demographic data, pre- and post-operative laboratory values, clinical characteristics, surgical treatment and follow-up were noted. Any serum Calcium ≥ 10.2 mg/dL within 6 months of surgery was considered persistence of hypercalcemia and recurrence if after 6 months.

Results: We identified 345 patients, 76% female (n=261) and median age 59 y (IQR 20-89). 67% of patients (n=236) presented with asymptomatic hypercalcemia. The most common symptoms were musculoskeletal complaints (n=31, 30%) and nephrolithiasis (n=25, 25%). Pre-operative median serum calcium was 11 mg/dL (IQR 9.7-16), and median PTH was 90 pg/mL (IQR 16-1706). Bilateral cervical exploration was performed in 36% (n=120) and single gland resection in 79% of cases (n=262). Median post-operative serum calcium was 9.2 mg/dL (IQR 5.5-11.3). 3.9% (n=13) of patients presented persistence of hypercalcemia, and recurrence was found in 23% of patients (n=79), 88% (n=68) asymptomatic. Highest post-operative median serum calcium was 10 mg/dL (IQR 6-12.4), and median number of post-operative calcium measurements per patient was 10 (IQR 0-102). Recurrent hypercalcemia could be attributed to secondary causes in 88% (n=68); medications being the most common, 22% (n=27). 32% (n=38) of all recurrent and persistent cases presented with only one abnormal post-operative calcium level and 80% (n=93) had 5 or less abnormal values during entire follow-up. 10% of patients (n=12) required treatment for post-operative hypercalcemia, surgery being the most common treatment, 83% (n=10), accounting for 3% of entire cohort. Median follow-up to recurrence and death were 12.8 and 16.7 years respectively.

Conclusions: Recurrent hypercalcemia after successful parathyroidectomy is higher than previously reported. Most cases are transient and often associated to other factors with only the minority requiring treatment. Long term follow up of serum calcium should be considered in patients after successful parathyroidectomy.

09. Redox profiling in adrenocortical carcinoma: which oxidative stress-related genes are clinically relevant?

Robert Grant¹, Prachi Mishra¹, Naris Nilubol¹

¹*Surgical Oncology Program, National Cancer Institute, National Institutes of Health*

Background: Adrenocortical carcinoma (ACC) is a deadly and neglected cancer with high rates of locoregional recurrence and metastasis.

Although dysregulated cellular oxidation and reduction (redox) is involved in carcinogenesis in many cancers, the role of redox in ACC is not well studied. To effectively target the altered redox pathways in ACC by systemic treatments or radiotherapy, we aim to identify the differentially expressed oxidative stress-related genes and their prognostic relevance in ACC.

Methods: We analyzed three independent datasets from the Gene Expression Omnibus (GSE10927/GSE33371 and GSE12368) and identified the differentially expressed genes involved in oxidative stress and reactive oxygen species (ROS) pathways in ACC. To assess the clinical relevance, we analyzed the mRNA expression of these genes by clinicopathologic features of ACC, recurrence, and survival using The Cancer Genome Atlas (TCGA) and GSE33371 datasets. The overall survival (OS) and disease-free survival (DFS) were estimated in a dichotomized cohort by mRNA expression using Kaplan-Meier method.

Results: We observed the significant and differential overexpression of thioredoxin (*TXN*) and glutathione peroxidase 8 (*GPX8*); and the downregulation of thioredoxin-2 (*TXN2*), thioredoxin reductase 2 (*TXNRD2*), peroxiredoxin 3 (*PRDX3*), catalase (*CAT*), *GPX1* and *GPX3* in ACC in 2 independent datasets.

ACC with mitosis > 10/HF was associated with the downregulation of *TXNRD1* and the upregulation of protein disulfide isomerase family A member 6 (*PDIA6*). Independently validated in the TCGA cohort, shorter OS and DFS were associated with the upregulation of *PDIA6* ($p=0.003$ and $p=0.001$) and the downregulation of *TXNRD1* ($p=0.037$ and $p=0.045$). The mRNA co-expression analysis identified the significant positive correlations between *TXNRD1* and thioredoxin interacting protein (*TXNIP*), peroxiredoxin 3 (*PRDX3*), peroxiredoxin 4 (*PRDX4*). In addition, the downregulation of *TXNIP* ($p=0.003$ and $p=0.023$) and *PRDX4* ($p=0.021$ and $p=0.047$) were significantly associated shorter OS and DFS, while downregulated *PRDX3* was associated with shorter OS only ($p=0.008$). We found a significant inverse correlation between *TXNIP* and *PDIA6* ($p=0.007$).

Conclusions: We identified multiple correlated and dysregulated oxidative stress-related genes in ACC in independent cohorts with significant associations with high ACC mitosis, OS, and DFS. The findings suggest that altered redox homeostasis is involved in ACC tumorigenesis and progression.

◆ 10. How and When is Multiglandular Disease Diagnosed in Sporadic Primary Hyperparathyroidism?

Ujas S Shah¹, Kelly K McCoy¹, Meghan L Kelley¹, Sally E Carty¹, Linwah Yip¹
¹Division of Endocrine Surgery, University of Pittsburgh Medical Center

Background: ~15% of patients with sporadic primary hyperparathyroidism (pHPT) have multiglandular disease (MGD), which may be suspected on preoperative imaging, but can only be confirmed intra- or post-operatively. The study aim is to determine how and when patients are diagnosed with MGD without routine four-gland exploration and to what extent different modalities contribute to the diagnosis.

Methods: After QI-IRB approval, consecutive cases of sporadic pHPT (2013-2019) undergoing initial exploration were reviewed from a single-institution prospective database. Preoperative SPECT-CT and neck ultrasound were routinely performed, and findings directed either bilateral (BE) or unilateral (UE) exploration guided by intraoperative PTH monitoring (IPM) using the dual criteria (<50% from pre-incision baseline and <65 pg/mL). MGD was defined as either resection of >1 enlarged parathyroid or hypercalcemia at ≥6 months' after single gland resection.

Results: Of 1890 patients with sporadic pHPT, MGD was identified in 259 (13.7%); 247 (95.4%) were diagnosed intraoperatively and 12 (4.6%) postoperatively. Despite the eventual diagnosis of MGD, SGD was suggested on preoperative SPECT-CT in 54.1%, ultrasound in 49.8%, and was concordant on both imaging studies in 29.3%. When MGD was diagnosed intraoperatively, BE was prompted by an inadequate drop with IPM after single gland resection in 39.3%, by preoperative imaging suggesting MGD in 37.7%, by a second enlarged ipsilateral gland in 10.9%, and by an initial gland size estimated at <200 mg in 10.1%, and 2.0% had unexpected MGD encountered during planned concurrent thyroidectomy. MGD was diagnosed by postoperative hypercalcemia at 6 months after resection of a single enlarged gland in 10/12 (83.3%) and at 14 and 21 months in the other two.

Conclusions: To avoid failure at initial parathyroid exploration for sporadic pHPT, expert surgeons utilize multiple approaches to diagnose and manage MGD. Preoperative localization studies alone are insufficient, missing MGD in at least 30% of cases. All examined adjuncts are informative, including IPM, preoperative imaging, and having a low threshold for four-gland exploration when a small gland is initially seen. Follow-up of at least 6 months also identifies MGD in 5% of affected patients and should be a part of routine care algorithms.

◆ 11. The Diagnosis of Sporadic Medullary Thyroid Cancer in the Era of Preoperative Molecular Testing

Ujas S Shah¹, Andrew J Lee¹, Robert L Ferris², Kelly K Mccoy¹, Sally E Carty¹, Linwah Yip¹

¹*Division of Endocrine Surgery, University of Pittsburgh Medical Center,*

²*Department of Otolaryngology, University of Pittsburgh Medical Center*

Background: Medullary thyroid carcinoma (MTC) can be challenging to identify on ultrasound and fine needle aspiration biopsy (FNAB), yet an accurate diagnosis can affect the extent of initial surgery and potentially optimize disease outcomes. The study aim is to determine if and how the preoperative diagnosis of MTC has been altered in the era of molecular testing (MT).

Methods: After QI-IRB approval, a retrospective, single-institution review of consecutive cases of histologic MTC following thyroidectomy from June 2017 through October 2020 was performed. Patients with known germline RET mutations and incidental microMTC (≤ 1 cm) were excluded.

Results: In 20 patients with MTC >1 cm, preoperative FNAB was positive for MTC in 16 (80%), suspicious in 1 (5%), follicular neoplasm in 2 (10%), and atypia/follicular lesion of undetermined significance in 1 (5%). MT was performed in 5 cases preoperatively and all had results consistent with MTC, including a high level of calcitonin gene expression and a concurrent somatic mutation (BRAF K601E, HRAS K117N, KRAS G12R, and RET S891A and M918T). The patient with suspicious cytology required an excisional lymph node biopsy to confirm MTC. In total, 80% (16/20) of patients were preoperatively diagnosed with MTC by cytology alone, which increased to 95% (19/20) including MT results. Total thyroidectomy with central compartment dissection was performed in 19/20, and 10 also had selective lateral neck dissection. The mean tumor size was 2.5 ± 1.3 cm, and 15/19 had central and 10/10 had lateral lymph node metastases. One patient with cytology positive for MTC had distant metastasis at diagnosis, received palliative thyroid lobectomy and died 4 weeks later. Postoperative MT in 4 MTC cases identified somatic mutations in RET M918T (3) and RET C634W (1). Germline RET testing was completed in 11 patients and there were no cases of de novo germline RET mutations.

Conclusions: In addition to RET, both RAS and BRAF K601E are driver mutations for sporadic MTC. Cytology was indeterminate in 15% of histologic MTC, and all had MT which provided the correct diagnosis preoperatively allowing for appropriate extent of initial surgery. In MTC, molecular testing can productively improve the preoperative diagnosis and guide management.

◆ 12. The Impact of Patient Age on Practice Patterns and Outcomes for Primary Hyperparathyroidism: A CESQIP Study.

Whitney Sutton¹, Joseph K Canner¹, Jessica B Shank², Abbey L Fingeret², Shkala Karzai¹, Dorry L Segev¹, Jason D Prescott¹, Aarti Mathur¹

¹Department of Surgery, Johns Hopkins University School of Medicine,

²Department of General Surgery, Division of Surgical Oncology, University of Nebraska Medical Center

Background: Management of asymptomatic primary hyperparathyroidism (PHPT) in older patients (age >50) is controversial. The 4th International Workshop on the Management of Asymptomatic PHPT recommends surveillance for older patients who lack objective signs of disease, whereas The American Association of Endocrine Surgeons (AAES) guidelines recommend consideration of parathyroidectomy for patients of any age with nontraditional, subjective constitutional, neuropsychiatric, or cognitive symptoms. Therefore, the primary objective of this study was to evaluate the association between patient age and both practice patterns and outcomes in the management of patients with sporadic PHPT.

Methods: The Collaborative Endocrine Surgery Quality Improvement Program (CESQIP) database was queried for all adults (age ≥18) who underwent an index parathyroidectomy for sporadic primary hyperparathyroidism between 2014-2020. Associations between patient age (≤50 years vs. >50 years) and both practice patterns and outcomes were evaluated separately using adjusted multivariable logistic and multinomial regression models.

Results: Of 9,938 patients who underwent only parathyroidectomy, 8,080 (82.3%) were >50 years old and 1,858 (18.7%) were ≤50. Of this cohort, 17% of older patients and 26% of younger patients presented with only subjective symptoms. Compared to younger patients, older patients were more likely to have an objective indication for parathyroidectomy (aOR=1.8, 95%CI: 1.6-2.0, p<0.001). They were also more likely to undergo ≥2 imaging studies pre-operatively (aOR=1.2, 95%CI: 1.1-1.3, p=0.003), to undergo bilateral neck exploration (aOR=1.4, 95%CI: 1.3-1.6, p<0.001), and to have multi-gland disease (aOR=1.6, 95%CI: 1.4-1.8, p<0.001). There was no difference between age groups and parathyroidectomy-related complications including hypocalcemia, vocal cord dysfunction, hematoma requiring evacuation, or reintubation, however, older patients were less likely to have any peri-operative morbidity (aOR=0.7, 95%CI: 0.6-0.9, p=0.011).

Conclusions: Older patients were more likely to meet objective criteria prior to undergoing parathyroidectomy by CESQIP participating surgeons, however they were less likely to have peri-operative complications compared to younger patients. Given the growing evidence demonstrating improvement of both objective and subjective symptoms after parathyroidectomy for PHPT, these findings encourage the referral for and consideration of surgical management for older patients with sporadic PHPT presenting with only subjective symptoms.

◆ 13. Can molecular testing safely rule out cancer in large thyroid nodules?

Andrew B Barnes¹, Tracy Justice-Clark¹, Wencheng Li¹, Reese W Randle¹
¹Wake Forest Baptist Health

Background: Molecular testing helps stratify risk of malignancy in indeterminate thyroid nodules, but its limitations are not well defined. We hypothesized that the ability of molecular testing to rule out thyroid cancer in large nodules is limited.

