



42nd ANNUAL MEETING

May 22-24, 2022

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**42ND Annual Meeting
MAY, 22-24, 2022**

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2017-2018	Martha Zeiger	Carmen Solorzano	Rebecca S. Sippel	Paul Gauger	Sareh Parangi
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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	

Year	President	Vice President	Secretary	Recorder
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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
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1994-1995	John M. Monchik	Jon A. van Heerden	Jay K. Harness	George L. Irvin, III
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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
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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 Beahrs	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.



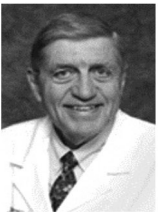
Edwin L. Kaplan, MD

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.



Janice Pasioka, MD

University of Calgary
Awarded virtually in April 2021
Dr. Pasioka served as our Secretary-Treasurer from 2003-2006 and President from 2009-2010.

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 PODIUM & POSTER COMPETITION WINNERS

The AAES Resident/Fellow Podium Competition was established in 1990 to encourage interest in endocrine surgery by those training as students and residents or fellows in general surgery. Presented work may be honored in either the Clinical or Basic Research categories. The AAES Poster Competition was established in 2007. The past three years of competition winners are shown below. For a complete list of past winners, visit www.endocrinesurgery.org/competition-awards

2021

Bixiao Zhao, MD - Brigham and Women's Hospital

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

Omair Shariq, MD - Mayo Clinic/University of Oxford

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

POSTER: Nasim Babazadeh, MD - Cleveland Clinic

"The Impact of Thyroid Nodule Affirmation Expression Atlas Results on Clinical Decision-Making"

POSTER: Ujas Shah, MD - University of Pittsburgh Medical Center

"How and When Multiglandular Disease Diagnosed in Sporadic Primary Hyperparathyroidism?"

2020

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

2019

Ton Wang – University of Michigan

"A novel heat shock protein 90 inhibitor potentially 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"

2021-2022 NEW MEMBERS

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Neeta Erinjeri, MD
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Priya Harakh Dedhia, MD
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John McAuliffe, MD
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Pavel Nockel, MD
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Contributions to the AAES Foundation help enrich and extend the horizons of endocrine surgery. Your gift helps support activities related to education and research of endocrine surgical diseases. The AAES Foundation recognizes cumulative lifetime contributions beginning at the Friend level. Donors who have either pledged to donate or have donated \$10,000 to the AAES Foundation will be deemed Norman Thompson Fellows. As of February 1, 2021, the following individuals and organizations have made contributions to the AAES Foundation.

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PAST MEETINGS

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Local Arrangements Chair:
Norman W. Thompson | 1993 | Williamsburg, Virginia
Local Arrangements Chair:
H. Heber Newsome |
| 1981 | Washington, DC
Local Arrangements Chair:
Glenn Geelhoed | 1994 | Detroit, Michigan
Local Arrangements Chair:
Gary B. Talpos |
| 1982 | Houston, Texas
Local Arrangements Chair:
Robert C. Hickey | 1995 | Philadelphia, Pennsylvania
Local Arrangements Chair:
John Kukora |
| 1983 | San Francisco, California
Local Arrangements Chair:
Orlo Clark | 1996 | Napa, California
Local Arrangements Chair:
Quan-Yang Duh |
| 1984 | Kansas City, Kansas
Local Arrangements Chair:
Stanley R. Friesen | 1997 | Baltimore, Maryland
Local Arrangements Chair:
Robert Udelsman |
| 1985 | Toronto, Ontario, Canada
Local Arrangements Chair:
Irving Rosen | 1998 | Orlando, Florida
Local Arrangements Chair:
Peter J. Fabri |
| 1986 | Rochester, Minnesota
Local Arrangements Chair:
Jon A. van Heerden | 1999 | New Haven, Connecticut
Local Arrangements Chair:
Barbara Kinder |
| 1987 | Chicago, Illinois
Local Arrangements Chair:
Edwin L. Kaplan | 2000 | Joint Meeting: London,
United Kingdom/Lille,
France
Local Arrangements Chair:
Jack Monchik |
| 1988 | Boston, Massachusetts
Local Arrangements Chair:
Blake Cady | 2001 | Atlanta, Georgia
Local Arrangements Chair:
Collin Weber |
| 1989 | Chapel Hill, North Carolina
Local Arrangements Chair:
Robert D. Croom | 2002 | Banff, Alberta, Canada
Local Arrangements Chair:
Janice L. Pasioka |
| 1990 | Cleveland, Ohio
Local Arrangements Chair:
Caldwell B. Esselstyn | 2003 | San Diego, California
Local Arrangements Chairs:
Jay K. Harness & John
Kukora |
| 1991 | San Jose, California
Local Arrangements Chair:
Maria Allo | 2004 | Charlottesville, Virginia
Local Arrangements Chair:
John B. Hanks |
| 1992 | Miami, Florida
Local Arrangements Chair:
George L. Irvin, III | | |

- | | | | |
|------|--|------|--|
| 2005 | Cancun, Mexico
Local Arrangements Chair:
Miguel F. Herrera | 2014 | Boston, Massachusetts
Local Arrangements Chair:
Richard A. Hodin |
| 2006 | New York, New York
Local Arrangements Chair:
Ashok R. Shaha | 2015 | Nashville, Tennessee
Local Arrangements Chair:
Carmen Solorzano |
| 2007 | Tucson, Arizona
Local Arrangements Chair:
Michael J. Demeure | 2016 | Baltimore, Maryland
Local Arrangements Chair:
John A. Olson, Jr. |
| 2008 | Monterey, California
Local Arrangements Chair:
Quan-Yang Duh | 2017 | Orlando, Florida
Local Arrangements Chair:
Mira Milas |
| 2009 | Madison, Wisconsin
Local Arrangements Chair:
Herbert Chen | 2018 | Durham, North Carolina
Local Arrangements Co-
Chairs: Sanziana Roman,
Julie Ann Sosa |
| 2010 | Pittsburgh, Pennsylvania
Local Arrangements Chair:
Sally E. Carty | 2019 | Los Angeles, California
Local Arrangements Chair:
Michael Yeh |
| 2011 | Houston, Texas
Local Arrangements Chair:
Nancy D. Perrier | 2020 | Canceled due to COVID-19
pandemic |
| 2012 | Iowa City, Iowa
Local Arrangements Chair:
Ronald Weigel | 2021 | Virtual
Program Chair:
Carrie Cunningham Lubitz |
| 2013 | Chicago, Illinois
Local Arrangements Chair:
Peter Angelos | | |

SPECIAL SESSIONS

Attendees are welcome to attend any sessions unless specifically stated.

THYROID CANCER PATIENT ADVOCACY SESSION

in Partnership with ThyCa

Sunday, May 22, 2022, 12:15 PM – 1:45 PM

This session will bring together Endocrine Surgeons who specialize in the care of thyroid cancer patients with patients and families to share knowledge and experiences. A panel of experts will discuss “What you should know” when facing a diagnosis of thyroid cancer, and will welcome questions and comments from participants.

CESQIP UPDATE

Monday, May 23, 2022, 7:00 AM – 8:00 AM

During this CESQIP session, we will hear a research talk using CESQIP data, updates on new tools and resources the committee is rolling out, and allow time for feedback and discussion.

PRESIDENTIAL PLENARY: EMERGING TECHNOLOGIES IN ENDOCRINE SURGERY

Monday, May 23, 2022, 11:00 AM – 12:00 PM

This session will be led by current AAES President Thomas J. Fahey, III, and past President Allan Siperstein, and will discuss the emerging technologies of radio frequency ablation and autofluorescence.

CHALLENGING ENDOCRINE SURGERY CASES - THE BENEFITS OF A MULTI-DISCIPLINARY APPROACH

Monday, May 23, 2022, 12:30 PM – 1:45 PM

This session will discuss several challenging cases with a panel discussion and audience participation.

TRACKING OUR PROGRESS: MEASURABLE OUTCOMES OF DIVERSITY, EQUITY, AND INCLUSION INITIATIVES

Tuesday, May 24, 2022, 7:00 AM – 8:00 AM

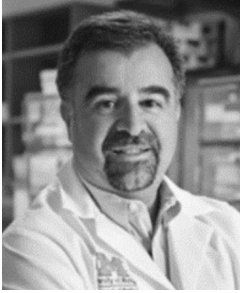
This session will present and discuss AAES demographic data that has been collected from AAES platforms and you'll hear several brief presentations.

AAES GUIDELINES – WHERE WE ARE AND FUTURE DISCUSSIONS

Tuesday, May 24, 2022, 12:15 PM – 1:15 PM

This session will review the current process for how AAES guidelines are initiated, reviewed, and updated. Panelists will also discuss highlights from the most recent guidelines for management of Secondary/Tertiary Hyperparathyroidism and Adrenalectomy.

UCSF CAROL & ORLO H. CLARK DISTINGUISHED LECTURE



Thomas J. Giordano, MD, Ph.D.,
University of Michigan

Sunday, May 22, 2022, 11:15 AM – 12:00 PM ET

Thomas Giordano, M.D., Ph.D. Dr. Giordano received his B.A. from Johns Hopkins University in 1983 and earned his M.D. and Ph.D. through a combined program at Rutgers University and UMDNJ - Robert Wood Johnson Medical School. His graduate studies in the department of Microbiology involved regulation of gene expression by phage T3 and T7 RNA polymerases. He completed residency training in Anatomic Pathology at the National Cancer Institute and fellowship training in Oncologic Pathology at Memorial Sloan-Kettering Cancer Center. After AP training, he joined the faculty of the Department of Pathology at the University of Michigan Medical School as Assistant Professor, was promoted to Associate Professor in 2001, and Professor in 2008. He also holds a joint appointment in the Metabolism and Endocrinology Division of the Department of Internal Medicine.

Dr. Giordano has interests in the molecular biology of endocrine neoplasia and maintains an active translational research program using contemporary molecular and genomic profiling techniques to address problems in endocrine and other types of oncologic pathology. He is Director of the Tissue and Molecular Core of the Michigan Comprehensive Cancer Center, Director of the Molecular Pathology Research Laboratory in the UM Department of Pathology, a former member of AP Test Committee for the American Board of Pathology, and past President of the Endocrine Pathology Society. Recently, he has become very involved in The Cancer Genome Atlas (TCGA) program of the NCI and NHGRI, where he serves as co-Chair of the Thyroid and Adrenocortical projects, member of the Pheochromocytoma Analysis Working Group, and member of the Steering Committee for their final Pan-Cancer project.

Dr. Giordano is board-certified in Anatomic Pathology.

UCSF CAROL & ORLO CLARK LECTURESHIP AT RECENT MEETINGS

- 2021 **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
- 2019 **Selwyn M. Vickers, MD, FACS**, University of Alabama School of Medicine
Relationships and Resilience: Lessons Learned from Mentors and Heroes
- 2018 **Julie Freischlag, MD FRCS**, Wake Forest University
Breakthrough to Brave
- 2017 **Jack A. Gilbert, PhD**, University of Chicago
Thyroid Cancer and the Microbiome
- 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
- 2015 **Gary Hammer, MD, PhD**, University of Michigan
Translating Adrenal Stem Cells: Implications for Adrenal Disease
- 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?
- 2013 **Anders O.J. Bergenfelz, MD, PhD**, Lund University Hospital
Quality Control in Clinical Practice and Postgraduate Education in Endocrine Surgery
- 2012 **Atul A. Gawande, MD, MPH**, Brigham and Women's Hospital
Strategies for Improving Surgical Performance
- 2011 **Allan H. (Bud) Selig**, 9th Commissioner of Major League Baseball
Major League Baseball – 2011 Economic and Health Related Issues
- 2010 **Alexander J.B. McEwan, MB**, University of Alberta
The State of the Art of Radionuclide Imaging and Therapy in Patients with Neuroendocrine Tumors
- 2009 **Jeffrey M. Trent, PhD**, Translation Genomics Research Institute
Genomics, and Biology Towards a More Personalized Medicine
- 2008 **F. John Service, MD, PhD**, Mayo Clinic
Hypoglycemia in Adults – 80th Anniversary of Hyperinsulinism
- 2007 **Virginia A. Livolsi, MD**, University of Pennsylvania
Thyroid Nodule FNA and Frozen Section: Partners or Adversaries

- 2006 **Michael Bliss, PhD**, University of Toronto
Harvey Cushing and Endo- Criminology
- 2005 **David Duick, MD**, Phoenix, Arizona
Thyroid Nodules and Mild Primary Hyperparathyroidism: Examples of Clinical Perplexities or Unresolvable Conundrums
- 2004 **Edward R. Laws Jr, MD**, University of Virginia
The Diagnosis and Management of Cushing's Disease
- 2003 **Sissy M. Jhiang, MD**, The Ohio State University
Lessons From Thyroid Cancer: Genetics and Gene Therapy
- 2002 **William F. Young Jr., MD**, Mayo Clinic
Adrenal-Dependent Hypertension: Diagnostic Testing Insights
- 2001 **Andrew F. Stewart, MD**, University of Pittsburg
Parathyroid Hormone-Related Protein: From Hypercalcemia of Malignancy to Gene Therapy from Diabetes
- 2000 **James Shapiro, MD**, University of Alberta
Pancreatic Islet Cell Transplantation
- 1999 **James Hurley, MD**, Cornell University
Post-Operative Management of Differentiated Thyroid Cancer
- 1998 **Susan Leeman, PhD**, Boston University
The NeuroPeptides: Substance P and Neurotensin
- 1997 **Bertil Hamberger, MD, PhD**, Karolinska Institute
The Nobel Prize
- 1996 **Victor E. Gould, MD**, Rush-Presbyterian-Medical Center
The Diffuse Neuroendocrine System: Evolution of the Concept and Impact on Surgery
- 1995 **Ivor M.D. Jackson, MD**, Providence, Rhode Island
Regulation of TSH Secretion: Implications for Disorders of the Thyroid Function
- 1994 **Gordon J. Strewler, MD**, San Francisco, California
The Parathyroid Hormone Related Protein: Clinical and Basic Studies of a Polyfunctional Protein
- 1993 **John L. Doppman, MD**, National Institutes of Health
Recent Advances in Endocrinologic Imaging
- 1992 **Donald Coffey, PhD**, Bethesda, Maryland
New Concepts Concerning Cancer
- 1991 **Gregory B. Bulkley, MD**, Johns Hopkins University
Endothelial Xanthine Oxidase: A Radical Transducer of Signals and Injury

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



Christopher McHenry, MD
MetroHealth

Monday, May 23, 2022, 3:15 PM – 4:00 PM ET

Dr. McHenry is a Professor of Surgery at Case Western Reserve University School of Medicine, Vice Chairman of the Department of Surgery and Director of the Division of General Surgery at MetroHealth Medical Center in Cleveland, Ohio. He is a Senior Director of the American Board of Surgery and past Chair of the Surgical Oncology Board. He is a past Vice Chairman of Advisory Council of General Surgery, past Chair of the Communication Pillar for the Advisory Councils and a past Governor for the American College of Surgeons. He was the 26th president of the American Association of Endocrine Surgeons serving from 2006-2007. He is also a past president of the Central Surgical Association, the Midwest Surgical Association and the Ohio Chapter of the American College of Surgeons. He serves on the Editorial Board for Surgery, the American Journal of Surgery, the American Surgeon and the International Journal of Endocrine Oncology.

Dr. McHenry is previous recipient of the Kaiser-Permanente Award for Excellence in teaching of medical students at Case Western Reserve University School of Medicine and the Department of Surgery Faculty Teaching Award given to a single faculty member yearly to recognize exceptional teaching of residents. He has published 165 papers in peer reviewed journals and 60 book chapters, and given over 175 invited presentations, most of which have dealt with topics in endocrine oncology and endocrine surgery.

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

- 2021 **Clifford Ko, MD, MS, MSHS, FACS, FASCRS**, American College of Surgeons
Evaluating and Achieving Surgical Quality in 2021
- 2019 **James McClintock, MD**, University of Alabama at Birmingham
From Penguins to Plankton - the Dramatic Impacts of Climate Change on the Antarctic Peninsula
- 2018 **John L. Cameron, MD**, John Hopkins Hospital
William Stewart Halsted; Our Surgical Heritage (Also an Endocrine Surgeon!)
- 2017 **David L. Nahrwold, MD**, Northwestern University
Surgery, Surgeons and their College
- 2016 **Samuel A. Wells, Jr., MD**, National Cancer Institute
The Diagnosis and Treatment of Thyroid Cancer: A Historical Perspective
- 2015 **Robert Beazley, MD**, Boston University School of Medicine
The Glands of Owen...Who Was Owen?
- 2014 **Patricia J. Numann, MD**, SUNY Upstate Medical University
Ode to an Indian Rhinoceros
- 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
- 2012 **Murray F. Brennan, MD**, Memorial Sloan-Kettering Cancer Center
Re-Operative Parathyroid Surgery Circa 1975
- 2011 **Jon A. van Heerden, MD**, Medical University of South Carolina
Pheochromocytoma Resection: Now and Then
- 2010 **Norman W. Thompson, MD**, University of Michigan
The Time Was Right
- 2009 **Edwin L. Kaplan, MD**, University of Chicago
Radiation Induced Thyroid Cancer – A Chicago Experience



ANNUAL MEETING INFORMATION

ACCREDITATION

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 accreditation requirements and policies of the Accreditation Council for Continuing Medical Education (ACCME) through the joint providership of American College of Surgeons and 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 meeting, live internet stream, and enduring) for a maximum of **19.25 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 **9.25** credits meet the requirements for Self-Assessment.