Methods: We compared small thyroid nodules (less than 4cm) to large thyroid nodules (4cm or greater) in a retrospective, single center, cohort study of indeterminate thyroid nodules analyzed with Thyroseq from 10/2015 through 4/2020. We defined a false negative result as a negative Thyroseq result with surgical pathology indicating malignancy in the sampled nodule.

Results: A total of 204 thyroid nodules were analyzed with Thyroseq and 62 underwent resection. Of these cases, where Thyroseq results could be compared to the final pathology, 48 were performed for small nodules and 14 were performed for large nodules. A greater proportion of large nodules were observed in men (50.0% vs 18.8% in small nodules, $p=0.02$), but median age was similar between the groups (49.0 years vs 52.5 years, $p=0.95$). For the small nodules, sensitivity of Thyroseq for detecting malignancy was 1 indicating the test identified every malignancy. For large nodules, sensitivity was 0.78. False negative results comprised a higher proportion of tests for large nodules than small nodules (14.3% vs 0%, $p=0.01$). In our cohort, the negative predictive value of Thyroseq in small nodules was 1 indicating a negative test reliably predicted a benign nodule, compared to 0.5 in large nodules indicating half of the negative results were wrong. A comparison of the 14 resected large nodules to all of the unresected large nodules ($n=20$), indicated similar age, sex, family history, and radiation exposure between groups ($p>0.05$ for all). Applying the same negative predictive value to the cohort of large nodules that did not receive resection after a negative result ($n=18$), it is possible that up to 9 thyroid malignancies were missed at our institution during the study period.

Conclusions: Large thyroid nodules are associated with more false negative results and a lower negative predictive value than small nodules undergoing molecular analysis, suggesting molecular testing cannot rule out cancer in indeterminate nodules over 4cm.

◆ 14. Informing Therapeutic Lymphadenectomy: Location of Regional Metastatic Lymph Nodes in Adrenal Cortical Carcinoma

Alaa Sada¹, Amy E. Glasgow¹, Melanie L. Lyden¹, Benzon M. Dy¹, Trenton R. Foster¹, Elizabeth B. Habermann¹, Irina Bancos¹, Travis J. Mckenzie¹

¹Mayo Clinic

Background: The anatomic boundaries of regional lymphadenectomy for adrenocortical carcinoma (ACC) have yet to be delineated. A retrospective review was conducted to assess metastatic lymph node (LN) location to elucidate possible patterns of lymph node spread with ACC.

Methods: Medical charts of adults undergoing resection of primary or recurrent ACC were reviewed (1997-2017). LN locations were categorized as inter-aortocaval, para-caval, para-aortic, right renal-hilar, left renal-hilar, retrocrural and/or celiac, based on locations of LN identified as positive on final pathology.

Results: Of 231 resected ACC patients, 14 (6%) had positive LN during initial resection for a total of 28 positive LN. Positive LN locations in left ACC (n=7 patients) were: 2 para-aortic, 2 left renal-hilar, 1 para-aortic and left renal-hilar and 1 unknown, while for right ACC (n=7): 2 para-caval, 1 para-caval and right renal-hilar, 1 inter-aortocaval, 1 celiac, 1 para-aortic, and 1 unknown. Preoperative CT suggested lymphadenopathy in 6 positive LN cases, did not suggest lymphadenopathy in 2, and was not available for 6 patients.

The median (IQR) examined number of LN was 3 (1,7), and of metastatic LN was 1 (1,3). There was no difference in median tumor size, grade, laterality or rate of lymphovascular invasion among patients with negative and positive LN, $P>0.05$. Planned lymphadenectomy was performed in 31 patients (10 had positive LN), unintended lymphadenectomy when regional LN was discovered in the specimen occurred in 4(0 positive LN); it is unknown whether the rest (16) had planned lymphadenectomy.

Of 55 resections for recurrent ACC, 9 patients had regional lymphadenectomy; two of them had lymphadenectomy during initial resection. Positive LN locations for recurrent left ACC (n=2): 1 para-aortic, and 1 para-aortic with left renal-hilar, while LN locations for recurrent right ACC (n=7): 2 inter-aortocaval, 2 right renal-hilar, 2 para-caval and one retrocrural.

Conclusions: The most common sites for LN metastases are para-caval for right ACC, and para-aortic and left renal-hilar for left ACC. However, more distant sites may be involved, including inter-aortocaval, celiac, and retrocrural. Further studies are necessary to determine the utility and the boundaries of therapeutic lymphadenectomy during resection of ACC.

15. Generation of adult stem cell derived organoid cultures from thyroid follicular cells

Jelte van der Vaart¹, Menno Vriens², Inne Borel Rinkes², Lynn Bosmans¹, Harry Begthel¹, Jeroen Korving¹, Hanneke van Santen³, Hans Clevers¹

¹*Oncode Institute, Hubrecht Institute, Royal Netherlands Academy of Arts and Sciences and University Medical Center, Utrecht, The Netherlands,*

²*Surgery, UMC Utrecht,* ³*Princess Máxima Center for Pediatric Oncology, Utrecht, The Netherlands and Department of Pediatric Endocrinology, Wilhelmina Children Hospital, University Medical Center Utrecht, Utrecht, The Netherlands*

Background: The thyroid is essential for maintaining systemic homeostasis by regulating thyroid hormone concentrations in the bloodstream.

Due to the limited number of representative model systems, there is limited understanding of fundamental thyroid biology as well as thyroid carcinogenesis.

Methods: To fill the caveats in the understanding of thyroid cell biology, we aimed to develop an adult stem cell-derived three-dimensional (3D) organoid culture system using murine and human thyroid follicular cells (TFCs).

Results: We have succeeded to grow such an organoid culture system that harbours the complete machinery of hormone production visualised by the presence of colloid in the lumen and essential transporters and enzymes in a polarised cell layer. Both the established murine as human thyroid organoids express canonical thyroid markers PAX8 and NKX2.1/TTF1. Moreover, the thyroid hormone precursor thyroglobulin is expressed in both cultures to similar levels as in tissue. Extensive characterisation furthermore identifies known and new biological insights in TFC subclassification, subcellular organisation and hormone production using state-of-the art techniques like single cell RNA sequencing, transmission electron microscopy and genome editing. These 3D *in vitro* cultures allow for a variety of thyroid-related studies including the progression of wild type cells towards cancer. Additionally, due to the success of generating patient-specific tumour organoids of primary differentiated thyroid carcinoma and metastasis, insights in drug resistance and metastases can be identified.

Conclusions: This newly developed organoid culture of murine and human wild type TFCs as well as tumour tissue opens up an extensive area of research that will help understand the drivers for growth and development of thyroid (cancer) cells and enable studies upon drug responsiveness.

◆ 16. Rapid intraoperative perfusion assessment of parathyroid adenomas with ICG using a wide-field portable hand-held fluorescence imaging system

Jared S Matson¹, Thinzar M Lwin¹, Michael Bouvet¹

¹*Surgery, University of California San Diego*

Background: Near-infrared imaging using intravenous Indocyanine green (ICG) dye has been introduced as a useful adjunct for real-time intraoperative guidance in visualizing parathyroid glands and assessing perfusion. In this study, we determined the length of time from ICG administration to peak fluorescence of parathyroid adenomas.

Methods: This is a retrospective study of 69 consecutive parathyroidectomies performed with ICG fluorescence angiography over a one-year period. Parathyroid perfusion was assessed using the SPY-PHI portable handheld near-infrared fluorescence imaging system. The length of time to peak parathyroid adenoma fluorescence after initial ICG injection and saline flush was recorded by an independent observer and video files were evaluated for each case.

Results: There were 66 total patients including 47 (71%) female patients and 19 (29%) male patients with an average age of 64 years. Three cases were excluded for technical reasons. Average time from ICG injection to initial parathyroid adenoma fluorescence was 26.7 [range 14.7-75.6] seconds and average time to peak fluorescence was 38.0 [range 22.7-87.6] seconds. A delay in saline flush time significantly correlated with delay in time to initial fluorescence ($p < .0001$) and time to peak fluorescence ($p < .0001$). Parathyroid fluorescence was seen with 68 injections (97%) while 100% of parathyroid glands demonstrated ex-vivo fluorescence. Sixty-four (97%) patients had localization of a suspected adenoma on preoperative imaging, with rates of detection of 69% for sestamibi scan, 71% for ultrasound, and 96% for CT scan. Of 38 patients who had both ultrasound and CT scan, there was improved localization with CT scan in 9 cases (24%) including localization to the opposite side of the neck in 3 (8%). Imaging was discordant with operative findings in 13 cases (20%), with the adenoma located in a different quadrant than was indicated in 9 cases (14%) and on the opposite side in 4 (6%). The average percent drop in PTH was 61% at 10 minutes post parathyroidectomy and 84% in the recovery room.

Conclusions: Despite advances in preoperative imaging, there remains a subset of cases in which parathyroid adenomas are not accurately localized and must be found intraoperatively. ICG fluorescence angiography is a rapid and effective adjunct for identifying parathyroid adenomas.

17. Pediatric Thyroidectomy Outcomes among Surgeons in the Collaborative Endocrine Surgery Quality Improvement Program (CESQIP)

Diana L Diesen¹, Jennifer Rosen²

¹*Department of Surgery, University of Texas Southwestern*, ²*Department of Surgery, MedStar Washington Hospital Center*

Background: Children undergo thyroid surgery for nodules, goiters, cancer, and hyperthyroidism. Need for thyroid surgery during childhood is uncommon so there is less information available on pediatric specific variables and outcomes. Data on these patients is either reported as single institutional reports spanning long periods of time or national database reports that lack endocrine specific outcomes. This study characterizes the clinical presentation, treatment, and outcomes in pediatric patients requiring thyroid surgery from a large national endocrine surgery database.

Methods: Using data from the Collaborative Endocrine Surgery Quality Improvement Program (2014-2000), we examined all patients ≤ 18 years of age focused on demographics, disease characteristics, operative details, pathology, postoperative outcomes and longitudinal outcomes.

Results: Among 586 pediatric patients who had thyroid surgery, the mean age of the cohort was 14 years (range of 0-18). The majority of patients were non-black 344 (58%) females 478 (81%) with history of prior anterior neck surgery 43 (7%) and previous irradiation 14 (2%). The procedures were total/near total thyroidectomy 389 (66%), lobectomy 172 (29%) with 79 (13.6%) having a central neck dissection, and 46 (8%) lateral neck dissection. The patients in this cohort had differentiated thyroid cancer 25% (148), medullary thyroid cancer (<10), and hyperthyroidism 206 (35%).

Postoperatively there were concerns for vocal cord dysfunction in 10 (1.7%) patients – 2% if operation included a total thyroidectomy and 4.5% if operation included a lymph node dissection. Clinical hypoparathyroidism was noted in 99 (16.8%) patients of which 22 required IV calcium. Rate of clinical hypoparathyroidism was 24 % if operation included total thyroidectomy and 32% if operation included a lymph node dissection. Return to the ED at 30 days and readmission rates were 3.9% and 1.9% respectively.

Conclusions: This is the largest contemporary review of pediatric thyroid surgery patients and the first report of pediatric thyroid surgery outcomes from a large prospective national endocrine database. This data stresses the risks in this patient population even among those with an endocrine heavy practice. This data also highlights the need for pediatric specific data variables which we are addressing in our national pediatric surgical collaborative.

◆ 18. Normocalcemic Primary Hyperparathyroidism: Is Pre-operative Imaging Necessary?

Andrea Gillis¹, Kimberly Ramonell², Jessica Fazendin², Brenessa Lindeman², Herbert Chen²

¹General Surgery, Albany Medical Center, ²Surgery, University of Alabama at Birmingham

Background: There are growing data that patients with normocalcemic primary hyperparathyroidism (pHPT) benefit from parathyroidectomy. Previous studies have suggested that these patients are more likely to have multiglandular disease. Thus, we sought to examine the incidence of multigland disease as well as the role of pre-operative imaging in patients with normocalcemic pHPT.

Methods: A retrospective review of our prospectively collected institutional database was performed on all pHPT patients who underwent parathyroidectomy (PTX) between 2001-2019. Patients were stratified into normocalcemic (serum Ca ≤ 10.4 mg/dL) and hypercalcemic (serum Ca ≥ 10.5 mg/dL) groups. Patient data, labs, pre-operative imaging localization, operative technique, surgical pathology, and post-operative outcomes were reviewed.