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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 Meeting 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
Presidential Address	1.00	
CESQIP Update	1.00	
Scientific Session III (Papers 9-13)	1.25	1.25
Scientific Session IV (Papers 14-18)	1.25	1.25
Presidential Plenary: Emerging Technologies in Endocrine Surgery	1.00	
Challenging Endocrine Surgery Cases - the benefits of a multi-disciplinary approach	1.25	
Scientific Session V (Papers 19-22 with DM)	1.25	1.25
Medical College of Wisconsin Stuart D. Wilson, M.D. Historical Lecture	0.75	
Scientific Session VI (Papers 23-26)	1.00	1.00
Tracking our Progress: Measurable Outcomes of DEI Initiatives	1.00	
Scientific Session VII (Papers 27-30, with DM)	1.25	1.25
Interesting Cases	1.50	
AAES Guidelines - Where We Are and Future Directions	1.00	
Scientific Session VIII (Papers 31-34)	1.00	1.00
	19.25	9.25

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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: 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.

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Toni Beninato	X			
Jordan Broekhuis	X			
Michael Campbell	X			
Denise Carneiro-Pla	X			
Carrie Cunningham Lubitz	X			
Thomas J. Fahey, III	X			
Abbey Fingeret	X			
Brendan Finnerty	X			
Tammy Holm	X			
Amanda Laird	X			
James Lee	X			
Peter Mazzaglia	X			
Adrienne Melck	X			
Kepal Patel	X			
Randell Scheri	X			
Thomas Wang	X			
Anthony Yang	X			

SPEAKERS/ MODERATORS/ DISCUSSANTS	NOTHING TO DISCLOSE	DISCLOSURE		
		COMPANY	ROLE	RECEIVED
Eren Berber		1. Ethicon 2. Medtronic	1. Consultant 2. Consultant	1. Consulting Fees 2. Consulting Fees
Mark Cohen		1. Hylapharm LLC 2. GigXr Inc 3. Pathware Inc 4. Wideawake VR Inc.	1. Owner/Founder 2. Advisory Board 3. Advisory Board 4. Advisory Board	1. Owner equity 2. Research funding 3. Stock 4. Stock
Thomas Giordano		Interpace Diagnostics	Consultant	Consulting Fee
Xavier Keutgen		TherSera Therapeutics	Consultant	Consulting Fees

The following Speakers, Moderators or Discussants have no disclosures:

Valerie Armstrong
Naira Baregamian
Hannah Barranco
Martin Barrio
Marisa Bartz-Kurycki
Tim Beck
Iuliana Bobanga
Melissa Boltz
Taylor Brown
Talia Burneikis
Quinn Capers
Sally Carty
Herb Chen
Alexander Chiu
Jee-Hye Choi
Reagan Collins
Patricia Conroy
Philip Crepeau
Carmela DE CREA
Aaron Delman
Andy Ding
Sophie Dream
Dawn Elfenbein
Brandon Ellsworth
Tyler Fields
Caitlin Finn
Andrew Fleming
Samuel Frey
Nicholas Frisco
Man Him Matrix Fung
Ian Ganly
Sara Ginzberg
Alex Gordon
Robert Grant
Cori Gray
Jacques Greenberg
Libby Grubbs
William Hope
Vivian Hsiao
Shawn Hsu
Yinin Hu
Judy Jin
Electron Kebebew
Lauren Krumeich

Eric Kuo
Jennifer Kuo
Geeta Lal
Brian Hung Hin Lang
Frances Lee
Marshall Lewis
Heather Lillemoe
Kristen Limbach
Eddy Lincango Naranjo
Jason Liu
Marie Luff
Michael Lui
Emily Ma
Alexander Manzella
Gabriele Materazzi
Aarti Mathur
Reid McCallister
Hannah McDonald
Julie McGill
Chris McHenry
Katie McManus
Jessica McMullin
Tyler Metz
Rose Metzger
Edwina Moore
Lilah Morris-Wiseman
Tricia Moo-Young
Fiemu Nwariaku
Rafael Pérez-Soto
Nancy Perrier
Mackenzie Postel
Jessica Preece
Murtaza Qazi
Minerva Angelica Romero Arenas
Kimberly Ramonell
Robert Ramp
Maria Cristina Riascos
Brian Ruhle
Alaa Sada
Samira Sadowski
Sujata Saha
Georgianna Sandilos
Vivek Sant
Bianka Saravana-Bawan

David Schneider
Max Schumm
Hannah Schwartz
Ludovico Sehnem Jr
Carolyn Seib
Omair Shariq
Joyce Shin
Aditya Shirali
Allan Siperstein
Philip Smith
Carmen Solórzano
Taylor St. Amour
Antonia Stephen
Audrey Stevens
Sydney Strup
Cord Sturgeon
John Sun
Leslie Swafford
Thomas Szabo Yamashita
George Taylor
Nicole Tobin
N. Rhea Udyavar
Hunter Underwood
Evandro Vasconcelos
Mandakini Venkatramani
Krishna Vikneson
Heather Wachtel
Rongzhi Wang
Robbie Woods
Kyla Wright
Tal Yalon
Caitlin Yeo
Linwah Yip
Hui Zheng
Polina Zmijewski



AGENDA

AGENDA

FRIDAY, MAY 20, 2022

7:30 am – 4:45 pm	Endocrine Surgery University
6:30 pm – 8:30 pm	ESU Fireside Chat Dinner

SATURDAY, MAY 21, 2022

8:00 am – 11:30 pm	Endocrine Surgery University, continued
8:00 am – 1:00 pm	Thyroid RFA Course (Cleveland Clinic)
8:00 am – 1:00 pm	Golf Tournament
8:00 am – 12:00 pm	Tennis Tournament
2:00 pm – 5:00 pm	AAES Fellows Ultrasound Course (Cleveland Clinic)
2:00 pm – 6:00 pm	AAES Council Meeting
6:30 pm – 8:30 pm	Council Dinner (invite only)
8:30pm – 10:30 pm	Young Surgeon's Social (Butcher & the Brewer)

SUNDAY, MAY 22, 2022

7:30 am – 4:30 pm	Registration Open
8:00 am – 10:00 am	AAES Committee Meetings
8:00 am – 9:00 am	Yoga
8:30 am – 10:00 am	Poster Judging & Walk Around (judges only)
10:00 am – 10:30 am	Exhibits & Poster Viewing
10:30 am – 11:15 am	AAES Opening Session
11:15 am – 12:00 pm	Carol & Orlo H. Clark Distinguished Lecture, Thomas Giordano, MD
12:00 pm – 2:00 pm	Lunch Break (no lunch provided)
12:15 pm – 1:45pm	Thyroid Cancer Patient Advocacy Session, in partnership with ThyCa
2:00 pm – 3:00 pm	Scientific Session I (Papers 1-4)
3:00 pm – 3:15 pm	Break: Exhibits and Poster Viewing
3:15 pm – 4:30 pm	Scientific Session II (Papers 5-8, with Distinguished Moderator)
4:30 pm – 5:30 pm	Presidential Address, Thomas J. Fahey, III, MD
6:30 pm – 8:30pm	President's Reception (Rock & Roll Hall of Fame)

MONDAY, MAY 23, 2022

7:00 am – 5:00 pm	Registration Open
7:00 am – 8:00am	Breakfast
7:00 am – 8:00am	New Member Breakfast (invite only)
7:00 am – 8:00 am	AAES Committee Meetings
7:00 am – 8:00 am	CESQIP Update
8:00 am – 9:15 am	Scientific Session III (Papers 9-13)
9:15 am – 9:30 am	Break: Exhibits and Poster Viewing
9:30 am – 10:45 am	Scientific Session IV (Papers 14-18)
10:45 am – 11:00 am	Break: Exhibits and Poster Viewing
11:00 am – 12:00 pm	Presidential Session: “Emerging Technologies in Endocrine Surgery”
12:00 pm – 2:00 pm	Lunch Break (lunch provided)
12:30 pm – 1:45 pm	Lunch Session: Challenging Endocrine Surgery Cases – the benefits of a multi-disciplinary approach
2:00 pm – 3:15 pm	Scientific Session V (Papers 19-22, with Distinguished Moderator)
3:15 pm – 4:00 pm	MCW Stuart Wilson, M.D. Historical Lecture, Chris McHenry, MD
4:00 pm – 4:15 pm	Break: Exhibits and Poster Viewing
4:15 pm – 5:15 pm	Scientific Session VI (Papers 23-26)
5:15 pm – 6:30 pm	AAES Business Meeting
6:30 pm - 7:30pm	2020 & 2021 Fellow Reception (invite only)
7:30 pm – 10:00 pm	AAES Gala Reception

TUESDAY, MAY 24, 2022

7:00 am – 12:00 pm	Registration Open
7:00 am – 8:00 am	Breakfast
7:00 am – 8:00 am	Tracking our Progress: Measurable Outcomes of DEI Initiatives
8:00 am – 9:15 am	Scientific Session VII (Papers 27-30, with Distinguished Moderator)
9:15 am – 9:45 am	Break: Exhibits and Poster Viewing
9:45 am – 11:15 am	Interesting Cases
11:15 am – 12:00 pm	Awards & Recognition of New Leadership
12:00 pm – 1:30 pm	Lunch Break (lunch provided)
12:15 pm – 1:15 pm	AAES Guidelines - Where We Are and Future Directions
1:30 pm – 2:30 pm	Scientific Session VIII (Papers 31-34)
2:30 pm	Meeting Adjourned



SCIENTIFIC PROGRAM

◆ Denotes Resident/Fellow Research
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 35.

SCIENTIFIC PROGRAM

Sunday, May 22, 2021

10:30 – 11:15 AM **AAES OPENING SESSION**

- Welcome – Thomas J. Fahey, III, MD
- In Memoriam – Thomas J. Fahey, III, MD
- Welcome to Cleveland - Vikram Krishnamurthy, MD
- Introduction of 2021 New Members – Shaghayegh Aliabadi-Wahle, MD
- Introduction of 2020 Paul LoGerfo Award Winner – Benjamin James, MD
 - Samira Sadowski, MD - National Institutes of Health
 - Dawn Eifenbein, MD - University of Wisconsin-Madison
- Introduction to 2020 AAES-ThyCa Award Winner – Benjamin James, MD
 - Taylor Brown, MD, MHS - Washington University

11:15 AM – 12:00 PM **UCSF CAROL & ORLO H. CLARK LECTURERSHIP** Thomas Giordano, MD

12:00 – 2:00 PM **LUNCH BREAK**

2:00 PM – 3:00 PM **SCIENTIFIC SESSION I (PAPERS 1-4)** MODERATORS: Peter Mazzaglia, MD, FACS, Warren Alpert School of Medicine at Brown University and Heather Wachtel, MD, University of Pennsylvania Perelman School of Medicine

◆ **01. Phenoxybenzamine is no longer the standard agent used for alpha blockade prior to adrenalectomy for pheochromocytoma: a national study of 552 patients**

Eric J Kuo¹, Ling Chen¹, Catherine McManus¹, James A Lee¹, Jason D Wright¹, Jennifer H Kuo¹

¹*Columbia University*

◆ **02. Pheochromocytoma Recurrence in Hereditary Disease: Does a Cortical-Sparing Technique Increase Recurrence Rate?**

Aditya S Shirali¹, Uriel Clemente-Gutierrez¹, Bernice L Huang¹, Michael S Lui¹, Yi-Ju Chiang¹, Camilo Jimenez², Sarah B Fisher¹, Paul H Graham¹, Jeffrey E Lee¹, Elizabeth G Grubbs¹, Nancy D Perrier¹

¹*Department of Surgical Oncology, The University of Texas MD Anderson Cancer Center*, ²*Department of Endocrine Neoplasia and Hormonal Disorders, The University of Texas MD Anderson Cancer Center*

◆ **03. Differentiating between adrenocortical carcinoma and lipid-poor cortical adenoma: a novel cross-sectional imaging-based score**

Tal Yalon¹, Mariana Yalon², Dan Assaf³, Karina Lenartowicz¹, Trenton Foster¹, Melanie Lyden¹, Benzon Dy¹, Irina Bancos⁴, Travis McKenzie¹

¹Endocrine surgery, Mayo Clinic, ²Radiology - CT innovation center, Mayo Clinic, ³Sheba Medical Center, ⁴Endocrinology, Mayo Clinic

◆ **04. Multi-genomic analysis of 243 adrenocortical cancer patient tumors identifies a novel microRNA biomarker target (miRNA 335-5p) strongly associated with poor survival.**

Reid S. McCallister¹, Ziad Sabry², Chitra Subramanian¹, Mark S Cohen¹

¹Department of Surgery, University of Michigan, ²Department of Pharmacology, University of Michigan

3:00 PM – 3:15 PM BREAK: EXHIBITS AND POSTER VIEWING

3:15 PM – 4:30 PM SCIENTIFIC SESSION II (PAPERS 5-8, WITH DISTINGUISHED MODERATOR)
MODERATORS: Mark Cohen, MD, University of Illinois, and Julie McGill, MD, Emory University

◆ **05. Disparities in Time to Surgeon Evaluation Among Patients with Primary Hyperparathyroidism**

Jordan M. Broekhuis¹, Natalia Chaves¹, Hao Wei Chen¹, F. Thurston Drake², Benjamin C. James¹

¹Surgery, Beth Israel Deaconess Medical Center, ²Surgery, Boston University School of Medicine

◆ **06. Black Patients Are More Likely to Undergo Parathyroidectomy for Secondary Hyperparathyroidism**

N. Rhea Udyavar¹, JiYoon Ahn², Philip Crepeau¹, Lilah Morris-Wiseman¹, Mara McAdams DeMarco², Dorry Segev¹, Aarti Mathur¹

¹Johns Hopkins, ²Johns Hopkins Bloomberg School of Public Health

◆ **07. Outpatient Endocrine Surgery Practice Patterns are Variable Among U.S. Endocrine Surgery Fellowship Programs**

Shawn Y Hsu¹, Alexa Melucci¹, Yatee Dave¹, Todd Chennell¹, Jessica Fazendin², Insoo Suh³, Jacob Moalem¹

¹Surgery, University of Rochester, ²Surgery, University of Alabama, ³Surgery, NYU Langone

◆ **08. The Use of a Preoperative Educational Time-Out in Endocrine Surgery to Move the Needle in Operative Autonomy**

Heather A Lillemo¹, David N Hanna², Kyla Terhune², Naira Baregamian², Carmen C Solorzano², Sunil K Geevarghese², Colleen M Kiernan²

¹*Surgical Oncology, MD Anderson Cancer Center*, ²*Surgery, Vanderbilt University Medical Center*

4:30 PM – 5:30 PM PRESIDENTIAL ADDRESS

Thomas J. Fahey, III, MD

Monday, May 23, 2022

7:00 AM – 8:00 AM CESQIP UPDATE

MODERATORS: David Schneider, MD – University of Wisconsin, and Yinin Hu, MD - University of Maryland Medical Center

PRESENTERS: Tim Beck, MD, PhD – Cleveland Clinic, Talia Burneikis, MD – Cleveland Clinic, Judy Jin, MD – Cleveland Clinic, Brian Ruhle, MD – University of Chicago, Philip Smith, MD, PhD – University of Virginia, Aarti Mathur, MD - The Johns Hopkins University School of Medicine

8:00 AM – 9:15 AM SCIENTIFIC SESSION III (PAPERS 9-13)

MODERATORS: Antonia Stephen, MD, Massachusetts General Hospital, and Xavier Keutgen, MD, University of Chicago

◆ **09. Automatic Extraction of Incidental Adrenal Nodules from Narrative Radiology Reports in Electronic Health Records: A Validation Study**

Max A Schumm¹, Ming-Yeah Y Hu¹, Vivek Sant¹, Steven S Raman², Run Yu³, Masha J Livhits¹

¹*Surgery, UCLA*, ²*Radiology, UCLA*, ³*Endocrinology, UCLA*

◆ **10. Sleep centers may be a promising setting for improving screening practices for primary aldosteronism**

Kyla Wright¹, Mandana Mahmoudi², Nidhi Agrawal², Hope Simpson², Michael Lui³, H Leon Pachter³, Kepal Patel³, Jason Prescott³, Insoo Suh³

¹*NYU Grossman School of Medicine*, ²*Department of Medicine, NYU Langone Medical Center*, ³*Department of Surgery, NYU Langone Medical Center*

◆ **11. Limited Disease Progression in Endocrine Surgery Patients with Treatment Delays Due to COVID-19**

Reagan A Collins¹, Catherine DiGennaro², Toni Beninato³, Rajshri M Gartland⁴, Natalia Chaves⁵, Jordan M Broekhuis⁶, Lekha Reddy³, Jenna Lee³, Angelina Dreimiller⁷, Maeve M Alterio⁸, Michael J Campbell⁹, Yeon Joo Lee¹⁰, Tyler K Khilnani¹¹, Miguel Valdivia y Alvarado¹², Feibi Zheng¹³, David McAneny¹⁴, Rachel Liou¹⁵, Catherine McManus¹⁵, Sophie Y Dream¹⁶, Tracy S Wang¹⁶, Tina W Yen¹⁶, Brendan M Finnerty¹⁰, Thomas J Fahey III¹⁰, Claire E Graves⁹, Amanda M Laird³, Matthew A Nehs¹⁷, Frederick Thurston Drake¹⁴, James A Lee¹⁵, Christopher R McHenry¹⁸, Benjamin C James⁶, Janice L Pasieka¹⁹, Jennifer H Kuo¹⁵, Carrie C Lubitz²⁰

¹Massachusetts General Hospital, ²Texas Tech University Health Sciences Center School of Medicine, ²Institute for Technology

◆ **12. The Relative Importance of Patient Outcomes to Surgeons' Initial Treatment Recommendations for Low-Risk Thyroid Cancer**

Alexander Chiu¹, Megan Saucke¹, Kyle Bushaw¹, Corrine Voils¹, Justin Sydnor², Megan Haymart³, Susan Pitt⁴