Results: All 2,218 patients with pHPT who underwent PTX were included in our study; 645 were normocalcemic (29.1%) and 1,573 were hypercalcemic (70.9%). Among normocalcemic patients, the mean age was 59 ± 14 years and 78% were female; 77% of hypercalcemic patients were female with a mean age of 60 ± 14 years. Patients with normocalcemic pHPT have a significantly higher incidence of multigland disease (normocalcemic 48% vs. hypercalcemic 26%, $p < 0.01$). There were 671 imaging studies performed in the normocalcemic pHPT group (ultrasound= 182, sestamibi= 462, 4D-CT neck= 27) and 1,887 imaging studies performed in the hypercalcemic pHPT group (ultrasound= 453, sestamibi=1,338, 4D-CT neck=96). The accuracy of ultrasound was not significantly different for normocalcemic when compared to hypercalcemic pHPT (40% vs 44%, $p=0.43$). However, sestamibi (44% vs 60%, $p < 0.01$) and 4D-CT neck (40% vs 66%, $p=0.02$) were less accurate imaging studies for normocalcemic compared to hypercalcemic pHPT. Bilateral neck exploration was required more frequently in normocalcemic patients (62% vs 34%, $p < 0.01$). Overall cure rate was equivalent between the groups: 98% in normocalcemic pHPT and 96% in hypercalcemic pHPT ($p=0.51$) based on 6 month post-operative normocalcemia.

Conclusions: Parathyroidectomy has a high success rate in patients with normocalcemic pHPT. Sestamibi and 4D-CT are less accurate in these patients necessitating a higher rate of bilateral neck exploration. Therefore, routine pre-operative sestamibi and 4D-CT scans may not be necessary or useful in patients with normocalcemic pHPT.

◆ 19. What are the Drivers of Cost in Parathyroidectomy?

Amanda R Doubleday¹, Christopher C Stahl¹, Kristin L Long¹, Rebecca S Sippel¹, Dawn M Elfenbein¹, Susan C Pitt¹, David F Schneider¹

¹*Endocrine Surgery, University of Wisconsin School of Medicine and Public Health*

Background: Variation exists in the workup and management of primary hyperparathyroidism. Current literature suggests that preoperative imaging allows for minimally invasive parathyroidectomy (MIP) but increases cost, and that bilateral neck exploration (BNE) mandates admission overnight. This study uses a matched cohort of patients undergoing parathyroidectomy to compare health system costs.

Methods: All patients that underwent parathyroidectomy from 2015-2019 at a single institution were identified by CPT code from the electronic health record (EHR). Actual cost data was obtained from a prospectively maintained institutional database and merged with the EHR patient data. Coarsened exact matching was used to create matched cohorts of patients that underwent a MIP or BNE. Weighted multiple linear regression was used to identify significant cost drivers.

Results: The matched data set included 560 patients; 281 patients underwent MIP, within that group a sub-analysis revealed 85 underwent MIP converted to bilateral exploration (MIPc), and 194 underwent BNE. The MIPc group had the longest average operative time, followed by BNE, then MIP (MIPc:105 minutes, BNE:101 minutes, MIP:68 minutes). Transient nerve injury remained low (MIP:0.4%, MIPc:2.4%, BNE:3.6%) while readmission rates were $\leq 1.1\%$ for all. Of the patients who had documented imaging, 74.5% had only 1 imaging study, while 25.5% had 2 or more imaging studies. The average total cost of preoperative imaging was highest in MIPc, followed by BNE, then MIP (MIPc:\$152.50, BNE:\$140.20, MIP:\$102.00, $p=0.16$). Same-day discharge was feasible for most regardless of extent of surgery (MIP:93.2%, MIPc:88.2%, BNE:89.2%, $p=0.19$). On multiple linear regression analysis after controlling for confounding variables, BNE added a total cost of \$609.00 compared to MIP. Overall, same-day discharge saved a total cost of \$2,333.50 per patient.

Conclusions: Contrary to previous literature, here we demonstrate that same-day discharge after parathyroidectomy is feasible and the most cost-saving variable regardless of imaging or extent of surgery. More imaging adds cost without necessarily the benefit of less invasive surgery.

◆ 20. Sex-related Differences in Clinical Presentations and Adrenal Vein Sampling Results in Patients with Primary Hyperaldosteronism

Frances T Lee¹, Sparsh Gupta¹, Irene Helenowski¹, Wenyu Huang¹, Anthony Yang¹, Cord Sturgeon¹, Riad Salem¹, Dina Elaraj¹

¹General Surgery, Northwestern University

Background: Primary hyperaldosteronism (PA) is a potentially curable cause of hypertension due to either a unilateral aldosterone-producing adenoma (APA) or idiopathic hyperaldosteronism (IHA) caused by bilateral hyperplasia, etiologies which may be distinguished by adrenal vein sampling (AVS). Females have been found to have better post-operative outcomes than males, but little is known regarding sex-related differences in clinical presentation.

Methods: Characteristics of 127 patients with PA who underwent AVS (57 females, 68 males) or adrenalectomy without AVS (2 females) from 2013-2019 were retrospectively analyzed. Comparisons between females and males were performed for multiple variables.

Results: Females vs males were younger at hypertension diagnosis (median [IQR]: 35 [30-38] vs 38 [30-45] years, $p=0.02$) and/or hypokalemia (median [IQR]: 40 [36-49] vs 51 [44-56] years, $p<0.001$). Females also had a shorter time interval from hypertension diagnosis to presentation for AVS/adrenalectomy (median [IQR]: 13 [7-18] vs 16 [10-22] years, $p=0.04$). At the time of AVS/adrenalectomy, females required less anti-hypertensive medications (median [IQR]: 4.2 [2.0-6.2] vs 5.4 [3.9-7.7] defined daily dose units, $p=0.007$) and potassium (median [IQR]: 40 [20-60] vs 60 [20-80] mEq daily, $p=0.02$). Males vs females were more likely to have comorbidities including renal insufficiency (18% vs 5%, $p=0.03$) and cardiovascular disease requiring aspirin/other anticoagulation therapy (50% vs 14%, $p<0.001$). Upon AVS, males were more likely to be surgical candidates with more APAs (78% vs 53%, $p<0.001$). However, females with APAs on AVS were more likely to undergo adrenalectomy (96% vs 79%, $p=0.049$).

Conclusions: PA remains an underdiagnosed condition among patients of both sexes with hypertension, as evidenced by prolonged time intervals from onset of hypertension to subtype classification or adrenalectomy. In particular, males are diagnosed with PA later than females and have more associated comorbidities upon presentation for AVS. Therefore, earlier diagnosis of PA, especially in young males with hypertension is needed.

◆ 21. Treatment at Academic Facilities is Associated with Increased Survival in Patients with Thyroid Cancer Undergoing Adjuvant Radiation Therapy

Daniel M. Hubbs¹, Ali Al Asadi¹, Adam S. Kabaker¹

¹*Surgery, Loyola University Medical Center*

Background: Thyroid cancer is the most common endocrine malignancy with Differentiated Thyroid Cancers (DTC) making up nearly 95% of thyroid cancers. Treatment of DTC is often curative with surgical resection alone, however for patients with residual disease or high risk of recurrence, Adjuvant Radiation Therapy (ART) may be indicated. For these patients requiring multidisciplinary care, the impact of treating facility type on patient outcomes is poorly defined.

Methods: The National Cancer Data Base (2004-2016) was queried to identify patients with non-metastatic, DTC, who underwent ART. Chi-Squared analysis was used to identify clinical and demographic differences between patients treated at Academic Centers (AC) and Community Centers (CC). Multivariable Cox proportional hazards modeling was used to adjust for demographic factors, tumor-related factors, and treatment factors in an effort to identify variables associated with overall survival (OS). Kaplan-Meier survival analysis was performed to construct unadjusted survival curves.

Results: Overall, 83,143 patients were identified: 34,489 (41.5%) patients were treated at AC and 48,654 (58.5%) patients were treated at CC. On univariate analysis, patients treated at AC were more likely to be uninsured (3.2% vs 1.9% $p < 0.001$) and have lymphovascular invasion (12.6% vs 9.4% $p < 0.001$). Patients treated at CC were more likely to have tumors < 2 cm (53.7% vs 51.8% $p < 0.001$), stage I disease (45.9% vs 39.7% $p < 0.001$), stage II disease (14.8% vs 12.6% $p < 0.001$), subtotal thyroidectomy (10.7% vs 8.9% $p < 0.001$), positive margins (16.9% vs 15.2% $p < 0.001$), and to have lived < 50 miles from the treating facility (93.7% vs 84.5% $p < 0.001$). On multivariable Cox analysis, female sex (HR 0.67; 95%CI[0.62-0.71]), private insurance (HR 0.76; 95%CI[0.58-0.98]), and total thyroidectomy (HR 0.90; 95%CI[0.82-0.98]) were associated with improved OS. Decreased OS was associated with treatment at CC (HR 1.10; 95%CI[1.03-1.18]), tumors > 4 cm (HR 1.78; 95%CI[1.62-1.95]), lymphovascular invasion (HR 1.37; 95%CI[1.21-1.56]), stage III disease (HR 1.11; 95%CI[1.01-1.22]), and stage IV disease (HR 2.10; 95%CI[1.89-2.33]).

Conclusions: The majority patients with DTC who undergo ART are treated at CC. Patients treated at AC had improved OS despite having larger tumors and more advanced disease.

◆ 22. The price of outpatient thyroid operations: A comparison between ambulatory surgical centers and hospital outpatient departments

Samuel J Enumah¹, Asmae Toumi², Luke J Keele³, Rachel R Kelz³, Carrie C Lubitz^{2,4}

¹*Surgery, Brigham and Women's Hospital, Harvard Medical School,*

²*Massachusetts General Hospital, Institute of Technology Assessment, Harvard Medical School,* ³*Surgery, Hospital of the University of Pennsylvania, Center for Surgery and Health Economics,* ⁴*Surgery, Massachusetts General Hospital*

Background: Across the U.S., an increasing proportion of thyroid-related procedures are performed in the outpatient setting each year. While ambulatory surgical centers (ASC) have gained popularity over the past decade, an understanding of the differences in commercial prices between ASCs and traditional hospital outpatient departments (HOPD) is lacking. Identifying differences in prices provides insight into the financial incentives for payors, providers, and patients about the best place to perform surgical care.

Methods: Adult patients who underwent a thyroid lobectomy or total thyroidectomy at a HOPD or ASC were identified in the IBM® MarketScan® Commercial database, 2007 to 2018. The primary outcome was total payment—the sum of facility, physician, and out-of-pocket payments. Itemized payments were also examined. Patients at ASCs were matched to HOPD patients on age, sex, insurance plan type, region, and procedure. Estimates of payments were compared using M-statistics for matched pairs.

Results: Our sample included 112,717 claims with 104,864 (93%) HOPD and 7,853 (7%) ASC. The proportion of thyroid operations performed at an ASC rose from 4% in 2007 to 9% in 2018. Before matching, the median total payment for a total thyroidectomy was \$3,564 (interquartile interval (IQI): [\$1,685, \$7,169]) and for a thyroid lobectomy was \$3,141 (IQI: [\$1,375, \$6,123]). We generated 7,863 matched pairs. After matching, the median total payment for a total thyroidectomy was \$3,137 (IQI: [\$1,768, \$5,606]) and for a thyroid lobectomy was \$2,925 (IQI: [\$1,460, \$4,940]). Total payments for total thyroidectomies and thyroid lobectomies were \$719 lower in the HOPD setting as compared to the ASC setting (paired difference: m-est, -719.30, SE 60.2; $p < .001$).

Conclusions: Total payments for total thyroidectomies and thyroid lobectomies were lower in HOPDs compared to ASCs. While there may be financial incentives for providers to generate higher revenue by operating at ASCs, this may mean that payors and patients pay extra for the same procedure depending on the site of care.

◆ 23. Therapeutic Targeting of Somatostatin Receptor Type 2 in Neuroendocrine Tumor Cells

Rupali Sharma¹, Bhargav Earla², James Madigan³, Samira Sadowski³

¹National Institutes of Health, ²School of Medicine, University of Alabama,

³Endocrine Surgery, National Institutes of Health

Background: Somatostatin surface receptors (SSTRs) are a unique feature of Gastro-Entero-Pancreatic Neuroendocrine Tumors (GEP-NETs). Poorly differentiated/high-grade GEP-NETs lose the ability to express SSTR type2 and thus become ineligible for SSTR2 targeted therapies. As epigenetic mechanisms play a crucial role in regulating gene expression, we explored the possible role of drug-induced modifications of SSTR2 expression. The goal of this study is to improve visibility and response to SSTR2 targeted therapy.

Methods: Three NET cell lines BON-1, QGP-1 (pancreatic) and GOT-1 (intestinal origin) were treated with HDAC inhibitors Valproic acid (VPA) and Tacedinaline (CI-994) and DNMT inhibitor Decitabine/Azacytidine. Epik 850k methylation array and RNA-seq was performed with VPA and azacytidine treatment for 96h. SSTR2 gene/protein expression was performed by Real time PCR using TaqMan probe and Fluorescence-activated cell sorting (FACS) for 24, 48 and 72h. Western blot analysis was performed for Pan acetylated H3 and SSTR2, using H3 and β -actin as loading controls, respectively. Densitometry was performed with NIH ImageJ software and all statistical analyses were performed using GraphPad Prism 8.