¹Department of Surgery, University of Wisconsin School of Medicine and Public Health, ²Wisconsin School of Business, ³Department of Medicine, University of Michigan School of Medicine, ⁴Department of Surgery, University of Michigan School of Medicine

◆ **13. Baicalein activates AMPK, inhibits the mammalian target of rapamycin, and exhibits antiproliferative effects in pancreatic neuroendocrine tumors in vitro and in vivo**

Kristen Limbach¹, Wei Wen¹, Quanhua Xing¹, Jin Yan¹, John Yim¹

¹City of Hope

9:15 AM – 9:30 AM BREAK: EXHIBITS AND POSTER VIEWING

9:30 AM – 10:45 AM SCIENTIFIC SESSION IV (PAPERS 14-18)
MODERATORS: Rose Metzger, MD, MPH, FACS
- Banner University Medical Center Phoenix, and
Minerva Angelica Romero Arenas, MD, MPH - Weill
Cornell Medicine - NYP Brooklyn Methodist

◆ **14. Novel PET C11 Choline imaging performance for detection of parathyroid disease**

Sujata Saha¹, Ahmad Parvinian¹, Robert A Vierkant¹, Trenton Foster¹, McKenzie Travis¹, Benzon Dy¹, Melanie Lyden¹

¹Mayo Clinic

15. Medullary Thyroid Cancer with RET V804M Mutation: More Indolent Than Expected?

Nicholas A Frisco¹, Alexander H Gunn¹, Samantha M Thomas², Michael T Stang³, Randall P Scheri³, Hadiza S Kazaure³

¹*School of Medicine, Duke University*

16. Indocyanine Green Fluorescence and Autofluorescence May Improve Post- Thyroidectomy Parathyroid Function

Gabriele Materazzi¹, Erica Pieroni¹, Leonardo Rossi¹, Carlo Enrico Ambrosini¹, Malince Chicas Vasquez¹, Paolo Miccoli¹

¹*University Hospital of Pisa*

◆ 17. Hyperparathyroidism at 1-Year Following Kidney Transplantation is Associated with Graft Loss

Philip K Crepeau¹, Xiaomeng Chen², Rhea Udyavar¹, Lilah Morris-Wiseman¹, Dorry L Segev¹, Mara McAdams-Demarco², Aarti Mathur¹

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

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

◆ 18. Effects of parathyroidectomy on kidney function in primary hyperparathyroidism: results of a prospective study

Samuel Frey¹, Matthieu Wargny¹, Claire Blanchard², Cécile Caillard², Samy Hadjadj¹, Bertrand Cariou¹, Lucile Figueres³, Eric Mirallie²

¹*L'institut du Thorax, UNIV NANTES, CNRS, INSERM, CHU de Nantes*

University Hospital of Nantes, ²Oncologic, Digestive and Endocrine Surgery, University Hospital of Nantes, ³Service de Néphrologie-Immunologie

Clinique, CHU de Nantes, University Hospital of Nantes

10:45 AM – 11:00 AM BREAK: EXHIBITS AND POSTER VIEWING

11:00 AM – 12:00 PM PRESIDENTIAL SESSION: “EMERGING TECHNOLOGIES IN ENDOCRINE SURGERY”
MODERATORS: Thomas J. Fahey, III, MD – New York Presbyterian-Weill Cornell Medicine, and Allan Siperstein, MD – Cleveland Clinic

PANELISTS: Carmen Solórzano, MD – Vanderbilt University Medical Center, Eren Berber, MD – Cleveland Clinic, Jennifer Kuo, MD – Columbia University Medical Center, Erivelto Volpi, MD - Oswaldo Cruz German Hospital - Sao Paulo

12:00 PM – 2:00 PM LUNCH BREAK

12:30 PM – 1:45 PM CHALLENGING ENDOCRINE SURGERY CASES - THE BENEFITS OF A MULTI-DISCIPLINARY APPROACH

MODERATOR: Julie McGill – Emory University

PANELISTS: Electron Kebebew, MD – Stanford University, Elizabeth Grubbs, MD – MD Anderson Cancer Center, Jorge Calles, MD – MetroHealth Medical Center

2:00 PM – 3:15 PM SCIENTIFIC SESSION V (PAPERS 19-22, WITH DISTINGUISHED MODERATOR)

MODERATORS: Denise Carniero-Pla, MD, FACS - Medical University of South Carolina, and Carolyn Seib, MD, MAS - Stanford University

♦ 19. Hypercalcemia with a Parathyroid Hormone Level of ≤ 50 pg/mL: Is this Primary Hyperparathyroidism?

Rongzhi Wang¹, Peter Abraham¹, Jessica M Fazendin¹, Brenessa M Lindeman¹, Herbert Chen¹

¹UAB

♦ 20. Optimal intraoperative parathyroid hormone parameters for normohormonal primary hyperparathyroidism

Lauren N Krumeich¹, Caitlin B Finn¹, Douglas L Fraker¹, Rachel R Kelz¹, Heather Wachtel¹

¹University of Pennsylvania

21. Efficacy of the Miami's criteria and Normalization of PTH levels after Parathyroidectomy in patients with Primary Hyperparathyroidism and Impaired Renal Function

Rafael Humberto Pérez-Soto¹, Gabriela Alejandra Buerba¹, Pablo León-Cabral¹, Mauricio Sierra-Salazar¹, Miguel F. Herrera¹, David Velázquez-Fernández¹

¹Surgery, INCMNSZ

♦ 22. Phenotypes of Primary Hyperparathyroidism: Does parathyroidectomy improve clinical outcomes for all?

Valerie L Armstrong¹, Patrick T Hangge¹, Richard J Butterfield¹, Nabil Wasif¹, Chee-Chee Stucky¹, Patricia A Cronin¹

¹Mayo Clinic, AZ

3:15 PM – 4:00 PM MCW STUART WILSON, M.D. HISTORICAL LECTURE

Christopher McHenry, MD

SCIENTIFIC SESSION VI (PAPERS 23-26)

MODERATORS: Geeta Lal, MD, MSc - University of Iowa Carver College of Medicine, and Evandro Vasconcelos, MD - Scientia Médicos Associados

◆ **23. Thyroid hormone replacement following lobectomy: long-term institutional analysis 15 years after surgery**

Hannah M Barranco¹, Kimberly M. Ramonell², Brenessa Lindeman³, Herbert Chen³, Jessica Fazendin³

¹School of Medicine, University of Alabama at Birmingham, ²Surgery, University of Pittsburgh Medical Center, ³Surgery, University of Alabama at Birmingham

◆ **24. Total Thyroidectomy is More Cost-effective Than Radioactive Iodine as an Alternative to Anti-thyroid Medication for Graves' Disease**

Emily Ma¹, Douglas J Turner², Jennifer H Kuo³, Rana Malek⁴, John A Olson², Daniel Mullins⁵, Yinin Hu²

¹University of Maryland School of Medicine, ²Surgery, University of Maryland Baltimore, ³Surgery, Columbia University Medical Center, ⁴Endocrinology, University of Maryland Baltimore, ⁵Pharmaceutical Health Services Research, University of Maryland School of Pharmacy

◆ **25. Simulated Data-Driven Hospital Selection for Surgical Treatment of Differentiated Thyroid Cancer**

Caitlin B Finn¹, Chris Wirtalla², Tory Mascuilli², Lauren N Krumeich², Heather Wachtel², Douglas Fraker², Rachel R Kelz²

¹NewYork-Presbyterian Hospital/Weill Cornell, ²Department of Surgery, University of Pennsylvania

◆ **26. A Comparison of CESQIP and NSQIP in Consistency and Ability to Predict Surgical Outcomes**

Vivian Hsiao¹, Hadiza S Kazaure², Frederick T Drake³, William B Inabnet III⁴, Jennifer E Rosen⁵, Daniel L Davenport⁶, David F Schneider⁷

¹General Surgery, University of Madison - Wisconsin, ²Endocrine Surgery, Duke University Medical Center, ³Endocrine Surgery, Boston University School of Medicine, ⁴General Surgery, University of Kentucky College of Medicine, ⁵Endocrine Surgery, MedStar Washington Hospital Center, ⁶General Surgery, University of Kentucky, ⁷Endocrine Surgery, University of Madison - Wisconsin

Tuesday, May 24, 2022

7:00 AM – 8:00 AM

TRACKING OUR PROGRESS: MEASURABLE OUTCOMES OF DEI INITIATIVES

MODERATOR: Minerva Romero Arenas, MD - Weill Cornell Medicine - NYP Brooklyn Methodist

PANELIST: Quinn Capers, MD - University of Texas Southwestern Medical Center

8:00 AM – 9:15 AM

SCIENTIFIC SESSION VII (PAPERS 27-30, WITH DISTINGUISHED MODERATOR)

MODERATORS: Sally Carty, MD - University of Pittsburgh, and Ian Ganly, MD, PhD - Memorial Sloan Kettering Cancer Center

◆ 27. What do patients want to know about surgery for low-risk thyroid cancer? A qualitative study

Hunter J Underwood¹, Megan C Saucke², Corrine I Voils², Benjamin R Roman³, Susan C Pitt¹

¹University of Michigan, ²University of Wisconsin, ³Memorial Sloan Kettering Cancer Center

◆ 28. The clinical significance of ACR TI-RADS 5 thyroid nodules: Not as risky as we think?

Kyla Wright¹, Tamar Brandler², Jason Fisher³, Gary Rothberger⁴, Babak Givi⁵, Jason Prescott³, Insoo Suh³, Kepal Pate³

¹NYU Grossman School of Medicine, ²Department of Pathology, NYU Langone Medical Center, ³Department of Surgery, NYU Langone Medical Center, ⁴Department of Medicine, NYU Langone Medical Center, ⁵Department of Otolaryngology-Head and Neck Surgery, NYU Langone Medical Center

◆ 29. Surgical Management of T1/T2 Node Negative Papillary Thyroid Cancer with Tall Cell Histology – Is Lobectomy Enough?

Robbie S. R. Woods¹, Conall W. R. Fitzgerald¹, Cristina Valero¹, Joseph Lopez¹, Luc G. T. Morris¹, Marc A. Cohen¹, Richard J. Wong¹, Snehal G. Patel¹, Ronald A. Ghossein², R. Michael Tuttle³, Ashok R. Shaha¹, Jatin P. Shah¹, Ian Ganly¹

¹Department of Head & Neck Surgery, Memorial Sloan Kettering Cancer Center, ²Department of Pathology, Memorial Sloan Kettering Cancer Center, ³Department of Endocrinology, Memorial Sloan Kettering Cancer Center

◆ **30. Association of Thyroid Cancer Molecular Profile with Tumor Phenotype and Cancer-specific Outcomes**

Jason B Liu¹, Sally E Carty¹, Kelly L McCoy¹, Kimberly M Ramonell¹, Esra Karslioglu-French¹, Elena M Morariu¹, N. Paul Ohori¹, Raja R Seethala¹, Marina N Nikiforova¹, Yuri E Nikiforov¹, Linwah Yip¹

¹University of Pittsburgh

9:15 AM – 9:45 AM BREAK: EXHIBITS AND POSTER VIEWING

9:45 AM – 11:15 AM INTERESTING CASES SESSION
MODERATOR: Fiemu Nwariaku, MD - University of Texas Southwestern Medical Center

1. Tick...Tick...Boom!

Nicole Tobin, MD – University of Wisconsin

2. Oscillating from One Extreme to the Other

Janice Pasieka, MD – University of Calgary

3. A Magic Treatment for a Masquerading Mass

Jessica Preece, MD – St Thomas' Hospital

4. Stones, Bones, Groans: Symptoms Caused by an Unknown

Hannah Schwartz – Lewis Katz School of Medicine at Temple University

5. Hypoglycemia- a diagnostic dilemma

John Sun, MD – Oregon Health & Science University

6. Do You Need Your Airway to “Breathe”?

William Hope, MD – Virginia Commonwealth University Hospital

7. When Medication Fails, Surgery Prevails

Leslie Swafford, MD – University of Arizona Phoenix

8. The Needle in the Haystack: searching for an elusive primary tumor

Frances Lee, MD – University of Chicago

12:00 PM – 1:30 PM LUNCH BREAK

12:15 PM – 1:15 PM

AAES GUIDELINES - WHERE WE ARE AND FUTURE DIRECTIONS

MODERATORS: Linwah Yip, MD - University of Pittsburgh, and Edwina Moore, MD - Surgical Health Specialists

PANELISTS: Melissa Boltz, MD - Penn State Hershey Medical Center, Sophie Dream, MD - Medical College of Wisconsin, Herb Chen, MD – University of Alabama at Birmingham (UAB), Lilah Morris-Wiseman, MD - Johns Hopkins University, Nancy Perrier, MD - MD Anderson Cancer Center

1:30 PM – 2:30 PM

SCIENTIFIC SESSION VIII (PAPERS 31-34)

MODERATORS: Cord Sturgeon, MD - Northwestern University, and Tricia Moo-Young, MD - NorthShore University HealthSystems

31. Cost-effectiveness of radiofrequency ablation versus thyroidectomy in the treatment of benign thyroid nodules

Eric J Kuo¹, Aaron Oh², Yinin Hu³, **Catherine McManus**¹, James A Lee¹, Jennifer H Kuo¹

¹Columbia University, ²Albert Einstein College of Medicine, ³University of Maryland

32. Engineering Functional 3-Dimensional Patient-Derived Endocrine Organoids for Broad Multiplatform Applications

Naira Baregamian¹, Konjeti R Sekhar¹, Evan Krystofiak², Maria Vinogradova², Giju Thomas³, Emmanuel Mannoh³, Carmen Solorzano¹, Colleen M Kiernan¹, Anita Mahadevan-Jansen³, Naji Abumrad¹, Michael L Freeman⁴, Vivian Weiss⁵, Jeffrey Rathmell⁵, W Kimryn Rathmell⁶

¹Department of Surgery, Vanderbilt University Medical Center, ²Department of Cell and Developmental Biology, Vanderbilt University, ³Vanderbilt Biophotonics Center, Vanderbilt University, ⁴Department of Radiation Oncology, Vanderbilt University Medical Center, ⁵Department of Pathology, Microbiology, and Immunology, Vanderbilt University Medical Center, ⁶Department of Medicine, Vanderbilt University Medical Center

33. The Impact of TI-RADS on Thyroid Nodule Cytology Rates

Kimberly M Ramonell¹, N. Paul Ohori², Jason B Liu¹, Kelly L McCoy¹, Alessandro Furlan³, Mitchell Tublin³, Sally E Carty¹, Linwah Yip¹

¹Surgery, University of Pittsburgh Medical Center, ²Pathology, University of Pittsburgh Medical Center, ³Radiology, University of Pittsburgh Medical Center

34. A MULTICENTER EVALUATION OF NEAR INFRA-RED AUTOFLUORESCENCE IMAGING OF PARATHYROID GLANDS IN THYROID AND PARATHYROID SURGERY

Ludovico Sehnem jr¹, Seyma Avci¹, Gizem Isiktas¹, Mohammed Elshamy¹, Mark Zafereo², Ralph Tufano³, Gregory Randolph⁴, Electron Kebebew⁵, Mira Milas⁶, Quan-yang Duh⁷, **Eren Berber**¹

¹Endocrine Surgery, Cleveland Clinic, ²Head and Neck Surgery, MD Anderson Cancer Center, ³Head and Neck Surgery, Sarasota Memorial Hospital, ⁴Head and Neck Surgery, Harvard Medical School, ⁵Endocrine Surgery, Stanford Medicine, ⁶Endocrine Surgery, College of Medicine Phoenix, ⁷Endocrine Surgery, University of California San Francisco

2:30 PM

MEETING ADJOURN



ABSTRACTS

◆ Denotes Resident/Fellow Competition Paper
NOTE: Author listed in **BOLD** is the presenting author

◆ **01. Phenoxybenzamine is no longer the standard agent used for alpha blockade prior to adrenalectomy for pheochromocytoma: a national study of 552 patients**

Eric J Kuo¹, Ling Chen¹, Catherine McManus¹, James A Lee¹, Jason D Wright¹, Jennifer H Kuo¹

¹*Columbia University*

Background: Phenoxybenzamine has been the standard agent for alpha blockade prior to adrenalectomy for pheochromocytoma. However, recent studies have not demonstrated clear superiority of a particular strategy to achieve adequate blockade, and access to and costs of medications have changed. We hypothesize these factors have changed the landscape of medications used to achieve blockade prior to resection of pheochromocytoma.

Methods: A retrospective analysis of patients in the IBM MarketScan Database who underwent adrenalectomy for pheochromocytoma from 2008 to 2019 was performed. Prescription claims data were used to categorize patients as having been blocked with phenoxybenzamine (PB), selective alpha blockers (SAB), calcium channel blockers (CCB) and/or beta blockers (BB) without an alpha blocker, or none of the above. Preoperative total and out-of-pocket pharmaceutical costs were calculated.

Results: 552 patients were identified, 58.7% were female. The median age was 49 (IQR 40-57) years. 291 (52.7%) patients were blocked with PB, 114 (20.7%) with SAB, 42 (7.6%) with only CCB and/or BB and 76 (13.8%) with none. 29 (5.3%) patients were prescribed both PB and SAB. The proportion of patients blocked with PB decreased from 71.0% in 2008 to 21.2% in 2019. The proportion of patients blocked with SAB increased from 6.5% in 2008 to 42.4% in 2019. The proportion of patients blocked with only CCB and/or BB increased from 3.2% in 2008 to 18.2% in 2019. The proportion of patients who were not prescribed any blockade was 9.7% in 2008 and 15.2% in 2019. The median preoperative total pharmaceutical cost in the PB group over the study period was \$1,788 (IQR \$920-4193), increasing from \$1,590 (IQR \$889-2544) in 2008 to \$9,640 (IQR \$5,061-16,625) in 2019. In contrast, the median preoperative total pharmaceutical cost in the SAB group was \$280 (IQR \$96-832). The preoperative out-of-pocket cost in the PB group was \$162 (IQR \$79-304) versus \$72 (IQR \$43-181) in the SAB group.

Conclusions: Phenoxybenzamine is no longer the standard agent used for alpha blockade prior to adrenalectomy for pheochromocytoma. SAB, CCB, and BB have been increasingly utilized, likely due to reduced out-of-pocket costs and wider availability compared to phenoxybenzamine.

◆ 02. Pheochromocytoma Recurrence in Hereditary Disease: Does a Cortical-Sparing Technique Increase Recurrence Rate?

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Background: Posterior retroperitoneoscopic adrenalectomy (PRA) is an excellent operation for patients with hereditary pheochromocytoma (HPheo). The approach lends well to those patients requiring cortex preservation. We sought to examine recurrence of pheochromocytoma in patients with HPheo in the era of PRA and evaluate predictors of recurrence.

Methods: Patients with HPheo who underwent initial adrenalectomy for pheochromocytoma at our institution between January 1, 1995 and September 1, 2020 with proven biochemical cure and follow-up >1 year were identified. Recurrence was defined as plasma metanephrines above the upper limit of normal with radiographic evidence of disease in the ipsilateral adrenal bed.

Results: Seventy-eight patients (median age 32.4 years, 60.3% female) with HPheo underwent a total of 114 adrenalectomies for pheochromocytoma. Adrenalectomies were performed in 40 MEN2A patients (51.3%), 10 MEN2B patients (12.8%), 17 VHL patients (21.8%), and 11 NF1 patients (14.1%). Sixty-two (54.4%) and 41 (36.0%) adrenalectomies were performed via cortical-sparing (CS) technique and PRA approach, respectively. During a median follow-up of 80.7 months (IQR 43.4-151.2 months), 12 ipsilateral recurrences (10.5%) were identified with a median time to recurrence of 64.3 months (IQR 38.5-94.2 months). Gender, tumor laterality, tumor multifocality, and size did not impact recurrence ($p>0.05$). There was no statistical difference in recurrence by adrenalectomy technique (14.5% in CS vs. 5.8% in total, $p=0.115$) or surgical approach (9.8% in PRA, 10.5% in open anterior, 12.5% in laparoscopic, $p=0.901$). Recurrence was more common in younger patients (27 vs. 33 years, $p=0.004$) and those with RETM918T germline mutation (23.5% vs. 8.2%, $p=0.05$). Kaplan-Meier survival analysis found no difference in disease-free survival (DFS) when examining surgical technique or approach ($p>0.05$), yet shorter DFS in patients with RET M918T germline mutation compared to those without the mutation ($p=0.013$). On multivariate analysis, only RET M918T germline mutation was independently associated with increased risk of recurrence (HR 4.30, 95% CI 1.26–14.66, $p=0.019$).

Conclusions: Recurrence after adrenalectomy occurred in 1 in 10 patients with HPheo with a median time to recurrence of 5.4 years. Neither the cortical-sparing technique nor retroperitoneoscopic approach independently increase recurrence. In the era of PRA, the RET M918T mutation was independently associated with pheochromocytoma recurrence.

◆ 03. Differentiating between adrenocortical carcinoma and lipid-poor cortical adenoma: a novel cross-sectional imaging-based score

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Background: Discriminating between adrenocortical carcinoma (ACC) and lipid-poor cortical adenoma (LPCA) preoperatively can frequently be difficult as these two entities have overlapping imaging characteristics. Differentiation will allow for selection of the most appropriate operative approach and may help prevent over treatment. We aimed to develop a novel cross-sectional imaging-based score.

Methods: Retrospective analysis of patients with pathologically proven ACC or LPCA that underwent resection in a single tertiary referral center between March 1998 to August 2020. Inclusion criteria were diameter greater than 1 cm, attenuation higher than 10 HU on non-enhanced CT, and conclusive histopathological diagnosis following resection. Patients with metastatic or locally advanced ACC (stages 3-4) were excluded. We developed a score using binary logistic multivariate regression model in five-fold derivation (~70%) cohorts with stepwise backward conditional regression as feature selection. Standardized mean regression weight were used as variable score points. The score was validated using five-fold cross validation on the test cohorts (30%).

Results: We identified 232 adrenals resected across 211 patients. By comparing the imaging characteristics of ACC (n=56) and LPCA (n=176), using multivariate logistic regression model, we revealed statistically significant differences between the two groups in size, unenhanced attenuation, washout, enhancement patterns, heterogeneity, calcification, necrosis, border irregularity, fat infiltration and lymph node prominence. Consistent through five-fold cross validation process, the variables included in the ACC score were: size, attenuation, peripheral septal enhancement pattern, heterogeneous thick peripheral enhancement with central hypodensity, heterogeneity, calcifications, necrosis, fat infiltration and lymph node prominence. The score mean performance were 100% sensitivity for exclusion of ACC, 80% specificity (95% CI 68.3-91.5), 66% PPV (95% CI 52.3 to 78.7), and 100% NPV with AUC of 0.974.

Conclusions: We defined and evaluated a novel nine variable, imaging-based, ACC exclusion score. This score outperformed any single variable and presents a low-risk model that will facilitate preoperative discrimination of ACC and LPCA. This scoring system has preoperative implications and can be utilized along with other clinical data to aid in selection of surgical approach and may help prevent unnecessary surgery in select patients.

◆ **04. Multi-genomic analysis of 243 adrenocortical cancer patient tumors identifies a novel microRNA biomarker target (miRNA 335-5p) strongly associated with poor survival.**

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Background: Adrenocortical carcinoma (ACC) is a rare endocrine cancer with poor overall survival. Genomic profiling studies have identified a large set of differentially expressed genes. However, linking a common target across multiple genomic datasets to survival outcomes as well as lncRNA dysregulation has not been well described. We hypothesize that a multi-genomic database analysis of a regulatory network of lncRNA-miRNA-mRNA associated with survival will identify novel biomarkers involved in the pathogenesis of ACC.

Methods: Genetic sequencing data for 243 human ACCs were accessed using the NCBI Gene Expression Omnibus. The GEO2R program identified the most significantly dysregulated genes or miRNA in ACC patients compared to normal adrenal tissue. R2: Genomics Analysis and Visualization Platform generated Kaplan-Meier curves for dysregulated genes. miRTarBase was used to link genes associated with poor survival and dysregulated miRNA. ENCOR1 identified lncRNA and miRNA associated with survival genes in ACC.

Results: Analysis of genes differentially regulated in 3 or more of the 6 databases showed 9 upregulated and 45 downregulated genes (bonf. $p < 0.01$) across the datasets. David functional annotation revealed cell cycle, P53 signaling, arachidonic acid and selenocompound metabolism pathways are altered in ACC. Survival analysis of the differentially expressed genes indicated that upregulation of 8 genes and down regulation of 23 genes are significantly associated with poor overall survival ($p < 0.05$) of ACC patients in the TCGA data. Of genes with bonf. $p < 0.5$, 8 upregulated (CDK1, CCNB2, CDKN3, GJC1, PTTG1, TPX2, KIAA0101, DEPDC1B) and 6 downregulated genes (DLG2, BRE, EPHX2, LMOD1, FAM65C and RSPO3) were identified as hub genes. Evaluation of the presence of hub genes in steroid-secreting ACC and response to mitotane showed similar expression levels. Analysis of miRNAs and lncRNA associated with differentially expressed genes identified a link between down regulation of hsa-miR- 335-5p (bonf. $p < 0.01$) and almost all of the down regulated hub genes. hsa-miR-335-5p expression also strongly correlated with the lncRNA Gas5 that is down regulated in ACC.

Conclusions: Downregulation of the novel target miRNA 335-5p mediates expression of hub genes and lncRNA strongly associated with poor overall survival in ACC. Further validation studies are needed for clinical translation of these findings as a potential new therapeutic strategy targeting hsa-miRNA 335-5p.

◆ 05. Disparities in Time to Surgeon Evaluation Among Patients with Primary Hyperparathyroidism

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Background: The majority of patients with primary hyperparathyroidism (PHPT) are not referred for surgeon evaluation. We hypothesized that disparities in rate of evaluation by preferred language, race/ethnicity, and insurance contribute substantially to this deficit.

Methods: We queried our institutional database for first incident hypercalcemia between 2010-2018. Patients with PHPT were included, while those with end-stage renal disease, history of kidney transplant, secondary or tertiary hyperparathyroidism, or previous parathyroidectomy were excluded. Demographics and clinical variables were collected including age, sex, preferred language, race, insurance, marital status, serum calcium and PTH, operative indications, and Elixhauser comorbidities. We created a Cox proportional hazards model to investigate time to evaluation, censoring for death or follow-up time of two years. Kaplan-Meier curves were generated by language, race/ethnicity, and insurance status.

Results: Among a cohort of 1,333 patients with PHPT, 377 (28%) were evaluated by a surgeon (median time to evaluation 55.5 days). Patients with English preferred language were more likely to be seen by a surgeon compared to other languages (30% vs. 18%, $p=0.004$). Similarly, White, non-Hispanic patients were more likely to be seen vs. all others (31% vs. 21%, $p=0.001$), as were patients with private insurance vs. other insurance types (39% vs. 20%, $p<0.001$). After adjusting for age, marital status, comorbidities, preoperative labs, and operative indications, patients with English preferred language had a 91% higher rate of surgeon evaluation and an adjusted average of 64 fewer days to evaluation compared to other languages (HR 1.91, CI 1.13-3.23, $p=0.016$). Additionally, white non-Hispanic patients had a 35% higher rate of surgeon evaluation and an adjusted average of 63 fewer days to evaluation compared to patients of minority race/ethnicity (HR 1.35, CI 1.03-1.77, $p=.027$). Patients with private insurance had an 81% higher rate of surgeon evaluation and an adjusted average of 57 fewer days to evaluation compared to patients with other insurance types (HR 1.81, CI 1.42-2.31, $p<.001$).

Conclusions: Patients with non-English preferred language, of minority race/ethnicity, or with non-private insurance had substantially lower rates of surgeon evaluation. A systems-level evaluation of factors contributing to these disparities, including structural racism and language-discordant communication, is needed to improve access to surgeon referral.

◆ 06. Black Patients Are More Likely to Undergo Parathyroidectomy for Secondary Hyperparathyroidism

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Background: The medical management of secondary hyperparathyroidism (SHPT) has evolved considerably over the past several decades, with parathyroidectomy (PTx) reserved for severe or medically refractory cases. Although prior studies have demonstrated that Black patients have more severe disease, it is unclear how medical treatment and socioeconomic disparities have impacted rates of PTx across racial groups. Our primary objective was to study racial differences in timing and likelihood of PTx in patients with SHPT due to ESRD.

Methods: We used the United States Renal Data System (USRDS) to identify 634,428 adult (age \geq 18) patients who were on maintenance dialysis between 2006-2016 with Medicare as their primary payor. The cumulative probability of PTx from the time of dialysis initiation was calculated. Adjusted multivariable Cox regression was performed to examine the relationship between race and PTx.

Results: Of this cohort, 27.3% were of Black race. Among Black patients, 23.1% lived in a neighborhood corresponding to a zip code in which the majority of residents were below a pre-defined poverty level, compared to 15.4% of White patients ($p<0.001$). By approximately 5.5 years, 25% of Black patients received PTx, whereas by approximately 8 years, 25% of White patients received PTx. The cumulative incidence of PTx from dialysis initiation was 8.8% at 10 years among Black patients, compared to 4.3% among White patients ($p<0.001$). Compared to White race, Black race was associated with a 1.83-fold increased likelihood of undergoing PTx (95% CI: 1.74-1.93) on unadjusted analyses. After adjusting for age, sex, cause of ESRD, BMI, comorbidities, dialysis modality, and poverty level, Black patients were more likely than White patients to undergo PTx (aHR=1.35; 95% CI, 1.27-1.43). Therefore, patient characteristics and socioeconomic status explained 27% of the association between race and likelihood of PTx.

Conclusions: Black patients with SHPT due to ESRD are more likely to undergo PTx with shorter intervals between dialysis initiation and PTx. This association is partially explained by patient characteristics and socioeconomic factors. Additional investigation is needed to understand if this represents a disparity in quality of care.

◆ 07. Outpatient Endocrine Surgery Practice Patterns are Variable Among U.S. Endocrine Surgery Fellowship Programs

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Background: Current studies and guidelines have demonstrated that outpatient endocrine surgery is safe, however none recommend specific post-operative protocols.

Methods: An internet-based survey, developed using expert input and 7 iterations of pretesting, was distributed to current (2021- 22) endocrine surgery fellows in the American Association of Endocrine Surgeons-accredited programs (n=23).

Results: Survey response rate was 91% (21/23) representing 20 U.S. institutions performing >15,000 cervical endocrine operations annually. Fourteen (67%) reported standardized discharge protocols across faculty.

The practice of same-day discharge (SDD) was not normally distributed ($p < 0.0001$) but was bimodally distributed. Whereas seven programs nearly always (>90%) discharged patients on the day of total thyroidectomy, ten programs reported almost never (<2%) doing so. Six (29%) operated at same-day surgical centers. Fifteen (71%) reported minimum observation periods before discharge, with no consistency across procedures or institutions. Patients undergoing total thyroidectomy were often observed for longer periods (range: 3-6+ hours.). Fifteen (71%) reported no geographic restrictions for SDD.

Nine relevant clinical factors had variable influence on SDD after thyroidectomy. In programs with >2% SDD, living alone precluded SDD in 2 programs, while lateral neck dissection and chronic anticoagulation/antiplatelet therapy precluded SDD in 1 program each. Lateral neck dissection and chronic anticoagulation/antiplatelet therapy reduced SDD greatly, whereas central neck dissection, Graves' disease, substernal goiter, continuous positive airway pressure (CPAP) use, difficult/bloody operation, and presence of signal on nerve stimulation had no or minimal effect on SDD.

Other postoperative practices also varied among programs. Whereas anticoagulation and antiplatelet agents were similarly held preoperatively across programs, medication resumption plans varied widely. Parathyroid hormone (PTH) levels were used more often than calcium levels to inform discharge plans such as observation periods or calcium supplementation protocols. Most programs with >90% SDD rarely checked calcium levels regardless of procedure. Routine calcium supplementation was reported in most programs (67%), whereas calcitriol was prescribed only sometimes (67%) or rarely (29%). More programs prescribed narcotics rarely (43%) than routinely (33%). When narcotics were given, most (86%) prescribed 1-10 pills.

Conclusions: Although most discharge protocols after thyroid or parathyroid surgery were standardized within institutions, there was significant variation in SDD practice patterns across institutions.

◆ 08. The Use of a Preoperative Educational Time-Out in Endocrine Surgery to Move the Needle in Operative Autonomy

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Background: As surgical training shifts toward a competency-based paradigm, deliberate practice for procedures should be a point of focus. The purpose of this study was to prospectively assess the impact of an established intervention, the Educational Time-Out (ETO), on resident operative performance and educational experience in Endocrine Surgery.

Methods: A preoperative ETO was performed during which residents and faculty identified an operative step of focus for thyroidectomies and parathyroidectomies and assessed the resident's level of autonomy for that step. Postoperative feedback was captured using the SIMPL application. For twelve months, the intervention was implemented on the Endocrine Surgery service. Outcomes included perceptions related to the impact of the ETO on education and autonomy. The Zwisch scale was used to classify levels of supervision, with meaningful autonomy defined as Passive Help or Supervision Only. Data were analyzed using descriptive statistics.

Results: Eight third-year general surgery residents and three attending surgeons participated in this study. Residents performed a median of 28 operations during their rotation. The ETO completion rate was 93%, capturing a total of 211 operations. At the end of each rotation, participants reported substantial improvement in frequencies of goal setting and perioperative discussion. There was strong agreement from both residents and attendings (90%) that the intervention strengthened the educational experience. Residents performed most steps (52%) at Active Help supervision, and reached meaningful autonomy for a median of 9 (IQR 4, 14) steps. Of 111 thyroidectomies and 101 parathyroidectomies, 30% and 37% of steps were performed at meaningful autonomy, respectively. Based on post-intervention survey data, there was improvement from the perceived baseline rates of meaningful autonomy for every step. Review of qualitative data revealed that nearly all dictated feedback was step-specific (97%) and encouraging/positive (97%). Feedback was optimal (specific and directed) in 46% of cases.

Conclusions: The ETO improved rates of resident goal setting, increased perioperative discussion, and strengthened educational experiences. Residents mostly performed at Active Help, which compares with national averages. Meaningful autonomy rates improved from perceived pre-intervention levels. Broader implementation of this intervention with all trainees at all levels will facilitate procedural, competency-based education in the operating room.

◆ 09. Automatic Extraction of Incidental Adrenal Nodules from Narrative Radiology Reports in Electronic Health Records: A Validation Study

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Background: Many adrenal incidentalomas do not undergo appropriate biochemical testing and complete imaging characterization to assess for hormone hypersecretion and malignancy. With the growing availability of clinical narratives in the electronic medical record, automated surveillance using advanced data analytic techniques may represent a promising method to initiate management and follow-up.

Methods: A data provisioning process using a series of structured query language (SQL) scripts was used to abstract all chest and abdominal CT and MRI reports from an academic healthcare system in 2018. Narratives and impressions were queried for key text relating to the identification of adrenal incidentalomas. Patients with a history of extra-adrenal malignancy undergoing staging or surveillance imaging were excluded. The prevalence and radiographic characteristics were analyzed. Patients with adrenal incidentalomas newly identified in 2018 were assessed for biochemical testing and nodule stability through August 2021.