Results: A significant negative correlation between SSTR2 promoter methylation and SSTR2 expression was found at 11 CpG islands and clustering according to cell line type. SSTR2 expression increased in BON1 ($p < 0.0001$) cells with CI-994 and VPA at 48 and 72h, and in QGP1 cells ($p < 0.05$) at 48h with CI-994. A significant dose and time dependent increase in SSTR2 surface expression in BON1 ($p < 0.001$) and QGP1 cells ($p < 0.01$) at 72h with VPA and CI-994, and in GOT1 cells with CI-994 at 72h ($p < 0.05$) was found by FACS. Pan-acetylated H3 protein expression increased significantly with CI-994 treatment in BON1 and QGP1 cells and correlated with increased SSTR2 protein expression in BON1 cells at 48 and 72h in a dose and time dependent manner.

Conclusions: Our findings indicate that promoter methylation is a major component of SSTR2 transcript regulation in NET cell lines. Using HDAC inhibitors and by inducing histone acetylation, the visibility of SSTR2 can be increased for improved targeting. This will potentially allow for effective targeted imaging and therapy of metastatic neuroendocrine cancers. This will be validated further in animal studies.

◆ 24. Impact of the 2015 American Thyroid Association Guidelines on Treatment in Older Adults with Low-Risk, Differentiated Thyroid Cancer

Whitney Sutton¹, Joseph K Canner¹, Shkala Karzai¹, Dorry L Segev^{1,2}, Jason D Prescott¹, Aarti Mathur¹

¹*Department of Surgery, Johns Hopkins University School of Medicine,*

²*Department of Epidemiology, Johns Hopkins University Bloomberg School of Public Health*

Background: The 2015 American Thyroid Association (ATA) guidelines recommend consideration of hemithyroidectomy for low-risk, differentiated thyroid cancer (DTC). Studies prior to this change in recommendations demonstrated significant treatment variation for older adults (age \geq 65) with DTC. Therefore, our primary objective was to evaluate the impact of the 2015 ATA guidelines on extent of surgery for DTC in older adults.

Methods: The Surveillance, Epidemiology, and End Results database was utilized to identify adults (age \geq 18) diagnosed with T1-2, N0, M0 DTC between 2010 and 2017. Changes in annual treatment rates of hemithyroidectomy (HT), total thyroidectomy (TT), and active surveillance (AS) before and after the 2015 guidelines were assessed using interrupted time series analysis stratified by patient age: younger adults(18-64 years old), older adults(65-79), and super-elderly(\geq 80).

Results: Of 53,699 patients with DTC, 81.2% were $<$ 65 years old, 16.7% were 65-79 years, and 2.0% were \geq 80 years. Prior to 2015, TT was performed in 82.0% of younger adults, 78.5% of older adults, and 67.5% of the super-elderly, whereas HT was performed in 15.7% of younger adults, 18.0% of older adults, and 21.0% of the super-elderly. After 2015, annual rates of TT decreased by 2.8% and 2.7% in younger and older adults($p<0.001$), but increased by 5.5% in the super-elderly($p=0.024$), whereas annual rates of HT increased by 2.3% and 1.7% in younger and older adults($p<0.001$), but decreased by 4.8% in the super-elderly($p=0.019$). Finally, after 2015, annual rates of AS increased by 0.5% in younger adults($p=0.015$) and by 1.0% in older adults($p<0.001$), but were unchanged for the super-elderly. Despite these rate changes, older adults and the super-elderly were still more likely than younger adults to undergo HT(aOR=1.1, 95%CI:1.1-1.2, $p<0.001$ and aOR=1.6, 95%CI:1.4-1.9, $p<0.001$, respectively) and AS (aOR=1.5, 95%CI:1.4-1.7, $p<0.001$ and aOR=6.5, 95%CI:5.4-7.9, $p<0.001$, respectively) when compared to TT.

Conclusions: For adults diagnosed with low-risk DTC in the United States, TT remains the most common treatment. However, annual rates of HT have increased 20-fold, with the greatest increase observed in younger adults. Treatment patterns for DTC continue to vary among older and super-elderly adults compared to the younger cohort, encouraging the implementation of objective risk stratification for treatment decision-making in the older population.

25. Did the COVID-19 Pandemic Impact the Practice of Endocrine Surgery?

Toni Beninato¹, Amanda M Laird¹, Claire E. Graves², F. Thurston Drake³, Amal Alhefdhi⁴, James A Lee⁵, Jennifer H Kuo⁵, Elizabeth G Grubbs⁶, Tracy S Wang⁷, Janice L Pasioka⁸, Carrie C Lubitz⁹

¹Rutgers Cancer Institute of New Jersey, ²University of California Davis, ³Boston University School of Medicine, ⁴King Faisal Specialist Hospital and Research Centre, ⁵Columbia University, ⁶University of Texas MD Anderson Cancer Center, ⁷Medical College of Wisconsin, ⁸Cumming School of Medicine, University of Calgary, ⁹Harvard Medical School, Massachusetts General Hospital

Background: The COVID-19 pandemic has had wide-ranging effects on clinical practice. This study investigates the impact of the initial phase of the COVID-19 pandemic on the practice of endocrine surgery.

Methods: A survey was sent to members of the American Association of Endocrine Surgeons in September 2020. Chi-square was used to determine association of outcomes in different groups. Kappa statistic was used for pre- and post-COVID correlation of practice patterns.

Results: Of 518 surgeons invited to participate, 77 (14.8%) responded; 51 (66%) were <50 years old and 43 (56%) were male. The majority (82%) practiced at academic hospitals and were from the United States (77%). All reported temporary suspension of elective surgeries; 89% reported that 'urgent' surgery was allowed. Approximately one-third (38%) were "deployed" to other duties during this time, including general surgery call (26%) or to an ancillary team for COVID-19 patients (14%). Once elective surgeries resumed, median number of cases backlogged was 30 (IQR 15-50). The majority were scheduled during normal block time, but some were performed during extended hours (29%), on weekends (8%) or at an additional facility (11%). The majority (70%) reported that the pandemic impacted compensation, mostly from decreased clinical volume (59%). This was more prevalent in private practice surgeons compared to academic (93% versus 65%, $p=0.04$). Most of the decrease in clinical volume was reported to be from fewer referrals (68%) or patient preference to delay care (77%). Additionally, 35% reported administrative staff were furloughed or laid off. There were substantial increases in the use of telemedicine services for new patient, post-op, and follow-up visits from pre-COVID-19 levels (all kappa <0.06). Overall practice patterns did not change in regards to use of in-office procedures (ultrasound, FNA, laryngoscopy), use of observation for papillary thyroid microcarcinoma, use of same day thyroid, parathyroid, or adrenal surgery, or length of observation of patients in the recovery room.

Conclusions: The COVID-19 pandemic led to suspension of elective operations for endocrine surgery patients and decrease in practice volume and compensation for most surgeons. However, even with distancing restrictions and resource limitations, surgeons maintained pre-COVID practice patterns for pre- and perioperative patient care.

◆ 26. Predictive Value of ThyroSeq Genomic Classifier in Management of Indeterminate Thyroid Nodules

Jared C Dublin¹, Michael Papazian¹, Elcin Zan², Thaira Oweity³, Wei Sun³, Kepal Patel⁴, Tamar C Brandler³, Babak Givi⁵

¹New York University Grossman School of Medicine, ²Department of Radiology, NYU Grossman School of Medicine, ³Department of Pathology, NYU Grossman School of Medicine, ⁴Division of Endocrine Surgery, Department of Surgery, NYU Grossman School of Medicine, ⁵Department of Otolaryngology-Head and Neck Surgery, NYU Grossman School of Medicine

Background: Indeterminate thyroid nodules (ITN) pose a diagnostic challenge for clinicians. Genomic classifiers such as ThyroSeq were developed to better guide clinicians in decision-making. Whether the diagnostic accuracy of these tests changes relating to the size of the nodule has not been previously studied. We analyzed the performance of ThyroSeq in relation to the size of the nodule.

Methods: All ITNs diagnosed and managed with ThyroSeq testing and surgery from 2014 to 2018 at NYU Langone Medical center were selected. Patient demographics, nodule characteristics, genomic profiles, treatment detail, and pathologic characteristics were recorded. Positive (PPV) and negative predictive values (NPV) were calculated and correlated with the nodule size. We further analyzed genetic signatures associated with the risk of malignancy.

Results: Of the 199 patients with cytologic diagnosis of ITN, who underwent surgery, 164 (82.4%) were interpreted as positive on ThyroSeq. In this group, only 42 (25.6%) ultimately had malignant findings on final pathology. In the 35 patients who underwent surgery despite a negative ThyroSeq interpretation, 6 (17.1%) were malignant. The observed cancer prevalence in our population was 24%. PPV of a positive test was 26% (95% CI [Confidence Interval], 19%-33%) and NPV was 83% (95% CI, 66%-93%). PPV and NPV improved as the nodule size increased (<2cm, N: 79; PPV: 25%; NPV: 60%) versus (>4cm: N: 26; PPV: 45%; NPV: 100%) The highest risk of malignancy was associated with RAS (16, 38.1% of all malignancies) and BRAF mutations (14, 33.3% of all malignancies).

Conclusions: In our patient population, the PPV and NPV of ThyroSeq was lower than prior reports. However, the performance significantly improved for larger nodules. This data could have implications for management of ITNs, specifically nodules larger than 4cm.

◆ 27. Intraoperative Video Laryngoscopy: A useful adjunct to intraoperative nerve monitoring in thyroid surgery?

Randall P Owen¹, Gustavo Fernandez-Ranvier¹, Aida Taya¹, David Steinmetz¹, Jee-hye Choi¹, Elliot Scott¹, Jamie Bousleiman¹, Alison Buseck¹, Irene Lou², Marissa Mencio³, Margaret Hofstedt⁴

¹*Surgery, Icahn School of Medicine at Mt. Sinai Hospital,* ²*The Brooklyn Hospital Center,* ³*Ascension Saint Thomas Ministry,* ⁴*University of Virginia school of medicine*

Background: Intraoperative recurrent laryngeal nerve monitoring (IONM) in thyroid surgery has become a popular adjunct to the gold standard of nerve visualization. We investigate the feasibility of using the novel technique of intraoperative video laryngoscopy (IOVL) and whether it contributes to interpreting nerve integrity.

Methods: This is an IRB approved prospective study of 56 participants (81 nerves at risk) undergoing thyroid surgery with concurrent use of intraoperative video laryngeal monitoring and intermittent standard EMG monitoring. Glycopyrrolate is administered prior to intubation to decrease secretions. The patient is then intubated using a standard endotracheal tube equipped with a laryngeal surface electrode. The fiberoptic video laryngoscope with curved plastic housing is placed into the pharynx alongside the endotracheal tube enabling a continuous view of the vocal cords and/or arytenoid cartilages during the operation. Intraoperatively, the vagus and recurrent laryngeal nerves are stimulated at 1.0-1.5 mA, pre- and post-thyroid resection. Video-captured vocal cord movement, as well as EMG amplitude and audio signal, are recorded for each nerve pre- and post-resection.

Results: Twelve nerves (15%) lost EMG signal following thyroid resection, and ten nerves (12%) had no signal pre- and post-resection the latter indicating equipment failure or malfunction. In 4/12 (33%) cases of signal loss, and 5/10 (50%) cases of absent signal, vocal cord movement was still visible on IOVL. Thus, in 9/22 cases (41%), IOVL confirmed nerve integrity when standard EMG monitoring did not. For the remaining 13 nerves with no EMG nerve signal, there was a corresponding lack of vocal cord movement on IOVL. There were 7/56 cases where EMG signal was present but there was no vocal cord movement on IOVL due to technical issues with the camera, patient body habitus, laryngeal anatomy, or excessive secretions. All patients with EMG signal loss or absence who had a postoperative laryngoscopy had normal vocal cord movement, except one, who had an immobile ipsilateral vocal cord.

Conclusions: IOVL is shown to be a feasible and useful adjunct to standard EMG nerve monitoring in determining nerve integrity during thyroidectomy.

◆ 28. The Impact of Thyroid Nodule Afirma Xpression Atlas Results on Clinical Decision-Making

Nasim T Babazadeh¹, Tiffany J Sinclair¹, Vikram Krishnamurthy¹, Judy Jin¹, Katherine Heiden¹, Joyce Shin¹, Eren Berber¹, Allan Siperstein¹

¹Cleveland Clinic

Background: The Afirma Genomic Sequencing Classifier (GSC) is a cancer rule-out test that partners whole transcriptome RNA sequencing genomic information with machine learning to identify nodules as benign or suspicious. The Afirma Xpression Atlas (XA) became available in 2018 and uses whole-transcriptome RNA-sequencing to report findings across 593 genes including 905 variants and 235 fusions. Positive predictive value is reported either for the specific alteration identified or for alterations of that gene, and the associated neoplasm type is listed. We report the results of XA testing at our institution during its first two years of clinical use.