Results: Of 36,618 patients queried, 8,557 were excluded due to a history of extra-adrenal malignancy. Data from 447 patients were flagged by the SQL and electronically abstracted. On internal validation, 307/447 (69%) patients were correctly identified as having adrenal nodules (1.1% overall prevalence). Median patient age was 67 years and 56% were female. The median nodule size was 1.7 (interquartile range 1.3-2.5) cm, 9% were bilateral and 60% were low density (unenhanced HU <10). Adrenal carcinoma was identified in 10 patients. In 2018, 121 patients were diagnosed with a new adrenal incidentaloma. Of 33 (27%) patients who had follow-up imaging at a median of 1.9 years, 97% of nodules were stable in size. Biochemical testing was performed in 49 patients (40%), of which 27 (55%) revealed functional nodules: 19 (39%) aldosteronoma, 5 (10%) cortisol secreting, and 3 (6%) pheochromocytoma.

Conclusions: Less than half of patients received appropriate biochemical testing after incidental diagnosis of an adrenal nodule, and the majority of patients did not have follow-up imaging. Advanced data analytic techniques on electronic imaging reports may aid in the clinical identification and improved management of patients with adrenal incidentalomas.

◆ 10. Sleep centers may be a promising setting for improving screening practices for primary aldosteronism

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Background: There is a bidirectional association between primary aldosteronism (PA) and obstructive sleep apnea (OSA), with evidence suggesting that treatment of PA can reduce OSA severity. Current guidelines recommend screening for PA in patients with comorbid hypertension and OSA, identifying potential candidates for medical or surgical treatment. However, emerging data suggests current screening practices are unsatisfactory. Moreover, there is limited data regarding the true incidence of PA among this population.

Methods: Sleep studies conducted at our institution between January and September 2021 were retrospectively reviewed. Adult patients with a sleep study positive for OSA (respiratory disturbance index [RDI] ≥ 5) and a diagnosis of hypertension were included. Patient medical records were reviewed and the laboratory data of those with existing biochemical screening for PA were assessed by an experienced endocrinologist.

Results: One thousand five patients undergoing sleep studies were reviewed. In total, 354 patients had comorbid OSA (confirmed by positive sleep study) and hypertension. Patients were predominantly male (67%) with a mean age of 58 years (range 21-90 years) and mean BMI of 34 (range 19-79). The screening rate for PA among included patients was 19% (n=67). The screening rate was significantly higher after initiation of a dedicated PA screening protocol (23% vs. 12% prior; p=0.01). Fourteen screens (21%) were positive for PA, while 45 (67%) were negative and 8 (12%) were indeterminate. Four had prior abdominal cross-sectional imaging, with 3 positive for an adrenal adenoma. Compared to all other included patients (n=340), patients with positive screens were more likely to have a history of hypokalemia (36% vs. 12%, p=0.007), as well as more severe OSA (mean pRDI 36 vs. 25, p=0.06). The frequency of comorbid hyperlipidemia (79% vs. 79%), diabetes mellitus (28% vs. 26%), and left ventricular hypertrophy (28% vs. 18%) did not differ in patients with positive screens compared to all other patients.

Conclusions: Current screening practices for PA among patients with comorbid OSA and hypertension are suboptimal. Patients evaluated at sleep centers may represent an optimal population for screening, as the prevalence of PA among this cohort appears high.

◆ 11. Limited Disease Progression in Endocrine Surgery Patients with Treatment Delays Due to COVID-19

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Background: The COVID-19 pandemic profoundly impacted the delivery of care and timing of elective surgical procedures. Most endocrine-related (thyroid, parathyroid, adrenal) operations were considered elective and safe to postpone, providing a unique opportunity to assess clinical outcomes under protracted treatment plans. Although certain endocrine diseases are comparatively indolent, we hypothesized that some patients would experience disease progression during the delay period and need an adjusted treatment plan.

Methods: Members of the AAES were surveyed for participation in the study. A REDCap survey was developed and distributed to assess the impact of COVID-19-related delays to care. Institutional Review Board approval and Data Use Agreements were obtained from all participating institutions. Information collected included patient demographics, primary diagnosis, resumption of care, and assessment of disease progression by the surgeon. Differences in delay by sex were assessed using chi-squared test, and Wilcoxon rank-sum test was used to assess mean differences in length of delay.

Results: Eleven out of 27 institutions completed the survey (40.7%). Of 600 patients, 75.3% (N=452) were female; average age was 55.0 (SD:15.2) years. 5.5% (33) of patients, 2 diagnosed with thyroid cancer, have not been seen since their original appointment was delayed. 83.7% (502) of patients had a delay in care with women more likely to have a delay (85.6% vs. 77.7% of men, $\chi^2=5.11$, $p=0.02$). Average length of delay was 91.5 (SD:69.6) days. Among patients with a delay in care, primary disease site included thyroid (53.8%), parathyroid (36.7%), adrenal (6.0%), pancreatic/GI neuroendocrine tumors (2.2%), and other (1.2%). 6.6% (24) of patients experienced disease progression and 6.4% (21) had a change from the initial operative plan. Length of delay was not associated with disease progression ($p=0.94$) or a change in operative plan ($p=0.39$).

Conclusions: While some patients experienced disease progression during COVID-19 delays to endocrine disease-related care, most patients with follow-up did not. Numerous patients were lost to follow-up, which is cause for concern. Our analysis indicates that temporary delay may be an acceptable course of action in extreme circumstances for endocrine disease. Risk assessment policies can be evaluated for future restrictions to elective care.

◆ 12. The Relative Importance of Patient Outcomes to Surgeons' Initial Treatment Recommendations for Low-Risk Thyroid Cancer

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Background: Background: The choice between Total Thyroidectomy (TT) and Lobectomy for small, low-risk thyroid cancer is controversial. Surgeon recommendations significantly influence this decision. We evaluated factors surgeons deem most important when making treatment recommendations in these cases.

Methods: Methods: We performed a cross-sectional survey of thyroid surgeons identified through Medicare billing data. In a hypothetical scenario, surgeons indicated treatment recommendation (TT/Lobectomy) for a healthy 45-year-old female with a solitary, low-risk, 2.0cm papillary thyroid cancer. They then rated the importance of patient treatment outcomes to their recommendation using constant sum scaling, a technique where 100 points are allocated among 10 patient outcomes: survival, recurrence, cancer removal, completion thyroidectomy, need for thyroid hormone, worry, return to normalcy, energy level, voice, and calcium. The distributions of points among outcomes were compared in those recommending Lobectomy and TT using Hottelling's T2 test.

Results: Results: Of 222 surveys, 166 were completed (74.8%). Respondents were 77.7% (n=129) male and 74.7% (n=124) White; 70.5% (n=117) were general surgeons and 29.5% (n=49) were otolaryngologists. The majority performed >25 thyroid operations/year (97.0%), and the average time in practice was 20.8 years (SD 10.2).

Overall, 35.3% (n=59) of surgeons recommended TT and 64.5% (n=107) Lobectomy. The relative importance of the 10 patient outcomes were significantly different between surgeons recommending TT and Lobectomy (p<0.05). Specifically, surgeons recommending TT were most influenced by impact on recurrence (19.0 points [95%C.I. 14.7-23.3]), patient worry (15.3pts [95%CI 11.2-19.4]), and the potential for completion thyroidectomy (14.4pts [10.8-17.9]). Surgeons recommending Lobectomy were most influenced by removal of the cancer (15.7pts [95%CI 12.9-18.6]), need for hormone replacement (14.2pts [95%CI 11.2-17.1]), and recurrence (12.0pts [95%C.I. 9.9-14.1]). The factors with the largest differences were need for hormone replacement (3.2-times more important if recommending Lobectomy[p<0.05]), and impact on recurrence (1.6-times more important if recommending TT[p<0.05]). For all, treatment impacts on calcium, voice, and energy level were least important.

Conclusions: Conclusion: Surgeons who recommend TT for low-risk thyroid cancer weighed the impact on recurrence significantly more and the need for hormone replacement significantly less than those recommending Lobectomy. Understanding surgeon outcome prioritization during treatment decisions is critical to reducing overtreatment of low-risk thyroid cancer.

◆ **13. Baicalein activates AMPK, inhibits the mammalian target of rapamycin, and exhibits antiproliferative effects in pancreatic neuroendocrine tumors in vitro and in vivo**

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Background: Limited systemic therapy options exist for advanced pancreatic neuroendocrine tumors (PNETs), but mTOR inhibition has been shown to prolong progression free survival. The natural compound baicalein inhibits mTOR and may have antiproliferative effects in PNETs at high concentrations. However, it is unknown if baicalein exhibits such effects at physiologically achievable concentrations and whether it exhibits synergy with other agents.

Methods: PNET cell lines BON-1 and QGP-1 were cultured with 4-40 μM baicalein, 0.4-2.0 μM everolimus, and 1-4 μM of a synthetic AMPK activating agent, COH-SR4, alone and in combination. Cell viability assays and immunoblotting were performed. Female SCID- beige mice were injected with BON-1 cells and treated with baicalein and COH-SR4 solutions via oral gavage. Tumor volumes were measured at 30 days and compared using t-test. Synergy was calculated using the Chou-Talalay method.

Results: Immunoblotting revealed that treatment of baicalein induced AMPK activation and subsequent mTOR inhibition at 24 hours in a dose dependent fashion in both BON-1 and QGP-1 cell lines. Treatment of these lines with baicalein alone led to a significant decrease in the ratio of viable cells compared with controls at 72 hours at concentrations $\geq 5 \mu\text{M}$ ($p=0.021$). Combination of baicalein with a synthetic AMPK activating agent, COH-SR4, led to significantly greater effect on cell viability in both cell lines than with baicalein alone ($p<0.001$, $p<0.001$) or with COH-SR4 alone ($p=0.004$, $p=0.015$), and synergy was observed. Combination of baicalein at concentrations of 20-40 μM with everolimus resulted in significantly lower cell viability in BON-1 cells than with everolimus alone ($p=0.005$, $p<0.001$). Tumor volume in vivo was significantly decreased with the combination of baicalein and COH-SR4 compared with controls ($p=0.003$).

Conclusions: Baicalein exhibits antiproliferative effects against PNET cell lines at doses as low as 5 μM , which are likely physiologically achievable, and demonstrates synergy with other AMPK activating agents, making it a promising agent for further study.

◆ 14. Novel PET C11 Choline imaging performance for detection of parathyroid disease

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Background: Focused parathyroidectomy in primary hyperparathyroidism (1HPT) is possible with accurate preoperative localization. A growing body of data exists regarding the role of radio-labelled C11 choline PET/CT in this setting. In cases of nonlocalized disease, PET C11 choline may be a useful adjunct to US, (123)I/(99)Tc-Sestamibi or 4D-CT imaging.

Methods: Patients with 1HPT who received a C11 choline PET/CT scan from 2017 to 2021 at a single institution were retrospectively reviewed. We assessed the sensitivity, positive predictive value and false negative rate of PET C11 choline in correctly predicting the location of parathyroid disease. We also compared the sensitivity, positive predictive value and false negative rate of standard modalities of US, (123)I/(99)Tc-Sestamibi, and 4D CT and examined concordance rates.

Results: We identified 43 patients, of whom 33 had a positive PET C11 choline finding. This cohort of patients had failed to localize on multiple standard imaging tests of US, (123)I/(99)Tc-Sestamibi and 4D CT with 98%, 95% and 60% having respectively received the above tests. Of those patients, 24 proceeded to surgery, 70% of whom were reoperative cases. Nineteen (79%) achieved an intraoperative cure. Imaging analysis showed that PET C11 choline achieved a sensitivity of 63% (95% CI 45-81%) and positive predictive value (PPV) of 65% (95% CI 47-84%). Comparatively, the sensitivity of US, (123)I/(99)Tc-Sestamibi and 4D CT in this highly selected cohort was only 2.3%, 13.1%, and 17.4% respectively. There were 6 false positive PET C11 choline results that went to surgery and were found to be either lymph nodes, normal parathyroids, or in one case recurrent laryngeal nerve neuroma with a total false positive rate of 18.6% (8 of 43).

Conclusions: PET C11 Choline is a useful adjunct for parathyroid localization in a complex population of patients who have failed standard localization techniques that may include US, I-123 Sestamibi, and/or 4D CT, and may have had prior reoperations. Although routine inclusion of PET C11 choline imaging is not necessary, it may aid in preoperative localization which may be particularly useful in the reoperative setting.

15. Medullary Thyroid Cancer with RET V804M Mutation: More Indolent Than Expected?

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Background: Patients with a RET V804M mutation represent a rare subset of patients with multiple endocrine neoplasia type 2A. Prior reports on the genotype-phenotype correlation of this ATA moderate-risk mutation have been variable.

Methods: Patients with a RET V804M mutation confirmed on gene sequencing who were treated at a single center were identified (January 1996-December 2020). Baseline characteristics, biochemical data, operative details, and pathology were analyzed.

Results: There were 80 patients; none had a history of or developed pheochromocytoma, hyperparathyroidism, or died in the 24-yr study period. Overall mean age at diagnosis was 41.5yrs (range=1-81yrs); 46.3% were male. 69 patients (86.3%) underwent surgery, of whom 54 (78.3%) underwent total thyroidectomy (TT) alone and 15 (21.7%) underwent TT with central with/out lateral neck dissection (CND/LND). 11 (13.8%, mean age=36.2) patients did not undergo surgery due to a combination of factors including age, medical complexity, and patient preference. 37 of 54 patients undergoing TT alone (mean age=40.1) had normal/undetectable calcitonin and 15 patients (mean age=43.0) had elevated calcitonin (median=7.5, range=5-237) pre-operatively. Pathology was benign (31.5%), C-cell hyperplasia (25.9%), papillary thyroid cancer (PTC) alone (1.9%), and MTC (40.7%, median tumor size=2.0mm); 4 patients had concurrent MTC and PTC. 37 patients had post-operative calcitonin data; 95% had normal/undetectable calcitonin (median follow-up=55.7 months).

10 of 13 TT+CND patients had elevated pre-operative calcitonin (median=27.6, range=5.1-147), and both patients undergoing TT+CND+LND had elevated pre-operative calcitonin (median=3182, range=361-6003). Median tumor size for TT+CND was 6mm and 24mm for TT+CND+LND. 2 of 13 TT+CND patients and both TT+CND+LND patients had positive nodes (TT+CND: median=1.5, range=1-2; TT+CND+LND: median=23.5, range=20-27). Of patients with available post-operative calcitonin (10/13), all TT+CND patients had normal/undetectable calcitonin at a median of 56.7 months. All TT+CND+LND patients had elevated postoperative calcitonin at one or more follow-up visit (median= 76; range=16-136) at a median of 50.2 months.

Conclusions: In this study comprising the largest described US cohort of patients with a germline RET V804M mutation, most patients, particularly those diagnosed at an early stage, had indolent disease. A small subset present with metastatic disease, underscoring the importance of early diagnosis and monitoring.

16. INDOCYANINE GREEN FLUORESCENCE AND AUTOFLUORESCENCE MAY IMPROVE POST- THYROIDECTOMY PARATHYROID FUNCTION

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Background: Indocyanine green fluorescence (ICGF) and autofluorescence (AF) are new tools that have been introduced during thyroidectomy to improve the post-operative parathyroid function (PPF). This study evaluated the utility of AF and ICGF to predict and potentially decrease the rate of hypoparathyroidism after thyroidectomy.

Methods: This is a randomized prospective study. Patients undergoing total thyroidectomy were randomly divided into 2 groups: Group A included patients in which AF was used to identify parathyroid glands (PGs) and ICGF was used to evaluate the PGs vitality once the thyroid gland was removed; Control Group (Group B) included patients undergoing conventional procedure. Data were analyzed to compare the rate of post-operative hypoparathyroidism and the rate of PGs identified.

Results: A total of 160 patients were enrolled. 80 were included in Group A and 80 in Group B. In Group A, a significant higher number of PGs were identified by means of AF (309 out of 320, 96.6%) compared to naked eye visualization (239 out of 320, 74.7%) ($p=0.0001$). AF enabled the identification of 7 PGs accidentally removed with the specimen, allowing their autotransplantation. The rate of transient hypoparathyroidism in Group A and Group B was 26.3% (21 cases) and 30% (24 cases), respectively ($p=0.5978$). The rate of definitive hypoparathyroidism in Group A and Group B was 2.5% (2 cases) and 5% (4 cases), respectively ($p=0.4053$). Group A included 51 patients (63.8%) with at least 1 PG with ICG score 2. The rate of transient hypoparathyroidism in patients with at least 1 PG with ICG score 2 was 15.7% (8 cases), which was significantly lower compared to the rate of patients without PGs with ICG score 2 (44.8%, 13 cases) ($p=0.0044$). The rate of definitive hypoparathyroidism in patients with or without at least 1 PG with ICG score 2 was 1.9% (1 case) and 3.4% (1 case), respectively ($p=0.6821$).

Conclusions: AF and ICGF are novel techniques that may preserve parathyroid function after thyroidectomy. Autofluorescence resulted helpful in identify PGs, whereas having at least 1 PG well vascularized (ICG score 2) may predict an adequate post-operative parathyroid function.

◆ 17. Hyperparathyroidism at 1-Year Following Kidney Transplantation is Associated with Graft Loss

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Background: Hyperparathyroidism (HPT) persists in many patients undergoing kidney transplantation (KT), yet a lack of consensus exists regarding its impact on post-transplant outcomes. The purpose of this study was to evaluate the association between HPT and post-KT outcomes and identify the subgroups most at risk for adverse outcomes.