Methods: All patient charts with available thyroid nodule XA results at our institution were reviewed. Indications for XA were most commonly Bethesda 3 or 4 cytology, but also included Bethesda 5 and 6 cytology, the latter of which were excluded in our analysis. Thyroid nodule characteristics, cytology, Afirma GSC results, XA results, and final histopathology were reported.

Results: XA was performed on 113 nodules since May 2018. Thirty nodules were excluded – 18 lack histopathology, 3 were lymphoma, and 8 were Bethesda 5/6. GSC identified three cases of non-follicular disease (two lymphomas and one medullary thyroid carcinoma). Of GSC suspicious nodules, 77.1% were cancer, which is a higher rate than previously published. Of the 83 included nodules, 35 had positive XA results, which included 10 variants among 8 genes, and 1 fusion. XA's sensitivity for detecting follicular-derived cancer was 43.8%, positive predictive value was 80.0%, specificity was 63.3%, and negative predictive value was 25.0%. XA positivity was not significantly associated with cancer on Chi-square test ($p=.59$).

Conclusions: As expected, XA is not a rule out test for follicular-derived cancer. Larger studies are needed to determine whether and how XA results predictably inform the risk of malignancy in thyroid nodules. Considering that 77.1% of GSC suspicious nodules were cancer in our cohort, XA would have to be very high-performing in order to change the pretest probability of malignancy. Further elucidating the association of specific variants and fusions with cancer risk may help guide patient discussions on indication for and extent of surgery based on XA results.

◆ 29. Mediastinal Parathyroidectomy: A Multidisciplinary, Minimally-Invasive Transthoracic Approach is Safe and Effective in Challenging Cases

Kimberly M Ramonell¹, Courtney Rentas², Erin Buczek³, John R Porterfield¹, Brenessa Lindeman¹, Herb Chen¹, Jessica Fazendin¹, Benjamin Wei⁴
¹Endocrine Surgery, University of Alabama at Birmingham, ²University of Alabama at Birmingham, ³Otolaryngology, University of Alabama at Birmingham, ⁴Cardiothoracic Surgery, University of Alabama at Birmingham

Background: Hyperparathyroidism (HPT) due to an ectopic mediastinal parathyroid gland is successfully accessed transcervically in the majority of patients. Those proving inaccessible from the neck pose a significant clinical and technical challenge. In this study, we present the largest case series of transthoracic robot-assisted mediastinal parathyroidectomies (TTRMP) performed with a multidisciplinary approach.

Methods: A review of 169 consecutive patients with primary HPT who underwent mediastinal parathyroidectomy at our institution between 2012 and 2019 was performed. Patients were stratified into 2 groups: transcervical approach (151) and TTRMP approach (16). Patient demographics, operative reports, pathology, and outcomes were analyzed. TTRMP cases were performed in combination with Thoracic and Endocrine/ENT Surgery for parathyroid reimplantation as appropriate.

Results: Overall, 15.5% of patients who underwent parathyroidectomy during this 7-year period had an ectopic mediastinal parathyroid gland. The majority of mediastinal parathyroidectomies were successfully performed via transcervical thymectomy (89.3%). Of the remaining patients with mediastinal glands, 60% underwent prior neck exploration by outside surgeons with 80% having persistent HPT and a mean 2.8-year delay from index operation until TTRMP. All 16 TTRMP patients had pathologically confirmed resection of hypercellular parathyroid tissue in the following locations: intrathymic (8), AP window (4), carina (3), and retroesophageal (1). Mean pre-operative calcium and PTH were 11.3 ± 0.2 mg/dL and 229 ± 44 pg/mL, respectively. All patients underwent CT neck/chest prior to TTRMP with 100% concordance in imaging and operative findings. All patients had a >50% decline in ioPTH values. Two patients underwent immediate parathyroid reimplantation. None were converted to open sternotomy. Mean post-operative calcium and PTH were 9.2 ± 0.2 mg/dL and 20.2 ± 5.6 pg/mL, respectively and median LOS was 1 day (range 1-4.) Four patients experienced symptomatic temporary hypocalcemia (25%) and 1 patient had permanent hypocalcemia (6.25%). Other complications included DVT (1), transient hoarseness (1), and subcostal neuralgia (1).

Conclusions: In experienced hands, TTRMP is a safe and effective approach to mediastinal parathyroids that are inaccessible from the neck. A multidisciplinary surgical approach should be used for reimplantation of parathyroid tissue in patients with previous exploration. These data reconfirm that most mediastinal parathyroids can be accessed transcervically with liberal use of thymectomy, when performed by high-volume parathyroid surgeons.

30. Fascial Vs Selective lateral neck dissection in patients with N1b papillary thyroid carcinoma

Marco Raffaelli¹, Carmela De Crea¹, Luca Sessa², Sofia Di Lorenzo², Chiara Paolantonio³, Francesca Prioli³, Pietro Princi², Luca Revelli², Rocco Bellantone¹

¹Fondazione Policlinico Universitario Agostino Gemelli IRCCS - Università Cattolica del Sacro Cuore, ²Fondazione Policlinico Universitario Agostino Gemelli IRCCS, ³Università Cattolica del Sacro Cuore

Background: Optimal surgical technique for lateral neck dissection (LND) in N1b papillary thyroid carcinoma (PTC) is not well established. Fascial LND (F-LND) has been proposed to remove levels II-V *en-bloc* with the superficial and middle layers of the deep cervical fascia, potentially reducing risk of recurrence. Conversely, F-LND could theoretically increase the risk of complications and determine a poor cosmetic outcome. We compared F-LND and selective LND (S-LND) (levels II-V) without fascial removal in terms of complications, accuracy of staging and cosmetic result.

Methods: Between January 2018 and September 2020, 70 N1b PTC patients underwent primary LND: 35 patients F-LND and 35 S-LND. Operative, post-operative and histological characteristics of all the included patients were compared. Patients' satisfaction with cosmetic result were evaluated by a visual analogic scale (VAS).

Results: No significant difference was observed between the two groups with respect to age, sex, extension of surgery (uni- or bilateral LND), operative time and post-operative stay (P=NS). Post-operative complications were not significantly different between F-LND and S-LND patients: 6Vs10 post-operative hypocalcemia, 3Vs2 unilateral laryngeal nerve injury, 1Vs0 post-operative neck hematoma requiring reoperation, 0Vs1 lymphatic leak requiring reoperation (P=NS). pT stage and mean number of removed and metastatic central neck nodes were similar between the groups (P=NS). The mean number of lateral neck lymph nodes removed was higher in F-LND patients when compared to S-LND patients (47.9±20.8 Vs 36.8±19.7, respectively, P<0.05). The mean number of metastasized lateral nodes were not significantly different between the groups (P=NS). No significant difference was observed between F-LND and S-LND regarding VAS score for patients' satisfaction with the cosmetic result (8.6±1.7 Vs 8.0±1.6, respectively - P=NS). At a mean follow-up of 12.7 months, no patients experienced recurrent disease.

Conclusions: F-LND is associated with a significantly higher nodal yield, without increasing the risk of complication or worsening the cosmetic result. The consequently reduced metastasized to removed nodes ratio indicates a more radical resection that could have potential benefit on the risk of recurrence. Further studies and longer follow up are needed to confirm the potential benefit on the oncologic outcome.

◆ 31. Resident Self-Assessment of Common Endocrine Procedures

Peter J Abraham¹, Jessica M Fazendin¹, Herb Chen¹, Brenessa Lindeman¹

¹Surgery, The University of Alabama at Birmingham

Background: General surgery residents are expected to be proficient in straightforward endocrine operations upon completion of their training program. However, in a prior study, attending endocrine surgeons disagreed that general surgery residents achieved sufficient competence to perform thyroid and parathyroid procedures in practice. This study aimed to elucidate residents' self-assessment of their ability to perform common endocrine operations.

Methods: A fifteen-question, anonymous survey was emailed to general surgery residents from seven U.S. residency programs between August-October, 2020 regarding their self-assessed ability to perform each step of a straightforward thyroidectomy and parathyroidectomy. Outcomes included demographics and self-assessed ability to perform various operative steps. Bi- and multi-variate analyses were conducted utilizing Chi-squared tests and logistic regression, as appropriate.

Results: Responses were received from 78 residents (31%). A majority were female (54%) and senior residents (PGY 3-5, 55.1%). The vast majority (92.1%, n=70) planned to pursue fellowship training, with 4.3% (n=3) selecting endocrine surgery. Most respondents (75.6%, n=59) did not anticipate performing thyroidectomies or parathyroidectomies once in practice. Among respondents, 78% completed both cases (n=61). Dissection of the recurrent laryngeal nerve was cited to be the most difficult step of both procedures, with only 10.3% (n=8) and 6.3% (n=10) of residents stating they could perform this step without attending assistance, respectively. Only 14.0% of senior residents (n=6) believed they could identify and dissect the recurrent laryngeal nerve unassisted during a thyroidectomy. However, 27.9% and 26.2% of respondents (n=17, 16, respectively) agreed they could complete a straightforward thyroidectomy for benign disease or parathyroidectomy skin-to-skin without assistance. Fewer respondents agreed they could complete a straightforward thyroidectomy for malignant disease (11.7%, n=7). Multivariate analysis revealed higher PGY-level ($p=0.046$) and completed number of cases ($p<0.001$) were significantly associated with greater self-assessed ability to perform endocrine operations unassisted.

Conclusions: Most general surgery residents surveyed did not feel capable of performing common, straightforward endocrine procedures without an attending present. Although confidence in operative ability increased with PGY-level and number of cases completed, the majority of senior residents still did not feel able to perform the operations unassisted.

◆ 32. The Effect of Phenotype on the Accuracy of Pre-operative Imaging in Primary Hyperparathyroidism

Abdullah A. Norain¹, Patrick T. Hangge¹, Richard J. Butterfield², Nabil Wasif¹, Chee-Chee H. Stucky¹, Patricia A. Cronin¹

¹*Oncologic and Endocrine Surgery, Mayo Clinic Arizona*, ²*Biostatistics, Mayo Clinic Arizona*

Background: Primary hyperparathyroidism (PHPT) is currently understood to comprise of three distinct biochemical phenotypes (classical, normocalcemic and normohormonal). The ability to identify adenomatous disease in the preoperative setting may vary amongst phenotypes. We compared the accuracy of preoperative imaging modalities in localizing parathyroid adenomas between phenotypes of PHPT.

Methods: We performed a retrospective review of patients who underwent parathyroidectomy for PHPT between 2015-2019 at our institution. Patients with secondary or tertiary hyperparathyroidism, MEN or syndromic disease were excluded. In patients with pathology demonstrating an adenoma, we compared the concordance between preoperative imaging and intraoperative adenoma location (left vs right). We performed sensitivity and specificity analysis to generate receiver operating characteristic curves (ROC) and compared the area under the curve (AUC) for ultrasound (US), Sestamibi/SPECT-CT (SES/SPECT), and 4DCT (parathyroid protocol) in localizing parathyroid adenomas.

Results: Our review yielded 453 patients who underwent parathyroidectomy for PHPT, of which 67.3% had excision of an adenoma. The classical phenotype dominated the cohort (80.8% vs 8.8% and 10.4% for normocalcemic and normohormonal variants, respectively). Single gland adenomatous disease was identified in 73.6% of patients with the classical phenotype and in 37.5% of normocalcemic and 43.5% of normohormonal patients ($p < 0.0001$). In patients with the classical phenotype, SES/SPECT (AUC, 0.77) significantly outperformed US (AUC, 0.58; $p < 0.0001$), but was comparable with 4DCT (AUC, 0.71; $p = 0.385$). In normocalcemic patients, both US (AUC, 0.7; $p = 0.0381$) and SES/SPECT (AUC, 0.76; $p = 0.0002$) outperformed 4DCT (AUC, 0.5). We observed no imaging performance differences in the assessment of normohormonal patients [US (AUC, 0.56), 4DCT (AUC, 0.68), SES/SPECT (AUC, 0.69)].

Conclusions: Many patients with non-classical PHPT have multigland disease. The phenotype of PHPT is associated with accuracy of preoperative imaging. SES/SPECT and 4DCT scan were comparable and SES/SPECT was more accurate than US in adenoma detection in patients with classical PHPT. But in patients with normocalcemic PHPT, 4DCT was less accurate compared to both US and SES/SPECT in the assessment of localized pathology. Surgical exploration rather than exhaustive preoperative localization imaging may be more appropriate for non-classical phenotypes.

◆ 33. Do Phenotypes of Primary Hyperparathyroidism Present Differently?

Abdullah A. Norain¹, Patrick T. Hangge¹, Richard J. Butterfield², Nabil Wasif¹, Chee-Chee H. Stucky¹, Patricia A. Cronin¹

¹*Oncologic and Endocrine Surgery, Mayo Clinic Arizona*, ²*Biostatistics, Mayo Clinic Arizona*

Background: Primary hyperparathyroidism (PHPT) is now understood to comprise three biochemical phenotypes. Any potential differences between the phenotypes are not fully understood. Our study compared patient characteristics and operative indications between classical, normocalcemic (ncHPT) and normohormonal (nhHPT) phenotypes of PHPT.

Methods: We performed a retrospective review of patients who underwent parathyroidectomy from 2015-2019 at our institution. Patients with secondary or tertiary hyperparathyroidism, MEN or other syndromic diseases were excluded. The relative distribution of operative indications was compared across the phenotypes. Indications assessed were age <50, serum calcium >11.2 mg/dL, creatinine clearance <60 mL/min, 24-hour urinary calcium excretion >400mg, osteoporosis (defined as T-score \leq -2.5 at any site on bone mineral density scan), history of bone fracture, and history of nephrolithiasis.

Results: 453 patients underwent parathyroidectomy for PHPT. The classical phenotype was most common (80.8% vs 8.8% and 10.4%, for ncHPT and nhHPT phenotypes, respectively). Normocalcemic patients were more likely to be Hispanic or Latino (15.4% vs 6.1% for classical and 2.2% for nhHPT phenotypes; $p = 0.0388$). The phenotypes were comparable in terms of gender, race, BMI, ASA classification, and smoking status. Single gland disease was identified in 73.6% of classical phenotype patients, 37.5% of ncHPT and 43.5% of nhHPT patients ($p < 0.0001$). Normohormonal patients were more likely to present at age <50 (21.3%) compared with ncHPT (2.5%, $p = 0.0086$) and classical phenotype patients (9.6%, $p = 0.0153$). Normocalcemic patients were significantly more likely to have osteoporosis (60.0%) compared with the classical phenotype (36.2%, $p = 0.0067$), but not compared with nhHPT patients (37.8%, $p = 0.8487$). Bone fracture history was present significantly more among nhHPT patients (28.3%) than classical patients (12.1%, $p = 0.0030$), and was comparable between nhHPT and ncHPT patients (20.0%, $p = 0.3738$).

Conclusions: We observed significant differences in the presentation of PHPT phenotypes. Despite their biochemistry, nhHPT and ncHPT phenotypes may have significant disease, and present with sequelae of untreated disease such as osteoporosis and bone fracture. Patients with osteoporosis should be assessed for PHPT despite being normocalcemic. Patients with non-classic disease should be referred and assessed for surgical indications.

◆ **34. Surgical Disparities Among Patients with Primary Hyperparathyroidism: A National Inpatient Sample Database Study**
Polina V Zmijewski^{1,2}, Krissia Rivera Perla^{2,3}, Gessy Leila R Paul⁴, Peter J Mazzaglia^{1,2}

¹Surgery, Rhode Island Hospital, ²The Warren Alpert Medical School of Brown University, ³Harvard T. H. Chan School of Public Health, ⁴Brown University

Background: Socioeconomic and racial disparities in access to medical care have been shown to impact the morbidity and mortality of patients with surgically managed conditions. Primary Hyperparathyroidism (PHPT) is cured only by parathyroidectomy. To date, no large database study has been performed to examine the role of racial and socioeconomic disparity on surgical referral.

Methods: Patients carrying a diagnosis of PHPT between the years of 2000-2014 were identified through the National Inpatient Sample (NIS) database. A Chi Square analysis was used to compare categorical variables and a logistic regression model with odds ratios (OR) was used to identify social predictors of surgical management.

Results: 98,226 patients were included. 74,441 (75.8%) were female. 15,408 (15.7%) were Black and 6,952 (7.1%) were Hispanic. 63,572 (64.7%) underwent parathyroidectomy. Black patients were significantly less likely to undergo operation than White patients (OR 0.77, {0.69- 0.87} p <0.001). No statistically significant difference in odds of operation was observed in Hispanic vs. White populations. Income quartile did not affect odds of surgery. Patients with Medicare were significantly more likely to be surgically managed when compared to Medicaid patients (OR 1.42, {1.22-1.66}, p <0.001). Privately insured patients were more than twice as likely to undergo operation (OR 2.07, {1.77-2.44}, p <0.001) as Medicaid patients. A subgroup analysis of patients <50 years old, all of whom met National Institute of Health criteria for parathyroidectomy, was performed. Of these 16,564 patients, privately insured patients were significantly more likely to undergo surgery than Medicaid patients (OR 2.34, {1.84- 2.99}, p<0.001). There was no statistically significant difference in odds of surgery based on race or income quartile in the subgroup analysis.

Conclusions: In patients diagnosed with PHPT, being of the White race and privately insured were factors predictive of undergoing operation for PHPT. Therefore, it is expected that patients who are Black and/or insured with Medicaid would be more likely to develop the morbidities associated with advanced Primary Hyperparathyroidism.

◆ 35. Cytotoxic T-cell Infiltration Predicts Improved Survival In Patients with Resected Adrenocortical Carcinoma: Clues for Novel Therapies From The Tumor Microenvironment

Luis I Ruffolo¹, Katherine M Jackson¹, Benjamin S Dale¹, Paul Burchard¹, Bianca De Las Casas¹, Olivia Lynch¹, Shawn Hsu¹, Tanupriya Agrawal¹, Luis De Las Casas², Jacob Moalem³

¹University of Rochester Medical Center, ²Pathology, University of Texas Southwestern, ³Surgery, University of Rochester Medical Center

Background: Adrenocortical Carcinomas (ACC) are rare but highly aggressive tumors arising from the adrenal cortex. While surgery remains the mainstay treatment for localized disease, advances in therapy for unresectable or metastatic tumors have been elusive, and treatment with mitotane remains the default systemic treatment. Here we describe our institution's case series in these rare tumors, and catalogue the unique immune infiltrate of long term survivors.

Methods: Following institutional review board approval, the electronic medical record of patients undergoing adrenalectomy from 2011-2018 were retrospectively reviewed and clinicopathologic, demographic, and treatment histories were abstracted. Archived paraffin embedded tissues were sectioned and stained CD8 as a marker of cytotoxic T-cell presence within the tumor. Tumor regions were defined by board certified pathologists and chromagen intensity was subsequently quantified by an Aperio digital microscopy system. Survival analysis was performed between high and low CD8+ density (as defined by receiver - operator calculations) using the Log-rank test, with significance at $p < 0.05$.

Results: During the seven year review, 31 patients underwent resection for ACC. Median age at diagnosis was 48 years, 65% of patients were female, and 58% of tumors were right sided. Forty-five percent of tumors presented with functional endocrinopathy. Eighty-seven percent of cases were performed via celiotomy. Fifty-five percent of patients received adjuvant chemotherapy with mitotane. With a median follow up of 2.7 years, 16/31 (52%) of patients experienced disease recurrence, with median recurrence occurring at 237 days after resection.

Twenty two cases were available for archival histopathologic assessment. IHC staining for cytotoxic T-lymphocytes (CD8+) demonstrated a four-fold variation in pixel positivity when quantified through the automated machine algorithm (pixel positivity ranging from 0.03% to 0.13%). Furthermore, an association with CD8+ positivity and longer overall-survival was observed with more densely CD8+ penetrated tumors exhibiting a longer overall survival (low positivity median overall survival 721 days, high positivity median overall survival 2360 days, Log-rank p -value = 0.03).

Conclusions: Adrenocortical carcinomas are characterized by variable infiltration of cytotoxic T Cells. An adaptive T-cell response appears to be protective in patients with ACC. Future work will focus on elucidating the mechanisms of tumor immunosuppression and T-cell exhaustion.

◆ 36. Feasibility of Posterior Retroperitoneoscopic Approach for Adrenalectomy in Morbidly Obese Patients

Helmi S Khadra¹, Alexander S Chiu¹, Richard C Maduka¹, Sara Abou Azar¹, Grace S Lee¹, Courtney Gibson¹

¹Department of Surgery, Yale University School of Medicine

Background: Posterior retroperitoneoscopic adrenalectomy (PRA) is becoming a more widely performed approach, but there are concerns about its feasibility in morbidly obese patients. Surgeons have been reluctant to perform PRA on morbidly obese patients due to concerns of inadequate working space and perceived higher rate of complications. This study aims to examine the safety and feasibility of PRA in morbidly obese patients.

Methods: A retrospective analysis of all PRA at our institution between March 2013 to September 2020 was performed. Outcomes were evaluated by patient weight at the time of operation. Non-obese was defined as body mass index (BMI) <30, obese was defined as BMI 30-39.9, and morbidly obese was defined as BMI ≥40. Principle outcome measures included length of operation, length of hospital stay, and incidence of complications. Complications were defined using the Clavien-Dindo classification. Clinical characteristics of patients and operative data were compared between the groups using ANOVA, chi squared analysis, and Fisher's exact test. Multivariate regression was performed to compare outcomes controlling for age, gender, race/ethnicity, tumor pathology, and tumor size.

Results: There were 249 PRA performed during this time period. Of these patients, 126 (50.6%) were non-obese, 101 (40.6%) were obese, and 22 (8.8%) were morbidly obese. There was no significant difference in the age, gender, or tumor size between the groups. Morbidly obese patients had similar operative times (97 vs. 103 min for obese and 95 min for non-obese, $p=0.45$) and average length of stay (2.3 vs. 1.9 days for both obese and non-obese, $p=0.84$). When comparing complication rates to non-obese patients (4.0%), obese (6.9%, $p=0.32$) and morbidly obese (9.1%, $p=0.28$) patients had a higher rate of complications; however, neither was statistically significant. Logistic regression controlling for patient and tumor factors demonstrated no difference in association with complications among non-obese vs. obese ($p=0.34$), or morbidly obese patients ($p=0.92$).

Conclusions: PRA in morbidly obese patients is feasible and offers a comparable perioperative course and postoperative outcomes to non-obese patients at a high-volume center.

◆ **37. Clinical Predictors of Pseudohypoxia Type Pheochromocytomas**
**Jordan J Baechle¹, Paula Marincola Smith², Carlos Ortega³, Tracy S Wang⁴,
Carman C Solorzano², Colleen M Kiernan²**

¹Jordan Baechle, Meharry Medical College, ²Surgery, Vanderbilt University,
³Vanderbilt University, ⁴Surgery, Medical College of Wisconsin

Background: Pheochromocytomas (Pheos) are rare tumors of neural crest origin with divergent transcriptional and metabolic profiles. The pseudohypoxia type (PHT) Pheos are characterized by succinate dehydrogenase (SDH) and Von Hippel-Lindau (VHL) tumor suppressor mutations. Compared to kinase signaling type (KST), PHT Pheos have poor prognosis. Genetic testing for Pheo diagnosis and prognostication is not widely available. The purpose of this study is to investigate clinically accessible parameters predictive of PHT Pheos.

Methods: Patients who underwent genetic testing and resection of Pheos at two academic centers from 2006-2020 were included in this retrospective study. Patients with PHT mutations SDH-AF2, -B, -C, -D, and VHL were compared to KST, and other Pheos. Demographic, clinical, and pathologic characteristics were compared using student's T and ANOVA tests. Operative hemodynamic instability was defined as systolic blood pressure (SBP) >200mmHg, SBP increase of >30% relative to baseline, and/or heart rate (HR) >110bpm. Mann-Whitney U test was used to assess area under the curve (AUC), sensitivity, and specificity. Recursive partitioning was used to model predictive thresholds for PHT Pheos and guide a PHT predictive score.

Results: Of the 79 patients included in the cohort, 17 (22%) had PHT Pheos, 29 (37%) KST, and 33 (41%) neither (no/other mutations). On preoperative evaluation, patients with PHT Pheos more frequently reported weight loss of >10% body weight (18 vs. 2%), had elevated red blood cell count (5.01 vs. 4.43m/mm³), hemoglobin (14.5 vs. 13.4g/dL), and hematocrit (44.0 vs. 40.2%), compared to non-PHT Pheos (all p-values <0.05). PHT Pheos also had lower baseline HR (70.0 vs. 77.5bpm), lower plasma metanephrines (0.10 vs. 0.66nmol/L), and lower rates of operative hemodynamic instability (23.5 vs. 61.3%) (all p-values <0.05). Pheo patients fulfilling ≥2 of the following: preoperative weight loss (>10% body weight), elevated preoperative hematocrit (>50%), normal baseline HR (<100bpm), and normal plasma metanephrines (<0.60nmol/L) were identified as high-risk for PHT Pheos (AUC=0.831, sensitivity=0.882, specificity=0.694).

Conclusions: Indicators of erythropoiesis (hemoglobin, hematocrit, and red blood cell count), plasma metanephrines, and weight loss may be useful preoperative clinical predictors of PHT Pheos and may help guide management and follow-up of Pheos when genetic testing is delayed/unavailable.

◆ 38. Utilization of FNA for Benign and Malignant Neoplasms in the ACS-NSQIP Thyroidectomy Database

Jessica L Dahle¹, Hadiza S Kazaure¹, Frances Wang², Michael T Stang¹, Randall Scheri¹

¹Department of Surgery, Section of Endocrine Surgery, Duke University Medical Center, ²Statistical Center, Duke University Medical Center

Background: Fine needle aspiration (FNA) is an essential tool for thyroid nodule risk stratification and operative planning. Little is known about FNA utilization patterns at the multi-institutional level.