Methods: We identified 818 participants from a prospective cohort of adult patients who underwent KT at a single institution between 12/2008-2/2020. Pre- and post-KT parathyroid hormone (PTH) levels were abstracted from medical records. All patients were linked to the national registry, which was used to ascertain graft loss and death outcomes. HPT was defined as PTH level ≥ 70 pg/mL at 1-year post-KT. Cox Proportional Hazards models were used to estimate the adjusted hazard ratios (aHRs) of all-cause mortality and death- censored graft loss (DCGL) by HPT among KT recipients who survived to 1-year post-KT. Models were adjusted for age at KT, sex, race/ethnicity, college education, pre-KT PTH level, cause of kidney failure, and years on pre-KT dialysis. A Wald test for interactions was used to evaluate the risks of all-cause mortality and DCGL by age, sex, and race.

Results: Of 818 recipients, 60.9% had HPT at 1-year post-KT. Compared to non-HPT patients, those with HPT were more likely to be Black (47.4% vs 32.8%), undergo pre-KT dialysis (86.7% vs 76.5%), and have a pre-KT PTH level ≥ 300 pg/mL (47.3% vs 25.6%) (all $p < 0.001$). In the year following KT, compared to non-HPT patients, more HPT patients were treated with calcimimetics (23.9% vs. 5.0%), parathyroidectomy (1.4% vs. 0.9%), or both (1.4% vs. 0.3%) ($p < 0.001$). Patients with HPT at 1-year post-KT had a 1.8-fold higher risk of DCGL (aHR=1.82, 95% CI:1.15-2.87) compared to their non-HPT counterparts. This risk did not differ by age, sex, or race (all $p > 0.05$). There was no association between HPT and all-cause mortality.

Conclusions: The risk of DCGL was significantly higher among patients with HPT at 1-year post-KT when compared to patients without HPT. Based on these findings, monitoring post-KT PTH and perhaps initiating earlier treatment for HPT should be considered.

◆ 18. Effects of parathyroidectomy on kidney function in primary hyperparathyroidism: results of a prospective study

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Background: An altered estimated glomerular filtration rate (eGFR <60 mL/min) is a criterion for surgery in patients with primary hyperparathyroidism (PHPT). However, benefits of parathyroidectomy on kidney function remain controversial. The objective of this study was to evaluate the eGFR change 12 months after parathyroidectomy for PHPT according to pre-operative kidney function.

Methods: Patients who underwent parathyroidectomy for PHPT between 2016 and 2020 (n=381) were enrolled in a monocentric prospective cohort. Patients without one-year follow-up or missing data (body mass index, systolic arterial blood pressure, serum calcium, albumin, phosphorus, PTH, creatinine and eGFR (CKD-EPI)) were not included (n=135). Patients were dichotomized according to their baseline eGFR: <60 mL/min (group 1) and ≥60 mL/min (group 2). Parameters were measured before and 12 months after parathyroidectomy.

Results: Out of 246 included patients, 27 (11%) were assigned to group 1 and 219 (89%) to group 2. Baseline mean eGFR was 46.8 ± 11.5 and 87.3 ± 14.7 mL/min in group 1 and 2, respectively. Group 1 patients were older than those in group 2 (70.6 ± 11.2 versus 61.7 ± 13.7 years, p=0.0006); their mean pre-operative serum calcium concentration was not significantly higher (2.85 ± 0.28 and 2.74 ± 0.17 mmol/L) and their median serum PTH level was significantly higher (126.5 [IQR 83.5; 294.7] versus 95.1 [76.6; 127.2], p=0.0208). The 6-month post-operative normocalcemic patients' rate was 91% (224/246). Post-operative median serum PTH levels were 61.6 [48; 69] and 42.2 [32.3; 54.5] pg/mL in group 1 and 2 (p=0.0002). Post-operative mean eGFR increased significantly in group 1 (50.9 ± 11.8 mL/min post-operatively, p=0.010 versus pre-operative value), and eGFR raw change after parathyroidectomy was significantly higher than in group 2 (+4.2 ± 7.8 versus -2.2 ± 9.1 mL/min, p=0.0004). In group 1, 13/27 patients (48%) improved their chronic kidney disease stage 12 months after parathyroidectomy (6/13 gained post-operative eGFR ≥60 mL/min), and only 2/27 worsened (7%). In group 2, 6/219 (2.7%) had a post-operative eGFR <60mL/min.

Conclusions: Parathyroidectomy for PHPT is associated with a kidney function improvement at one year in patients with pre-operative eGFR <60 mL/min. These results strengthen the current guidelines for surgery.

◆ 19. Hypercalcemia with a Parathyroid Hormone Level of ≤ 50 pg/mL: Is this Primary Hyperparathyroidism?

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Background: Primary hyperparathyroidism (pHPT) is characterized by hypercalcemia with inappropriately normal or elevated parathyroid hormone (PTH). However, the absolute PTH value which is defined as inappropriately normal is not clear. We review our experience with parathyroidectomy in patients with hypercalcemia and a PTH of ≤ 50.0 pg/mL [normal range 12.0-88.0 pg/mL].

Methods: Between November 2000 and August 2021, 2384 patients underwent parathyroidectomy for primary hyperparathyroidism. Of these, 185 patients had preoperative PTH ≤ 50.0 pg/mL [PTH ≤ 50]. The biology and outcomes were compared to patients with PTH >50.0 pg/ml [PTH >50]. Chi-square, independent-samples t-test and multinomial logistic regression were used for statistical analyses. $p < 0.050$ was considered statistically significant. IBM SPSS 27.0 was used for statistical analysis.

Results: Of the PTH ≤ 50 patients, the median PTH was 40.0 pg/mL [range 11.6-50.0 pg/mL]. 13 of 185 patients had pre-operative PTH levels ≤ 25.0 pg/mL. All patients were found to have hypercellular abnormal parathyroid glands with a cure rate of 98.6%. Single adenomas were only present in 42.6% while 57.4% had multi-gland disease. When comparing the PTH ≤ 50 to the PTH >50 group, the PTH ≤ 50 group was younger (55.7 ± 15.7 vs. 60.1 ± 14.2 , $p < 0.001$), had lower BMI (28.7 ± 7.1 kg/m² vs. 31.2 ± 7.9 kg/m², $p < 0.001$), higher preoperative vitamin D (38.6 ± 17.5 ng/mL vs. 31.6 ± 14.3 ng/mL $p < 0.001$), and higher incidence of multi-gland disease (57.4% vs. 31.6%, $p < 0.001$). There was no difference between gender, race, patient-reported symptoms (including fatigue, kidney stones, bone disease, prior fracture and abdominal pain), previous parathyroidectomy, preoperative calcium, intraoperative PTH $> 50\%$ drop, incidence of ectopic glands, cure rate or postoperative complications (persistent or recurrent hyperparathyroidism and postoperative hypocalcemia).

Conclusions: Patients with primary hyperparathyroidism can present with hypercalcemia with a PTH as low as 11.6 pg/mL. In patients with preoperative PTH levels ≤ 50 pg/ml, the majority have multi-gland disease. These patients should undergo bilateral parathyroid exploration.

◆ 20. Optimal intraoperative parathyroid hormone parameters for normohormonal primary hyperparathyroidism

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Background: Normohormonal primary hyperparathyroidism (PHPT) is a subtype in which parathyroid hormone (PTH) levels are normal but inappropriately elevated for the degree of hypercalcemia. The optimal decline in intraoperative PTH (IOPTH) for these patients is unknown. The study goal was to determine IOPTH parameters most predictive of long-term cure and hypocalcemia in patients with normohormonal PHPT.

Methods: We performed a retrospective cohort study of patients with PHPT undergoing parathyroidectomy (2002-2019) at a tertiary hospital, comparing patients with normohormonal and classic PHPT. Normohormonal PHPT was defined as PTH ≤ 65 pg/mL with elevated serum (>10.6 mg/dL) and/or ionized (≥ 5.2 mg/dL) calcium. All patients underwent PTH testing preoperatively and ≥ 15 minutes after gland removal. Biochemical outcomes were assessed ≥ 6 months postoperatively. The primary outcome was cure, defined as calcium ≤ 10.6 mg/dL. The secondary outcome was hypocalcemia (≤ 8.4 mg/dL). Groups were compared using Wilcoxon rank sum tests, proportion tests, and receiver operating characteristic (ROC) curves.

Results: For 1,091 patients, 131 (12.7%) had normohormonal PHPT. Median follow-up was 33.2 months (interquartile range: 18.9- 105). Patients with normohormonal and classic PHPT had no differences in rates of cure (95.4% vs. 98.0%, $p=0.06$) or hypocalcemia (3.8% vs. 2.9%, $p=0.57$). On ROC analysis, percent IOPTH decline correlated well with cure for normohormonal and classic groups (area under the curve [AUC]: 0.80 and 0.68). For patients who achieved $\geq 50\%$ IOPTH decline, cure rates were similar between those with normohormonal and classic PHPT (98.1% vs. 98.4%, $p=0.82$). However, the median percent IOPTH decline in cured patients was significantly lower in those with normohormonal PHPT (65.1% vs. 84.3%, $p<0.0001$). Percent decline in IOPTH strongly predicted hypocalcemia in the normohormonal group (AUC: 0.91) but was not associated with hypocalcemia in the classic group (AUC: 0.57). For patients with $\geq 75\%$ PTH decline, hypocalcemia was more common in normohormonal PHPT (12.8% vs. 3.3%, $p=0.002$).

Conclusions: Percent IOPTH decline predicts cure and hypocalcemia in patients with normohormonal PHPT. Compared to patients with classic PHPT, those with normohormonal PHPT are at increased risk of hypocalcemia and may be cured with lower IOPTH decline. A 50-75% IOPTH decline may be the optimal range to achieve cure and minimize hypocalcemia in normohormonal PHPT.

21. Efficacy of the Miami's criteria and Normalization of PTH levels after Parathyroidectomy in patients with Primary Hyperparathyroidism and Impaired Renal Function

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Background: Intraoperative PTH (ioPTH) dynamics have been used to establish surgical treatment success in patients with primary hyperparathyroidism (pHPT). Criteria for cure includes > 50% decline in ioPTH at 10 minutes post-excision and normalization of ioPTH. Our aim was to investigate the role of glomerular filtration rate (GFR) and creatinine levels in the behavior of ioPTH.

Methods: A total of 156 patients with successfully treated pHPT (normocalcemia at 6 months) were analyzed. Preoperative GFR was determined using the Cockcroft-Gault formula. Blood samples for quick PTH were collected at the time of intubation, 5-min, 10-min and 30-min post adequate parathyroid excision. Patients were divided into three groups: 1) GFR >60 mL/min, 2) GFR <60 mL/min and normal creatinine (Cr) levels (<1.2 mg/dL) and 3) GFR < 60 mL/min and Cr levels >1.2 mg/dL. Comparative analysis of the percentage of patients achieving the Miami criteria for cure and normalization of the ioPTH was performed.

Results: There were 23 males (14.7%) and 133 females (85.3%) with a mean age of 56.15±14.4 years. One-hundred and thirty-three patients had uniglandular disease and 23 multiglandular disease. Patients with uniglandular disease were treated by single gland excision. In patients with multiglandular disease, parathyroid tissue equivalent to a normal gland was left in place. There were 118 patients (75.7%) in group 1, 18 (11.5%) in group 2, and 20 (12.8%) in group 3. There was no difference between groups in terms of the percentage of patients fulfilling the Miami's criteria at 10 and 30 minutes. An inverse relationship between all ioPTH levels and the GFR was observed (ANOVA, p<0.001). Rates of abnormally elevated ioPTH (> 88 pg/mL) 30 minutes after surgery were observed in 0, 16.7%, and 29.4% of groups 1, 2 and 3, respectively (p < 0.0001).

Conclusions: Miami's criteria are equally useful in patients with normal and reduced GFR. As Cr levels increase over 1.2 mg/dL and the GRP declines under 60 mL/min the likelihood of reaching normal ioPTH levels 30 minutes after surgery is significantly lower.

♦ 22. Phenotypes of Primary Hyperparathyroidism: Does parathyroidectomy improve clinical outcomes for all?

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Background: Primary hyperparathyroidism (PHPT) consists of 3 biochemical phenotypes; classic, normocalcemic (ncPHPT), and normohormonal (nhPHPT). However, the clinical outcomes of patients with ncPHPT and nhPHPT are not well described. The objective of this study was to examine surgical and clinical outcomes by phenotype.

Methods: A retrospective review was performed of patients who underwent parathyroidectomy for PHPT at a single institution from 2015-2019. Pre- and post-operative clinical data were collected. Logistical regression analysis of post-operative symptomatic kidney stones and Cox Proportional Hazard analysis of recurrence free survival were performed. A p-value <0.05 was considered statistically significant.

Results: 421 patients were included (340 classic, 39 ncPHPT, 42 nhPHPT). There were no significant differences in patient characteristics or co-morbidities although more ncPHPT (16%) were Hispanic, p=0.037. The median follow-up was 9.5 months (range 0-126). There was no difference in postoperative complications between phenotypes.

ncPHPT was significantly associated with persistent disease with 6/25 (19.4%) patients experiencing persistent disease compared to 1/35 (2.8%) and 3/243 (1.2%) in nhPHPT and classic phenotypes, respectively (p<0.001). ncPHPT had significantly increased risk of recurrence compared to classic phenotype [HR (95% CI) 3.50 (1.66, 7.36), p=0.0016].

Among patients who presented with kidney stones preoperatively (n=94), ncPHPT were more likely to experience symptomatic stone disease postoperatively, 6/13 (46.2%) compared to 11/68 (16.2%) classic, and 2/13 (15.4%) nhPHPT, p=0.0429. ncPHPT was the only found univariate predictor of postoperative kidney stone recurrence in patients with preoperative kidney stones history [OR (95% CI) 4.44 (1.25, 15.77), p=0.029].

A pre- and post-operative DEXA scan was available for 99 patients (77 classic, 14 ncPHPT & 8 nhPHPT). The highest percentage change at the first postoperative DEXA scan for classic PHPT (mean ± SD, 6.4 ± 9.1) and ncPHPT (4.8 ± 11.9) showed improvement, as compared to nhPHPT which remained stable (0.2 ± 14.2), but there was no significant difference between phenotypes (p=0.09).

Conclusions: The 3 phenotypes of PHPT are distinct clinical entities. ncPHPT had higher incidence of persistent/recurrent disease and episodes of postoperative renal colic, with improvements in postoperative bone density. This data should inform preoperative discussions with patients of ncPHPT and nhPHPT and to manage postoperative expectations.

♦ 23. Thyroid hormone replacement following lobectomy: long-term institutional analysis 15 years after surgery

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Background: The decision to pursue lobectomy versus total thyroidectomy is highly individualized and should include counseling for potential thyroid hormone replacement therapy (THRT). However, reported rates of THRT following lobectomy vary considerably from 15%-48% and are limited by short-term follow-up. We sought to assess long-term THRT requirement for lobectomy.

Methods: Patients undergoing thyroid lobectomy from 1/2005 to 7/2010 at an academic institution were retrospectively reviewed. Prior or subsequent contralateral lobectomy and preoperative THRT were excluded. Patient demographics, clinical and laboratory data, surgical pathology, and THRT initiation were compared. Statistical analyses were performed by t-test, Fisher's exact test and multivariate logistic regression.

Results: In total 243 patients were included. The rate of THRT use after lobectomy was 47.7% (116/243). The majority were female (84.7%) and mean age at index operation was 53 ± 1 years. Median length follow-up was 7.2 years (0.02-15.23). Lobectomy was performed for benign pathology in 97% (235/243) of patients. In those requiring replacement, mean post-operative TSH level 9.15 ± 1.2mIU/L. Mean time to THRT initiation was 621 ± 102 days, with 24% starting on therapy ≥2 years after surgery. When comparing THRT to no-THRT patients, there was no difference in mean age, sex, or malignant pathology rates. Concurrent Hashimotos was diagnosed in 23.2% of THRT vs 7.8% no-THRT patients (OR 3.54, 95% CI: 1.6-7.3; p<0.001). More THRT patients had prior radiation or RAI compared to no-THRT patients (5.5% vs. 1.7%) but not statistically significant (p=0.16). Amongst no-THRT patients, 51 of 127 have TSH levels recorded >5 years post-operative (median 10.7 ± 2.7 years). Of these 51 patients, the mean age is 52, 3.9% have Hashimotos, and mean TSH 2.22 mIU/L. On multivariate analysis only Hashimotos disease was independently associated with THRT use after lobectomy (OR 3.48, 95% CI 1.6-8.3; p=0.003).

Conclusions: With long-term follow-up, nearly 50% of all patients who underwent lobectomy required THRT. One-quarter of patients did not start THRT until at least 2 years post-operative and patients with Hashimoto's were 3.5 times more likely to need THRT. Therefore, patients should be followed for a minimum of 2 years after thyroid lobectomy for hypothyroidism.

♦ 24. Total Thyroidectomy is More Cost-effective Than Radioactive Iodine as an Alternative to Anti-thyroid Medication for Graves' Disease

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Background: Literature from the UK and Australia indicate that radioactive iodine (RAI) is both less costly and more effective than surgery for Graves' disease. However, a recent study showed that patients who undergo RAI report worse quality-of-life than those treated by thyroidectomy. The objective of this study is to compare cost-effectiveness between RAI and total thyroidectomy (TT) for Graves' disease, accounting for these updated data. We hypothesized that TT is the more cost-effective approach, and that this result would be driven by superior long-term quality-of-life.

Methods: A Markov decision-analysis model was created to simulate clinical outcomes and costs of medication-refractory Graves' disease treated with RAI or TT. Treatment complication rates were derived from peer-reviewed literature. Effectiveness was measured in quality-adjusted life-years (QALYs) based on published data. Costs were extracted from national Medicare reimbursement rates. All model estimates were subjected to one-way, two-way, and probabilistic sensitivity analyses to gauge outcome confidence and identify factors that strongly influence cost-effectiveness. Willingness-to-pay was set at \$50,000/QALY.