Methods: Using the ACS-NSQIP thyroidectomy database (2016-17), demographic, clinical and operative characteristics of patients who did not undergo an FNA (“no-FNA”) were compared to those who underwent FNA (“FNA”). Multivariate logistic regression was used to identify factors associated with non-utilization of FNA.

Results: Among 6872 patients whose final pathology revealed benign or malignant thyroid neoplasms, 1291 (18.8%) did not undergo a FNA. For this no-FNA group, mean age was 51.3 years and 79.2% were female. The most common indications for surgery were goiter (50.5%) and solitary nodule (35.9%). Approximately 50.3% underwent total thyroidectomy, 42.4% lobectomy and 7.2% a neck dissection. Final pathology revealed papillary thyroid cancer (57%), follicular or Hürthle cell cancer (5%) and 38% were benign neoplasms. Among the 811 no-FNA patients whose final pathology revealed well-differentiated thyroid cancer, 10.4%, 9.5% and 15.0% had T1b, T2 and T3 tumors, respectively. Nodal disease was reported in 3.0%.

When demographic, clinical and operative characteristics of the no-FNA group were compared to those of the FNA group, no-FNA patients were more likely to be female (79.2% vs 76.4%, $p=0.03$), black (13.6% vs 8.6%, $p<0.001$), have a BMI ≥ 30 (48.9% vs 43.9%, $p=0.003$), ASA class ≥ 3 (38.5% vs 31.5%, $p<0.001$) and undergo total thyroidectomy (50.3% vs 37.7%, $p<0.001$). After multivariate adjustment, black vs white race (odds ratio [OR]=1.42, 95% CI 1.17-1.74), ASA class ≥ 3 (OR=1.34, 95% CI 1.16–1.54), total thyroidectomy vs. lobectomy (OR=1.40, 95% CI 1.22-1.60) and prior neck surgery (OR=2.03, 95% CI 1.68-2.47) were independently associated with higher likelihood of no-FNA (all $p<0.001$). Conversely, increased age (per 5-year increase OR=0.96, 95% CI 0.94-0.99) and undergoing neck dissection (OR=0.37, 95% CI 0.29-0.47) were associated with higher likelihood of FNA (all $p\leq 0.001$).

Conclusions: Nearly one in five patients whose final pathology revealed benign or malignant neoplasms did not undergo a preoperative FNA. Non-utilization of FNA was more likely among female, black, obese, high ASA class patients and those undergoing total thyroidectomy.

39. Factors Affecting Surgeon Selection of Operative Approach to Adrenalectomy

Jon A Nelson¹, Jennifer Kuo², Priya Dedhia³, Tracy Wang⁴, Wen Shen⁵, Carmen Solorzano⁶, Colleen Kiernan⁶, Barbra S Miller³

¹Banner - University Medical Center Phoenix, ²Columbia University, ³The Ohio State University, ⁴Medical College of Wisconsin, ⁵University of California San Francisco, ⁶Vanderbilt University

Background: There are multiple operative approaches to adrenalectomy (ADX), each with advantages and disadvantages. Factors influencing a surgeon's decision to select a particular operative approach are not well understood. The purpose of this study was to identify factors influencing how surgeons select an approach to ADX.

Methods: A single-phase mixed methods survey was distributed to AAES and IAES members, the ACS endocrine communities, and via social media. Background questions (15) examined demographics, training, practice volume, and approaches to ADX utilized. Five clinical scenarios varied patient history, pathophysiology, anatomy, and tumor characteristics to identify rationale for a particular approach. Descriptive statistics and results of multinomial regression analyses were generated.

Results: There were 150 respondents from 27 countries. Surgeons had been in practice for a mean of 15.6 ± 10.2 years (range 1-41), utilized a mean of 3.66 ± 1.45 (maximum 7) approaches for ADX, performed a mean of 253.2 ± 308 (range 1-2500) ADXs over their career and 4.7 ± 8.8 ADXs in the past year. Most were in academic practice (76%) and were endocrine surgery fellowship trained (71%). Increased volume was not associated with knowing a greater number of approaches to ADX ($r=0.34$); however, the more approaches known, the greater the variation in approach selected when evaluating patients ($p=0.004$). Surgeon preference vs. patient and tumor factors influenced approach equally (57% vs. 43%, $p=NS$). Patient and tumor factors influencing approach were BMI, adrenal/tumor size, and adrenal pathology, whereas surgeons performing posterior retroperitoneoscopic ADX (PRA) more often considered subcutaneous fat depth, location of adrenal gland relative to the kidney, tumor relationship to renal vasculature, and distance from ribs to pelvis. Type of training, years in practice, country of practice, and practice setting were not associated with any significant difference between choice of approach in clinical scenarios, but younger surgeons were less familiar with certain approaches. A wide variation in type of training to learn new procedures was noted.

Conclusions: Knowledge of a greater number of approaches to ADX allows for greater flexibility depending on the clinical scenario and may be advantageous. Surgeons examine different factors when considering anterior and posterior approaches.

◆ **40. Factors associated with post-operative pancreatic fistula formation in patients with neuroendocrine tumors: a NSQIP analysis**
Elizabeth A Hedges¹, Tahsin M Khan¹, Alexander J Rossi¹, Bruna Babic², Naris Nilubol¹

¹National Cancer Institute, ²Weill Cornell Medicine

Background: Post-operative pancreatic fistula (POPF) remains one of the most common and potentially serious complications following pancreas surgery. However, limited data exists on the factors associated with POPF in patients with neuroendocrine tumors (NETs) specifically. Our aim was to establish factors associated with POPF in patients with NETs using a large, national database.

Methods: The American College of Surgeons National Surgical Quality Improvement Program (ACS NSQIP) database was queried for the years 2014 through 2018 to identify patients undergoing pancreas-directed procedures for neuroendocrine tumors (NETs). Pancreatic fistulas were categorized as no fistula, grade A, or grade B/C. The impact of tumor characteristics (functional status, T, N, M stage) and operative technical variables (type of surgery, pancreatic duct size, pancreatic gland texture, type of pancreatic reconstruction, and vascular reconstruction) on POPF formation was evaluated using descriptive statistics. Outcomes following PPOF (reoperation, overall readmissions, unplanned readmissions) were also evaluated.

Results: Of 22,890 patients undergoing pancreatectomy, 3532 had NETs. Overall POPF rate was significantly higher in patients within the NET group (24.8% (14.8% grade A, and 10.0% grade B/C)) than for the non-NET group (16.4% (9.6% grade A, and 6.8% grade B/C)) ($p < 0.0001$). Compared to the non-NET cohort, NETs had significantly more small ducts < 3 mm (60.1% vs. 30.5%), soft gland texture (72.9% vs. 42.6%), and underwent more distal pancreatectomies (53.5% vs. 20.1%). Within the NET cohort, only operative techniques and high-risk pancreatic features were associated with statistically significant higher rates of POPF on univariate analysis. These included pylorus preserving pancreaticoduodenectomy, pancreatic duct < 3 mm, soft pancreatic gland texture, and pancreaticogastrostomy reconstruction. On multivariate analysis, duct size, gland texture, and type of pancreatic reconstruction remained significant factors contributing to POPF. We found no differences in POPF rates by NET characteristics such as functioning vs. non-functioning, and T, N, and M stages.

Conclusions: POPF is a more common post-operative complication in patients with NET compared to the non-NET group. POPF is dictated primarily by technical and gland factors and not by tumor characteristics.

◆ 41. Vessel-Sealing Devices, Intra-operative Nerve Monitoring, and Drain Utilization and Their Association with Neck Hematoma and Recurrent Laryngeal Nerve Injury: Evaluation of >18,000 NSQIP Patients
Christina Schweitzer¹, Sam M Wiseman¹

¹Surgery, St. Paul's Hospital & University of British Columbia

Background: American Association of Endocrine Surgeons (AAES) thyroidectomy guidelines consider vessel-sealant devices (VSD) as being adjunctive surgical technologies that reduce operative time with safety and efficacy comparable to knot tying. Intra-operative nerve monitoring (IONM) is also considered safe and may assist the surgeon with recurrent laryngeal nerve (RLN) identification. Drains are not recommended as they do not improve outcomes, and may increase postsurgical infection rates, pain, and length of hospital stay. The primary outcome evaluated was rate of VSD, IONM, and surgical drain utilization. The secondary outcomes evaluated were rates of RLN injury and neck hematoma, both of which can lead to airway obstruction and need for re-operation.

Methods: The American College of Surgeons National Surgical Quality Improvement Program (NSQIP) Thyroidectomy database was retrospectively analysed from its introduction in 2016 through 2018. For secondary outcomes, cases were excluded if either adjunct utilization or complications were unknown.

Results: Between 2016 and 2018, 18,078 thyroidectomies were registered in the NSQIP Thyroidectomy database. VSD were used in 63.9% of cases, and IONM in 63.0%. Both VSD and IONM were used in 45.4% of cases. VSD but not IONM was used in 18.1%, and IONM but not VSD in 16.2% of cases. Neither was used in 17.4% of cases. A surgical drain was used in 28.0% of cases.

Neck hematoma occurred in 1.8% of thyroidectomies. When VSD were used the rate of neck hematoma was 1.6% compared to 2.2% without VSD ($p=0.005$). Use of surgical drains was associated with a numerical increase in rates of neck hematoma from 1.8% to 2.0% ($p=0.43$). RLN injury occurred in 6.1% of cases. IONM was associated with a lower rate of RLN injury, at 5.7% vs. 6.8% ($p=0.003$). When VSD was used without IONM, the RLN injury rate was 7.4%, vs. 5.7% when both were used ($p<0.001$).

Conclusions: This real-world data supports the continued uptake of VSD and IONM as adjuncts that reduce rates of hematoma and RLN injury from thyroidectomy. When VSD are used, IONM should also be used to reduce the risk of RLN injury. Drains should not be used in most cases.

◆ 42. Diagnostic Accuracy of Ultrasound in Predicting Extrathyroidal Extension and its Relation to the Body Mass Index in North American Population

Ahmed S Elnahla¹, Deena S Hadedeya¹, Abdallah Attia¹, Mohanad S Youssef, ¹, Bryce Christensen¹, Hossam S Shalaby¹, Eman S Toraih¹, mahmoud S omar¹, Mohamed S Shama¹, Emad S Kandil¹

¹*tulane university*

Background: Extrathyroidal extension (ETE) was proposed as an important parameter in papillary thyroid carcinoma (PTC) that defines strategic plans for active surveillance. Ultrasound is the current preoperative modality for risk stratification. Prior studies are mostly from Asia, where most of the patients are normal weight. We aimed to examine the effect of body mass index (BMI) on the accuracy of ultrasound in detecting ETE in North American patients.

Methods: Two authors blinded to the final surgical pathology reviewed the ultrasonographic images of PTC patients who underwent surgical resections. Multiple sonographic features were evaluated including ETE, capsular abutment, bulging of contour, loss of echogenic capsule, peripheral vascularity.

Results: A total of 204 patients with PTC were included. A 20.58% were normal weight and 79.41% were overweight and obese. Loss of echogenic capsule rendered the best diagnostic performance (OR=4.48, 95%CI=1.86-10.78, $p=0.019$), with 33% sensitivity and 88% specificity ($p<0.001$).

Diagnostic accuracy was higher in normal weight patients compared to overweight/obese using loss of echogenic capsule parameter (OR=9.67, 95%CI=1.42-65.37 vs OR=3.65, 95%CI=1.29-10.29, $p=0.010$) with 66.6% vs 30% sensitivity ($P=0.007$). The area under the curve (AUC) for ETE, represented differential diagnostic accuracy according to the BMI. AUC was significantly higher in normal weight patients 0.71 ± 0.06 , compared to 0.43 ± 0.05 in overweight and obese patients, $p<0.001$.

Conclusions: Ultrasonography is associated with low accuracy in predicting ETE in overweight and obese patients. Herein, for the first time, we are showing the effect of BMI on the accuracy of ultrasonography in predicting ETE, which make it challenging to use as the main method to select North American population for active surveillance.

◆ 43. Challenges and Solutions in Predicting Endocrine Surgical Risk

Vivian Hsiao¹, Dawn M Elfenbein², Susan C Pitt², Kristin L Long², Rebecca S Sippel², David F Schneider²

¹General Surgery, UW Hospitals & Clinics, ²Endocrine Surgery, UW Hospitals & Clinics

Background: The National Surgical Quality Improvement Program (NSQIP) risk calculator often guides preoperative counseling, but challenges abound in prediction of Endocrine Surgical risk. The rarity of complications causes severe class imbalance in predictive models. Patients are often interested in composite risk of complications rather than a specific complication. Finally, individuals may tolerate different thresholds of risk. The purpose of this study is to test an Endocrine Surgical risk prediction tool for composite outcomes that addresses class imbalance and thresholding effects.

Methods: The NSQIP thyroidectomy module years 2016-2018 was used to build a risk calculation tool. We created a composite outcome of endocrine-specific complications (postoperative hypocalcemia, recurrent laryngeal nerve injury, and neck hematoma) and a composite systemic complication outcome of 19 NSQIP variables. We implemented data preprocessing and optimizations to address imbalanced class sizes. We trained and selected from several standard machine learning algorithms for classification. We evaluated the final performance of each classifier using area under the receiver operating characteristic (AUROC).

Results: Of 18,078 included patients, 405 (2.24%) patients suffered systemic complications and 1367 (7.56%) endocrine-specific complications. A logistic regression model performed best in predicting systemic complications, with AUROC 0.758 (95% CI: 0.693, 0.807). Preprocessing for class imbalance improved AUROC to 0.788 (CI: 0.728, 0.843). Setting a 5% risk threshold, logistic regression specificity was 23.5%, sensitivity 84.7%, positive predictive value (PPV) 2.2%, and negative predictive value (NPV) 98.7%. At the 15% threshold, specificity improved to 34.5%, sensitivity 83.3%, PPV 2.5% and NPV 99.0%.

Decision trees performed best in predicting endocrine-specific complications. The class imbalance optimization improved AUROC from 0.716 (CI: 0.682, 0.749) to 0.767 (CI: 0.740, 0.790). At a 5% risk threshold for logistic regression, specificity was 23.0%, sensitivity 70.8%, PPV 6.7% and NPV 91.0%. At a 15% threshold, specificity was 36.8%, sensitivity 69.2%, PPV 7.8% and NPV 93.9%.

Conclusions: Systemic and endocrine complications are rare in the NSQIP thyroidectomy module even when considered as composite outcomes. Though predictions improved with strategies to address class imbalance, class imbalance remains a pitfall in creating meaningful risk calculators because predictions favor more common outcomes. Therefore, risk calculators should be used judiciously when counseling endocrine surgery patients.

◆ 44. Variation Of Serum Albumin Levels After Total Thyroidectomy: How significant is this variation for postoperative calcium management?

Matthew Bridges¹, Mahsa Javid¹, Malek Mushref², Denise Carneiro-Pla¹
¹*Surgery, Medical University of South Carolina,* ²*Endocrinology, Medical University of South Carolina*

Background: Calcium management following total thyroidectomy varies based on surgeon preference. Empirical postoperative administration of oral calcium supplementation is standard protocol for some, while others await postoperative day (POD) 1 calcium levels to decide on replacement. Serum total calcium rather than corrected calcium is often used postoperatively, as it is assumed that albumin levels will not vary following a short period of fasting before a surgical procedure in well-nourished patients. However, small variations in serum albumin levels can change the management of patients prone to hypocalcemia, such as following total thyroidectomy. We hypothesized that albumin levels do vary and should be considered in order to avoid injudicious calcium replacement in this group of patients.

Methods: Charts of 656 consecutive patients who underwent total thyroidectomy over eight years (2012-2019) at an academic institution were reviewed. Four-hundred-and-seventeen patients had preoperative and POD1 serum total calcium and albumin levels. Total serum calcium was then corrected for low albumin levels using the formula: serum calcium(mg/dL)+0.8x(4-plasma albumin(g/dL)). Albumin and calcium levels were considered low if <3.5g/dL and <8.4mg/dL (NR 8.4-10.2), respectively. Variation of biochemical levels were analyzed using Wilcoxon signed-rank tests, with p-value<0.05 considered significant. All patients received postoperative oral calcium supplementation starting on POD0.

Results: From the 417 patients studied, 48 had low albumin levels preoperatively. Of those with normal preoperative albumin (369), POD1 albumin levels were low in 270 patients (73%, range 2.5-3.4g/dL). The preoperative to postoperative variation in levels of albumin was significant, p<0.0001, with median decline of 0.6g/dL. POD1 calcium levels varied significantly when corrected for albumin, with a median increase of 0.56mg/dL, p<0.0001. POD1 total serum calcium was below normal in 69 (17%) patients; however, when corrected using POD1 albumin, only 11(3%) patients had low calcium levels, (p=0.0389, Mann-Whitney U). Postoperative total calcium levels were <8mg/dL in 31 patients, however corrected calcium was <8mg/dL in only one patient.

Conclusions: Serum albumin levels often decline on POD1 even in well-nourished patients. This may significantly impact management of patients prone to hypocalcemia such as following total thyroidectomy. Albumin levels should be measured in all patients postoperatively when serum calcium levels are utilized to determine calcium replacement.

◆ 45. Does parathyroid hormone venous sampling combined with 4DCT improve cure rates in re-operative parathyroidectomy?

Kelvin Memeh¹, Jelani Williams¹, Lee Stratton¹, Edwin Kaplan¹, Xavier Keutgen¹, Gregory Christoforidis², Peter Angelos¹

¹Section of Endocrine Surgery, Department of Surgery, The University of Chicago Medicine, ²Section of Neuroradiology, Department of Radiology, The University of Chicago Medicine

Background: Patients undergoing re-operative parathyroidectomy (RP) present unique diagnostic and operative challenges, with increased surgical risks and reduced cure rates. Optimizing the pre-operative localization of the parathyroid glands is fundamental to reaching a cure during RP. While 4DCT has improved pre-operative localization overall, its performance in the re-operative setting is variable. In this study we aim to determine if parathormone venous sampling (PVS) combined with 4DCT improves the cure rate during RP.

Methods: We reviewed all RP patients between January 2011 and June 2019 who had 4DCT with PVS after discordant or negative Ultrasound and Sestamibi scan. We compared the diagnostic accuracy of 4DCT alone vs. 4DCT with PVS using the intra-operative parathyroid location, intra- and post-operative parathyroid hormone (PTH) levels and final pathology results as the gold standard. Cure was defined as normocalcemia for at 4 - 6 months after RP. The added value of PVS to 4DCT was estimated as the difference in cure-related accuracy, using the McNemar's test.

Results: 99 patients underwent 4DCT with PVS, out of which 72 underwent RP for persistent (n = 35), or recurrent (n = 25) hyperparathyroidism and for previous thyroid surgery (n = 12). 46 were females, and the median age, pre-operative PTH and calcium levels were 62(51.5 – 71 years), 111.5 (IQR 84.5 -160.5 pg/ml), and 10.8 (IQR 10.3 – 11.35 mg/dl), respectively. 16 patients had mediastinal gland, while 6 patients had multigland disease. Final pathology was hypercellular (n = 58), adenomatous (n = 5), or cancerous (n = 4) parathyroid. The abnormal parathyroid gland was removed in 65 patients but was not found in seven patients. Cure was achieved in 58 (80.6%) patients; 44 patients were accurately lateralized by 4DCT alone compared to 55 patients by 4DCT with PVS. There was a statistically significant improvement in the sensitivity [94% vs 75.9% ($P = 0.0045$)] and accuracy [86.2% vs 69.2 ($P = 0.0192$)] of 4DCT in detecting the abnormal parathyroid gland when combined with PVS. There were no PVS-related complications.

Conclusions: Adding PVS to 4DCT significantly improves the localization of diseased parathyroid glands and improves cure rates in patients undergoing re-operative parathyroidectomy.

46. Radiographic behavior of adrenal incidentaloma in extra-adrenal malignancy

Yufei Chen¹, Monica Jain¹, Sunny Trivedi¹, Rushil Rawal¹, Daniel Shouhed¹, Anat Ben-Shlomo¹, Ashley Wachsmann¹, Edward Phillips¹

¹*Cedars-Sinai Medical Center*

Background: Adrenal incidentalomas are being found with increasing frequency, with growth rates ranging from 7-27.8%. One population subject to increased imaging are patients being surveilled for malignancy. The natural behavior of adrenal incidentalomas in patients with extra-adrenal primary malignancy is not well described.

Methods: A retrospective review of all patients who had an adrenal mass identified on two or more cross-sectional imaging scans were identified through keyword search of a radiology database. Patients who had imaging performed for extra-adrenal malignancy who had radiographic follow-up of >6months were included. Growth or decrease in size of an adrenal mass was defined as change of ≥ 5 mm on sequential scans.

Results: 183 patients who underwent 1832 scans (median=8) were identified. There were 92 females (50.3%) with mean age at first scan of 66.5 years and median follow-up of 55.2months. The most common imaging modality was computed tomography (82.3%), followed by magnetic resonance imaging (10.3%). The most common malignancy indication was lung cancer (26.8%), breast cancer (19.1%), prostate cancer (6.6%), renal cell cancer (6.6%), colorectal cancer (6.0%) and pancreatic cancer (6.0%).

Adrenal nodules were unilateral in 139 patients (76.0%). Overall, adrenal nodules remained stable in 78 patients (42.6%). Adrenal nodules grew in 58 patients (31.7%), decreased in size in 17 patients (9.3%) and both increased and decreased in size in 30 patients (16.4%). There was no significant difference in growth of adrenal nodules between the most common malignancy types ($p=0.271$).

The initial scan described the adrenal nodule as benign in 79 patients (43.2%), indeterminate in 31 (16.9%) and concerning for metastasis in 24 (13.1%). Patients with an initial scan concerning for malignancy had a lower chance of stable disease (16.7%) compared with those described as benign (54.4%) or indeterminate (41.9%), ($p=0.005$). Six patients (3.3%) underwent minimally-invasive adrenalectomy during the follow-up period, with pathology showing metastatic lung cancer in 3, metastatic breast cancer in 2 and mass-forming hematopoiesis process in one patient.

Conclusions: Adrenal tumors are not uncommon findings in patients undergoing surveillance for extra-adrenal malignancy. Fewer than half of patients with adrenal incidentalomas show stability of their adrenal lesion on follow-up, but only 3.3% ultimately underwent surgical adrenalectomy.

IN MEMORIAM

Michele Mims, RN



Michele Mims was born on January 25, 1954 in Nashville, Tennessee to Helen (Lewis) and Cato Lee and on August 3, 2020 Michele returned to her Light Star; to the Source from which she came. Michele attended the Highland Park Church. She graduated from North High School and attended Tennessee State University in Nursing. Michele started her professional career at St. Thomas Hospital and in 1986 joined the

Nashville Surgery Center. In 2001 she went to Vanderbilt University Medical Center as an Endocrine Registered Nurse. She was a board member of the Endocrine Nurse Society where she served as the Program Chair. Michele retired from Vanderbilt University Medical Center.

Michele enjoyed photography and joined The Nashville Photography Group and received numerous honorable mentions. Michele was active in the Women of Focus Book Club. She was an active member of the Red Hat Society and was bestowed the title “Queen Mizzie Me”. Michele was an active member of the NAACP.

Livingston Wong, MD



On Sunday, October 25, 2020, we lost Dr. Livingston Wong, a truly iconic figure in the medical community of Hawai`i. Dr. Wong obtained his undergraduate education at the University of Hawai`i at Manoa and his M.D. degree from Oregon Health Sciences School of Medicine. He completed his surgery training at the prestigious Massachusetts General Hospital in 1965 and returned home

to Hawai`i as a Clinical Instructor in the Department of Surgery of the John A. Burns School of Medicine in 1966. He rose through the academic ranks to become Professor of Surgery and served as Vice Chair from 1991 – 2004, Acting Chair from 1997-1998, and Interim Chair from 2000 – 2001.

Dr. Wong was the founder of Surgical Associates, Inc., and a pioneer in kidney and bone marrow transplants in Hawai`i. He was a premier general and transplant surgeon in Hawai`i and was widely respected for his surgical skills, sound judgement, wisdom, and humility. Dr. Wong was a surgeon's surgeon providing mentorship, advice, and support to many of the surgeons in our community. He was a true surgeon-scientist and understood the importance of scientific investigation and inquiry. Most of all, he loved what he did!

Dr. Wong was the recipient of numerous awards including the A.H. Robins Outstanding Physician of the Year Award in 1978, Ten Who Made a Difference in Hawai`i (awarded by the Honolulu Star-Bulletin) in 1990, the University of Hawai`i Alumni Association Distinguished Alumni Award in 1998, and the Maryknoll School Distinguished Alumni Award in 1999. He was a member of the prestigious Alpha Omega Alpha medical honor society and served as the President of the Pacific Coast Surgical Association from 2003 – 2004.



SAVE THE DATE

42nd ANNUAL MEETING

May 22-24, 2022

Local Arrangements Chair

Vikram D. Krishnamurthy, MD

Program Chair

Peter Mazzaglia, MD

A silhouette of a city skyline is shown at the bottom of the page. It includes various buildings, a bridge, and a tall tower on the right side.

Cleveland

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201 EAST MAIN ST., SUITE 1405, LEXINGTON, KY 40507

T: 859-402-9810 | F: 859-514-9166

E: INFO@ENDOCRINESURGERY.ORG

WWW.ENDOCRINESURGERY.ORG