Results: Total thyroidectomy yielded 23.6 QALY versus 20.9 QALY for RAI. The incremental cost-effectiveness ratio was \$2802 per QALY, indicating that surgery is highly cost-effective relative to RAI. Across 1000 microsimulations, TT outperformed RAI in 88.9% of cases. Sensitivity analyses indicate that the model outcomes are driven predominantly by post-treatment quality-of-life, with contributing effects from rates of treatment-related complications and the impact of these complications on quality-of-life.

Conclusions: For patients with Graves' disease who either cannot tolerate or are refractory to anti-thyroid medications, TT is a more cost-effective alternative than RAI. Future research should validate reported differences in quality-of-life between these two treatment modalities.

◆ 25. Simulated Data-Driven Hospital Selection for Surgical Treatment of Differentiated Thyroid Cancer

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Background: Surgery at high-quality hospitals is associated with fewer complications and improved survival for differentiated thyroid cancer. We simulated the impact of referral to higher-quality, convenient hospitals on post-operative serious adverse events for thyroid cancer patients.

Methods: Medicare patients aged ≥ 66 years who underwent a partial or total thyroidectomy for differentiated thyroid cancer (2008- 2019) were identified through procedure and diagnosis codes in the linked SEER-Medicare registry. Age 65 was excluded given the 1- year lookback period. A training cohort (random 80% sample) was used to calculate the adjusted risk of 30-day serious adverse events at each hospital using standard predicted-to-expected ratios. Based on the predicted-to-expected ratios, hospitals were divided into quality quartiles. We applied the quality quartiles to the testing cohort (remaining 20%) and simulated outcomes of patients as if they were treated at the closest better hospital or the best hospital within 30 miles of their home using Bayesian logistic regression with hospital-specific fixed-effects. We evaluated the simulated change in 30-day serious adverse events, cost, and travel distance.

Results: We identified 11,811 patients including 10,516 (89%) with papillary and 1,295 (11%) with follicular carcinoma. Patients in the training cohort ($n=9,477$) received care at 905 hospitals. Risk-adjusted serious adverse event rates ranged from 11.9% at quartile one hospitals to 44.8% at quartile four hospitals ($p<0.001$). Using the testing cohort ($n=2,334$), we identified a higher-quality local hospital for 682 (29.2%) patients. Simulating care at the closest better hospital yielded an absolute reduction of 5.4% and relative reduction of 27.1% in risk of serious adverse events, with \$67 savings per patient. The best local hospital yielded an absolute reduction of 7.2% and a relative reduction of 36.3% in serious adverse events with \$366 mean savings. Simulated alternative hospital selection changed travel distance from 14 miles at the original hospital to 13.8 miles at the closest better and 16.2 miles at the best hospital.

Conclusions: Hospital quality, as assessed by post-operative complications, varied for Medicare patients with differentiated thyroid cancer. Simulated care at higher-quality local hospitals improved outcomes and cost without increasing travel distance. Optimizing hospital selection for elderly patients with thyroid cancer may substantially reduce post-operative morbidity.

◆ 26. A Comparison of CESQIP and NSQIP in Consistency and Ability to Predict Surgical Outcomes

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Background: The Collaborative Endocrine Surgery Quality Improvement Program (CESQIP) tracks thyroidectomy outcomes with self-reported data. The National Surgical Quality Improvement Program (NSQIP) tracks similar outcomes with data collected by professional abstractors. We aimed to compare these databases at both a single-center and national level, in terms of data completeness and ability to predict surgical outcomes.

Methods: In the single-center analysis, consistency between data recorded in both CESQIP and NSQIP at a single institution (2013- 2020) was evaluated using McNemar's test. In the national-level analysis, all available data from CESQIP and NSQIP (including the thyroidectomy module, 2016-2019) were used to compare predictive capability for five outcomes of interest: composite thyroidectomy-specific complication (TSC), composite systemic complication (SC), readmission, reoperation, and mortality. A stepwise logistic regression model was fitted for each outcome by database, using only variables common to both databases. We compared predictive capability (measured by area-under-curve; AUC) for each model and respective registry.

Results: In the single-center analysis, 66 cases were recorded in both CESQIP and NSQIP. The highest number of discrepancies among outcomes was found in the reoperation variable (two captured in NSQIP but not in CESQIP; $\chi^2=2.00$, $p=0.16$). At the national level, there were 24,842 cases in NSQIP, and 17,666 cases in CESQIP. Preoperative characteristics and cancer stage were similar. Proportions of 30-day TSC, SC, readmission, reoperation, and mortality were 13.51%, 2.13%, 1.74%, 1.39% and 0.09% respectively in NSQIP, and 6.84%, 1.85%, 1.64%, 0.66% and 0.06% in CESQIP. The AUC of NSQIP was significantly higher for predicting readmission (73.72% [71.55%-75.63%] vs. 62.61% [59.20%-65.66%]); the AUC of CESQIP was significantly higher for predicting TSC (74.74% [95% CI 73.30%-76.09%] vs. 69.48% [68.59%-70.45%]). Of all common variables examined, NSQIP had 3.44% of values missing while CESQIP had 27.22%.

Conclusions: CESQIP reports lower rates of both TSC and SC compared to NSQIP. After covariate adjustment, CESQIP was more accurate in predicting TSC, underscoring its role in collecting more granular, disease-specific variables. However, a higher proportion of data are missing. The infrastructure of NSQIP leads to more rigorous data capture, but CESQIP is better equipped to predict thyroid-specific outcomes.

◆ 27. What do patients want to know about surgery for low-risk thyroid cancer?

A qualitative study

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Background: Shared decision-making about treatment for low-risk thyroid cancer requires patients and surgeons to work together to select the treatment that best balances risks and expected outcomes with patient preferences and values. To participate in decision making, patients must be activated and ask questions. We aimed to characterize what topics patients prioritize during treatment decision making.

Methods:

We identified substantive questions asked by patients with clinically low-risk (T1-2, N0) thyroid cancer and their family members during audio-recorded consultations with 9 surgeons at two unique healthcare systems. Questions about scheduling and logistics were excluded. Data were analyzed using qualitative content analysis to identify major themes among patient and family questions and how surgeons responded to them.

Results: Overall, 28 of 30 patients with low-risk thyroid cancer asked 253 substantive questions (median 8, range 0-25). Patients were 20-71 years old, mostly white (86.7%) and female (80%). Major themes identified in order of frequency included extent of surgery, thyroid hormone supplementation, surgeon experience, risk of cancer progression, radioactive iodine, and etiology of thyroid cancer. Patients often directly probed for a recommendation regarding the extent of surgery, while surgeons tended to respond indirectly by describing the types of people that might prefer each treatment option. Patients also asked about how the extent of surgery could impact quality of life, whereas surgeons' responses focused more on oncologic benefits and surgical risk. Clarifying questions were commonly asked regarding the conduct of hormone supplementation, radioactive iodine, and surveillance. Several patients directly asked about the surgeons' experience and the risk of the cancer "spreading" to the contralateral thyroid lobe, lymph nodes, or distant sites.

Conclusions: Patients with low-risk thyroid cancer ask probing and clarifying questions in response to surgeon education about treatment options. Patient questions often focus on the decision regarding extent of surgery, quality of life, non-surgical aspects of thyroid cancer care, and the disease. Surgeon responses do not consistently directly answer patients' questions, but focus instead on the risks, benefits, and conduct of surgery itself. These observations suggest surgeons have an opportunity to improve shared decision-making by providing information that patients prioritize.

♦ 28. The clinical significance of ACR TI-RADS 5 thyroid nodules: Not as risky as we think?

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Background: Although the prevalence of thyroid nodules is high, few prove to be malignant. Based on sonographic features, the American College of Radiology (ACR) Thyroid Imaging Reporting and Data System (TI-RADS) categorizes malignancy risk of thyroid nodules with associated management recommendations for each category level. Malignancy rates among nodules with a highly suspicious TI-RADS level (TR5), though frequently have been reported to be high, warrant examination in the context of additional risk stratification tools including cytopathology and molecular testing.

Methods: All patients who underwent fine needle aspiration (FNA) for TR5 nodules from January 2018-September 2021 in a large integrated academic health system were reviewed. Using the Bethesda System for Reporting Thyroid Cytopathology, category V and VI were set as malignant. Molecular testing (ThyroSeq v3) yielding ≥50% risk of malignancy was deemed positive and correlated with surgical pathology.

Results: Four hundred ninety-six TR5 nodules were identified. On FNA cytopathology, 61 (12.3%) were malignant. The breakdown included: 15 (3%) Bethesda I, 362 (73%) Bethesda II, 52 (10.5%) Bethesda III, 5 (1%) Bethesda IV, 6 (1.3%) Bethesda V, 55 (11.1%) Bethesda VI. Of Bethesda III/IV nodules with molecular testing (n=53), 24.5% yielded positive results. In total, 42 (8.5%) nodules underwent surgical resection, most of which were Bethesda VI (n=26, 61.9%). Of excised nodules, 33 (78.6%) nodules were malignant, 6 (14.3%) benign, and 3 (7.1%) noninvasive follicular thyroid neoplasm with papillary-like nuclear features. All TR5 nodules with malignant cytology (Bethesda V/VI) were malignant on histopathology. On average, the total TI-RADS points were higher in malignant nodules compared to benign (9.3 vs. 7.3, p=0.015). Moreover, benign nodules more frequently received TI-RADS points by default due to radiologists' inability to determine composition or echogenicity (33% vs. 3% among malignant nodules; p=0.01).

Conclusions: TR5 designation in thyroid nodules is associated with a lower risk of malignancy than previously reported, and does not appear to independently augment malignancy risk over cytopathology or molecular testing data. Benign and malignant nodules with TR5 designation have discrepancies in certain TI-RADS characteristics and individual points assigned, which may offer an opportunity for quality improvement and standardization measures in ultrasound reporting practices.

♦ 29. Surgical Management of T1/T2 Node Negative Papillary Thyroid Cancer with Tall Cell Histology – Is Lobectomy Enough?

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Background: Papillary thyroid carcinoma (PTC) with tall cell histology has been described as demonstrating more aggressive behaviour compared to classical PTC. Additionally, tall cell variant is considered intermediate risk on ATA guidelines. Therefore, tall cell histology diagnosed on lobectomy may lead to completion surgery and radioactive iodine treatment. However, the subgroup of low stage tumors with tall cell histology may not benefit from aggressive treatment. We compare patients that underwent lobectomy for node negative T1/ T2 tall cell tumors and classical PTC.

Methods: The study cohort was selected from our departmental database of differentiated thyroid cancers treated surgically between 1985 and 2015. Patients with T1 or T2 tumors that had no clinical evidence of regional disease were included in the study. Patients who underwent early planned completion surgery were excluded. Tall cell tumors were defined as those demonstrating $\geq 30\%$ tall cells. Survival and recurrence outcomes were compared between groups using the log-rank test.

Results: Of 6,259 patients in the departmental database, there were 3,925 patients with T1/T2 and N0/X disease. Thyroid lobectomy and isthmusectomy was performed in 996 (25%) patients. There were 429 classical PTCs, 70 tall cell cases, 367 follicular variant PTCs and 130 others. Lobectomy and isthmusectomy was performed for T1/ T2N0X disease in 70 (15%) tall cell cases and 429 (23%) classical PTC cases. There was no significant difference in 10-year overall survival ($p=0.56$) or locoregional recurrence-free probability ($p=0.52$). Disease-specific survival and local or central nodal recurrence-free probability was 100% in both groups. In the PTC group, there were nine cases with subsequent contralateral lobe tumors and five recurrences in the lateral neck. No recurrences were seen in the tall cell group.

Conclusions: T1 or T2 node-negative tumors with tall cell histology can be satisfactorily managed with thyroid lobectomy and isthmusectomy, with equivalent oncological outcomes to classical PTC.

◆ 30. Association of Thyroid Cancer Molecular Profile with Tumor Phenotype and Cancer-specific Outcomes

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Background: Molecular testing (MT) improves the diagnostic accuracy of thyroid cancer. Whether specific MT results are associated with tumor phenotype or provides additional prognostic information needs further delineation.

Methods: We studied a consecutive cohort of thyroid cancer patients who had index thyroidectomy and ThyroSeq-v3 next generation sequencing MT on preoperative FNA cytology or histology in routine clinical management (11/17-10/19). MT results were categorized into three Molecular Risk Groups (MRG-low, MRG-intermediate, and MRG-high) according to Steward et al. (JAMA Oncol 2019) and correlated with histopathologic phenotype. The primary endpoint was biochemical and/or structural recurrence, defined according to 2015 ATA Guidelines. Recurrence-free survival (RFS) was analyzed by the Kaplan-Meier method and with multivariable Cox regression.

Results: Discrete genetic alterations (mutations, fusions, copy number alterations) were detected in 304/359 cancers, of which 143 (47.0%), 119 (39.1%), and 42 (13.8%) were MRG-low, MRG-intermediate, and MRG-high, respectively. Most were papillary carcinomas (316 patients, 88.0%). Recurrence occurred in 38 (10.8%) patients over median follow up of 30 months (IQR 16). Compared to MRG-low cancers, MRG-intermediate cancers were diagnosed in younger patients (mean 4 years, $p=0.04$) and more often had microscopic extrathyroidal extension (ETE; 26.1% vs. 2.1%, $p<0.001$), involved margins (19.3% vs. 2.1%, $p<0.001$), lymphatic invasion (36.1% vs. 3.5%, $p<0.001$), and nodal disease (31.9% vs. 1.4%, $p<0.001$). Compared to MRG-intermediate cancers, MRG-high cancers were diagnosed in older patients (mean 14 years, $p<0.001$) and more often had gross ETE (35.7% vs. 5.0%, $p<0.001$), vascular invasion (33.3% vs. 10.1%, $p=0.001$), and stage II/III/IV disease (61.9% vs. 8.4%, $p<0.001$).

All patients with synchronous/metachronous metastatic disease ($n=8$) had an MRG-high genotype. Estimated 3-year RFS was 92.9%, 81.8%, and 72.2% for MRG-low, MRG-intermediate, and MRG-high genotypes, respectively (log-rank $p=0.004$). Adjusting for age, sex, and tumor size, cancers with MRG-high and MRG-intermediate genotypes were 3.3 (95% CI 1.2-9.5) and 1.8 (0.8-4.0) times, respectively, more likely to recur than those with MRG-low genotypes.

Conclusions: Using modern comprehensive tumor genotyping, the genetic profile of thyroid cancers was not only associated with histopathologic phenotype, but also predictive of recurrence in short-term follow-up. MT results can thus provide valuable preoperative prognostic data to guide initial thyroid cancer treatment planning.

31. Cost-effectiveness of radiofrequency ablation versus thyroidectomy in the treatment of benign thyroid nodules

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Background: Radiofrequency ablation (RFA) is an emerging technology in the United States to treat benign thyroid nodules. The cost- effectiveness of RFA in comparison to traditional thyroidectomy is unknown.

Methods: A patient level state transition microsimulation decision model was constructed comparing radiofrequency ablation with lobectomy in the management of benign thyroid nodules. Our base case was a 45-year-old woman with a solitary 30cc nodule. Estimates of health utilities, complications, and mortality were obtained from the literature and costs were estimated using Medicare reimbursement data. The primary outcomes of interest included total cost, quality-adjusted life years (QALYs), and incremental cost- effectiveness ratios (ICER).

Results: RFA was assumed to cost \$5,000 in the base case analysis, and success was defined as a volume reduction ratio (VRR) greater than 50% with an initial success rate of 78%. Patients with VRR < 50% underwent a second treatment of RFA. Ultrasounds after RFA were performed at 1, 3, 6, and 12 months, then annually. With respect to thyroid lobectomy, the rate of postoperative hypothyroidism was assumed to be 25% and surveillance ultrasounds were performed annually. Radiofrequency ablation represented the dominant strategy, yielding 21.88 QALYs for a total cost of \$14,975.92 in comparison to lobectomy, which yielded 21.46 QALYs for a total cost of \$18,892.37. In a one-way sensitivity analysis varying the cost of RFA across of range of values, the RFA strategy remained cost-effective until the cost of RFA exceeded \$18,600, assuming a willingness to pay \$50,000 per QALY.

Conclusions: RFA is a cost-effective strategy in the treatment of benign thyroid nodules.

32. ENGINEERING FUNCTIONAL 3-DIMENSIONAL PATIENT-DERIVED ENDOCRINE ORGANOIDS FOR BROAD MULTIPLATFORM APPLICATIONS

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Background: Recent advancement in 3-dimensional (3D) patient-derived organoid models has revolutionized the field of cancer biology. In contrast, development of endocrine tumor organoid platforms has lingered, largely due to the challenging in-culture growth of terminally differentiated, hormonally active endocrine cells. There is an urgent need for development of endocrine tumor organoid models, such as medullary thyroid carcinoma (MTC), adrenocortical carcinoma (ACC), and papillary thyroid carcinoma (PTC), as well as a spectrum of benign hyperfunctioning parathyroid and adrenal tumor organoid models. Our group aimed to engineer functionally intact 3D models of thyroid, parathyroid and adrenal tumors to expand their in vitro and broad translational applications for advancement of endocrine research.

Methods: Using our recently developed FNA-based methodology, we established 3D endocrine organoid models. We prospectively collected human PTC (n=6), MTC (n=3), ACC (n=3), benign parathyroid (n=5) and adrenal (n=5) tumors and optimized 3D semi-solid culture conditions for organoid formation, growth, and proliferation. Structural and functional analyses of formed endocrine organoids were carried using brightfield microscopy, immunofluorescence, immunohistochemistry, electron microscopy, near-infrared fluorescence (NIRAF) imaging, ELISA hormone assays for parathyroid hormone (PTH), Calcitonin and Cortisol. Endocrine organoids and isolated tumor-infiltrating T lymphocytes (TILs) were directly co-cultured, and supernatants assessed for cytokine response using ELISA assay. Endocrine organoids were irradiated and examined for proliferation and antioxidant response.

Results: We successfully established novel 3D endocrine organoid models of MTC, ACC, parathyroid and cortisol-secreting adrenal tumors in vitro. Both, morphologically and functionally, 3D endocrine organoids recapitulated their respective complex tumor microenvironment with robust expression of endocrine organ-specific markers and maintained hormonal production. Endocrine organoids recreated NIRAF properties of the endocrine tissues of origin. Organoid co-cultures with TILs induced altered cytokine production profile, while irradiation enhanced antioxidant response. Parathyroid organoids demonstrated functional hormonal responsiveness to fluctuating Calcium concentrations in culture media.

Conclusions: We have successfully modeled and analyzed the complex endocrine microenvironment for a spectrum of endocrine tumors in 3D culture. Our novel engineered endocrine organoid models of MTC, ACC, parathyroid and benign adrenal tumors represent an exciting and elegant alternative to current limited 2D systems and afford future broad multiplatform in vitro and translational applications, including in endocrine immuno-oncology.

33. The Impact of TI-RADS on Thyroid Nodule Cytology Rates

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Background: Nodule characterization using the Thyroid Imaging Reporting and Data System (TI-RADS) for ultrasound classification of malignancy risk may improve identification of nodules appropriate for further assessment by FNA biopsy. The impact of this modality on FNA cytology reporting is unknown. The aim of this study was to evaluate rates of cytologic classifications before and after TI-RADS implementation at a high-volume academic institution in the US.

Methods: After multidisciplinary consensus, synoptic description of thyroid nodules using TI-RADS classification was implemented for all ultrasound reports system-wide. Single institutional review of cytology categorization by Bethesda criteria (BI-VI) from 1/2014 to 10/2021 was performed, changes in frequency of cytology categorization were analyzed by linear regression, and pooled cohorts of pre- (2014-2018) and post-TI-RADS (2019-2021) cytology call rates were compared.

Results: Overall 7,413 specimens were included with a mean 926 specimens per year (range 715-1,444) which was not significantly different pre- and post-TI-RADS (1,014 vs. 780; $p=0.16$). From 2014 to 2021, the frequency of benign (BII) cytologic diagnoses per year declined from 49.7% to 19.4% and AUS/FLUS (BIII) rates increased from 21.3% to 51.5%; both demonstrated strong linear trends and an inverse relation with slopes of -4.8 and 4.4 and R^2 values of 0.92 and 0.93, respectively ($p<0.001$ for both). Suspicious for malignancy (BV) rates increased from 1.2% to 1.8% in a linear trend (slope 0.12, R^2 0.61; $p=0.02$) but less robustly than for BIII. However, no linear trends in Non-diagnostic (BI; slope -0.03; $p=0.74$), Follicular Neoplasm (BIV; slope 0.2; $p=0.37$), or Malignant (BVI; slope 0.15; $p=0.42$) cytology were identified. Calculation of mean cohort frequencies showed that after system-wide implementation of TI-RADS, the likelihood of BII cytology decreased (43.1% vs. 21% [CI:12.71-31.45]; $p=0.001$) while the likelihood of BIII (28.3% vs. 47.7% [CI:10.03-28.81]; $p=0.002$) and BV (1.1% vs. 1.7% [CI:0.16-1.01]; $p=0.015$) cytology significantly increased.

Conclusions: In this retrospective study, implementation of TI-RADS was associated with a 2.5-fold decline in the proportion of thyroid nodules with benign cytology and a 2.5-fold increase in AUS/FLUS, suggesting that the use of ultrasound criteria for thyroid malignancy beneficially contributes to more appropriate triaging of thyroid nodules for biopsy.

34. A MULTICENTER EVALUATION OF NEAR INFRA-RED AUTOFLUORESCENCE IMAGING OF PARATHYROID GLANDS IN THYROID AND PARATHYROID SURGERY

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Background: There is a lack of consensus on how to incorporate near infra-red (NIFI) autofluorescence (AF) in thyroid and parathyroid surgery. Our aim was to develop a prospective data registry and gather expert opinion on appropriate use of this technology in thyroidectomy and parathyroidectomy procedures

Methods: This was a prospective institutional review-board-approved multicenter collaboration of seven academic centers in the US. Within 23-months, clinical, operative, pathologic, biochemical and AF data of patients undergoing thyroidectomy and parathyroidectomy procedures were entered into Redcap database. A digital questionnaire was also filled out by 24 participating surgeons. Descriptive statistical analysis was performed.

Results: There were 751 procedures entered into the prospective registry, including thyroidectomy in 404 patients and parathyroidectomy in 347 patients. Of the patients undergoing parathyroidectomy, 346 had sporadic primary, 3 secondary and 8 tertiary hyperparathyroidism. Diagnosis was a single adenoma in 221 (63.8%) patients, double adenoma in 79 (22.8%) patients and hyperplasia in 46 (13.3%) patients. 41 percent (n=10) of surgeons found AF to be useful to identifying PGs before they become apparent to the eye and 67 percent (n=16) correlated the AF patterns to normal and abnormal glands (normal glands brighter and more homogenous). 38 percent (n=9) of surgeons used AF signals, rather than frozen section to confirm parathyroid tissue. 87 percent (n=21) and 78% (n=18) of the surgeons, respectively, did not think that AF improved the success rate after parathyroidectomy nor the ability to find ectopic parathyroid glands (PGs). A total of 404 thyroidectomy procedures was performed. 66 percent (n=16) of surgeons reported a routine NIFI of thyroid specimens to rule out incidental parathyroidectomy, but only 36.3% (n=8) commented that AF decreased incidental parathyroidectomy rates in thyroidectomies. 45% (n=10) believed that AF improved their ability to preserve PGs during central neck dissection.

Conclusions: This is the largest multicenter prospective evaluation of AF imaging in thyroid and parathyroid surgery. Although there was a consensus on the utility of NIFI for PG detection and/or preservation during parathyroidectomy and thyroidectomy procedures, there was heterogeneity in perceived value and technical incorporation for each surgeon.



POSTERS

◆ Denotes Resident/Fellow Competition Poster

(V) denotes virtual only poster

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

◆ 01. Epigenetic targeting of bromodomain and extra-terminal domain proteins as a novel therapy for pancreatic neuroendocrine tumors

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Background: Pancreatic neuroendocrine tumors (PNETs) are associated with limited treatment options and poor outcomes for patients with advanced disease. Epigenetic dysregulation is implicated in the development of PNETs and inhibitors of the bromodomain and extra-terminal domain (BET) family of epigenetic reader proteins (BRD2, BRD3, and BRD4) have emerged as a promising anti-cancer therapy. However, the role of BET proteins, and potential utility of BET inhibitors in PNETs, is not well understood. Here, we characterised the expression of BET proteins in human PNET samples and performed in vitro efficacy and mechanistic studies using the BET inhibitor I-BET151.

Methods: Expression of BET proteins was assessed in 54 resected human PNET specimens and compared with adjacent non-tumor pancreas using immunohistochemistry. Three PNET cell lines (BON1, QGP1, and MIN6) were treated with I-BET151 and changes in viability, apoptosis, and cell cycle progression were assessed using CellTiter-Blue, CaspaseGlo, and flow cytometry assays, respectively. Early (6h) transcriptomic responses to BET inhibition were examined using thiol(SH)-linked alkylation for the metabolic sequencing of RNA (SLAM-seq), while standard RNA sequencing (RNA-seq) was used to characterise late (48h) changes.

Results: Overexpression of BRD2, BRD3 and BRD4 was observed across all subtypes of functioning and non-functioning PNETs, relative to normal adjacent pancreas. BET family members were also expressed in all 3 PNET cell lines, with BRD2 showing higher expression compared to BRD3 and BRD4. Treatment with I-BET151 inhibited proliferation of all 3 cell lines at submicromolar concentrations (IC50: 0.24 – 0.48µM) after 96h. The anti-proliferative effects of I-BET151 remained present for >48 hours after removal of the compound. Moreover, I-BET151 stimulated apoptosis by ~2-3-fold ($P < 0.05$) and increased the proportion of cells arrested in the G1 phase of the cell cycle. SLAM-Seq and RNA-Seq revealed that I-BET151 treatment resulted in 156 and 2,928 differentially expressed genes, respectively, which were enriched in cancer-relevant pathways, including cell cycle regulation and mTOR signaling.

Conclusions: BET proteins are an actionable target in human PNETs and pharmacological BET inhibition shows therapeutic efficacy in PNET cells through direct and indirect modulation of gene expression. The findings support further in vivo evaluation of BET inhibitors as a novel therapy for PNETs.

◆ 02. The Papillary Thyroid Cancer Glycome Reveals Patterns of Complex-Type, Branching N-glycans

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Background: Complex-type asparagine-linked (N)-glycans on glycoproteins have been implicated in tumorigenesis and associated with progression and metastasis in several cancers. We aimed to characterize differences in the glycome of papillary thyroid cancer (PTC) compared to normal thyroid tissue.

Methods: RNA-seq data for twenty paired normal and cancerous tissues from patients with PTC were acquired from the Human Cancer Genome Atlas to assess differential expression of glycogenes. Data were expressed as reads per kilobase of transcript, per million mapped reads (RPKM). Tissue lysates from six additional paired samples were enzymatically treated and western/lectin blotting was performed to evaluate the structural features of the glycome across samples. The N-glycans were enzymatically released, purified, and permethylated for detailed characterization by matrix-assisted laser desorption/ionization-time of flight mass spectrometry (MS).

Results: RNAseq data revealed a decrease in expression of sialyltransferase ST6GAL1 in cancer tissues compared to normal (7.6 vs. 14.6 RPKM, $p=0.0197$). Sulfotransferase GAL3ST3 was highly expressed, but not significantly different between cancer and normal tissues (9.2 vs. 12.0 $p=0.1089$). Expression of glycogenes related to complex- and branching- N-glycans was varied, with MGAT3 demonstrating significantly increased expression in cancer (9.63 vs. 0.81, $p=0.0002$), while MGAT5 was highly expressed but not significantly different (7.90 vs. 9.75, $p=0.05$). Lectin blotting with ConA and PHA-L revealed a relative decrease in hybrid-type N-glycans in cancer samples correlating with an increase in complex-type N-glycans. Similarly, cancer tissues demonstrated decreased presence of sialic acid epitopes stained by SNA on N-glycans compared to benign tissues. Staining by 06 antibody (anti-3-O-sulfated galactose) revealed the presence of sulfated N-glycans, which were decreased in cancer tissues compared to benign. MS analysis confirmed a transition to increasingly complex N-glycans reflected by higher mean relative abundance of tri- and tetra-antennary N-glycans (2% vs. 0.7%, $p=0.003$) and GlcNAc-containing N-glycans (6% vs. 0.5%, $p=0.0307$), correlating with RNA-seq and western/lectin blotting results.

Conclusions: Glycoprotein N-glycans in PTCs demonstrate broad sulfation, a reduction in sialylation, and a transition to complex- and branching-type N-glycans compared to normal tissues. Further study of these altered glycans and their function will increase understanding of thyroid tumor biology and improve diagnostics in thyroid cancer.

(V) 03. Concurrent Papillary and Anaplastic Thyroid Cancer: Clarifying the Spectrum of Aggressive Behavior

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Background: Anaplastic thyroid carcinoma (ATC) is a rare and lethal form of thyroid cancer. However, overall prognosis is unclear when it focally arises in a background of papillary thyroid cancer (PTC). We aimed to characterize the clinicopathologic features of tumors with concurrent PTC and ATC histologies (cPTC/ATC), and assess outcomes by treatment.

Methods: The National Cancer Database was queried for histologic codes denoting PTC, ATC, and cPTC/ATC, defined as Grade 4 PTC, diagnosed from 2004-2017. Clinicopathologic features, overall survival, and treatment were analyzed by histologic type.

Results: 386,862 PTC, 763 cPTC/ATC, and 3,880 ATC patients were identified. Patients with cPTC/ATC had clinicopathologic features in-between those of PTC and ATC, including age (50.1±15.0 PTC vs. 66.5±13.9 cPTC/ATC vs. 70.2±12.0 years ATC, p<0.001), rates of tumor size >4cm (7.4% vs. 57.5% vs. 79.1%, p<0.001), extrathyroidal extension (16.8% vs. 80.4% vs 84.8%, p<0.001), and distant metastases (1.0% vs. 24.0% vs. 38.7%, p<0.001). The median survival was shorter for cPTC/ATC compared to PTC, but longer than ATC (not reached vs. 10.2±1.3 vs. 3.7±0.1 months, p<0.001). On multivariable Cox regression analysis of cPTC/ATC patients, age >55yo (hazard ratio 2.79, 95%-CI [1.78-4.47], p<0.001), Charlson-Deyo score ≥2 (3.33, 95%-CI [1.68-6.60], p=0.001), distant metastases (1.92, 95%-CI [1.31-2.83], p=0.001), lymphovascular invasion (1.51, 95%-CI [1.05-2.18], p=0.027), and positive surgical margins (2.28, 95%-CI [1.55-3.37], p<0.001) were associated with worse survival, whereas total thyroidectomy (0.28, 95% CI [0.15-0.51], p=<0.001) and EBRT (0.64, 95%-CI [0.42-0.99], p=0.045) were associated with improved survival. If any aggressive features were present, including positive lymph nodes, distant metastases, extrathyroidal extension, positive margins, or lymphovascular invasion, the median survival of cPTC/ATC decreased to 7.8±0.7 months; it was not reached in their absence (p<0.001). Among patients with cPTC/ATC, the median survival improved as resection extent increased (no surgery:4.2±0.7; R2:4.1±1.8; R1:7.5±0.9; R0:71.3±22.6 months, p<0.001) and was prolonged by EBRT for R2 margin status (R1, -EBRT:8.0±2.8; R1, +EBRT:7.2±0.5; R2, -EBRT:1.8±0.7; R2, +EBRT:7.6±2.4 months, p=0.003).

Conclusions: Median survival of patients with cPTC/ATC lies within a spectrum between that of PTC and ATC, and is dependent on certain aggressive clinicopathologic features. Survival is favored if an R0 resection is obtained, or if EBRT is administered following R2 resection.

◆ 04. National Trends in Guideline-Based Management of Papillary Thyroid Carcinoma Over Time: Disparities Based on Hospital Setting

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Background: Over time, the American Thyroid Association (ATA) guidelines on the management of well-differentiated thyroid cancer have increasingly supported less aggressive therapy for tumors up to 4cm. Using the National Cancer Database (NCDB), we investigated the impact of these guidelines on the management of these tumors on a national scale.

Methods: All patients with papillary thyroid carcinoma diagnosed between 2004-2018 in the NCDB were selected. Patients with tumors larger than 4cm, metastatic disease, or clinical evidence of nodal involvement were excluded. Patient demographics, tumor characteristics, and treatment were analyzed. Rates of thyroid lobectomy, total thyroidectomy, and total thyroidectomy plus radioactive iodine (RAI) were tabulated before and after the 2009 and 2015 ATA guideline changes. The study population was grouped by date of diagnosis (2004-2008, 2009-2014, and 2015-2018).

Results: We identified 192,418 patients who underwent surgical treatment during the study period. The majority were female (154,005, 80.0%) and White (148,919, 77.4%). The rate of lobectomy decreased from 15.2% to 13.0% after the 2009 guideline changes ($p < 0.001$) but subsequently increased to 19.8% after the 2015 changes ($p < 0.001$). Among patients undergoing total thyroidectomy, the rate of adjuvant RAI administration decreased from 50.5% to 40.3% after the 2009 guideline changes ($p < 0.001$) and subsequently decreased to 26.0% after the 2015 changes ($p < 0.001$). Similar trends were observed for subgroups based on sex and race/ethnicity. During the study period, lobectomy rates at academic institutions increased overall (14.5% to 21.9%, $p < 0.001$); however, community hospitals saw an overall decrease (18.0% to 17.3%, $p = 0.04$). Among community hospitals, those in the West saw the greatest increase in lobectomy rates (11.3% to 18.2%, $p < 0.001$), while no changes were observed in the Northeast (18.8% to 19.8%, $p = 0.33$), Midwest (16.6% to 16.6%, $p = 0.99$), and South (16.2% to 15.8%, $p = 0.25$). Lastly, a greater increase in lobectomy rates was observed for tumors 1-4cm (6.7% to 14.1%, $p < 0.001$) than tumors < 1 cm (23.7% to 26.2%, $p < 0.001$).

Conclusions: Among papillary thyroid carcinomas up to 4cm, the ATA guideline changes corresponded with increased lobectomy rates and reduced adjuvant RAI administration. These changes were primarily seen in academic institutions, suggesting an opportunity for expanding guideline-based education and care in the community setting.

◆ **05. Pediatric Primary Hyperparathyroidism: Surgical pathology and long-term outcomes in sporadic and familial cases**

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Background: Hyperparathyroidism (HPT) is a rare diagnosis in the pediatric population. Long-term data regarding surgical outcomes is scarce.

Methods: Single-center retrospective review (1994-2020) of all clinical variables in patients under the age of 21 undergoing surgery for primary HPT.

Results: Sixty-six patients were identified, 61% female. Mean age at diagnosis was 17±3 years (6-21). Seventy-one percent were symptomatic at diagnosis, most commonly with nephrolithiasis (37%). Thirty-six percent of patients had a known mutation at time of diagnosis, most commonly MEN-1(67%), followed by Familial isolated HPT (19%) and MEN 2A (9%). Of patients without known mutation at diagnosis, 23% had genetic testing, of which 23% were positive for familial syndromes. Pre-operative median serum calcium and PTH were 11.5 mg/dL (Q1-11.1, Q3-12.5) and 99 pg/mL (Q1-71, Q3-133) respectively, without significant difference between sporadic and familial. Most patients (90%) underwent pre-operative imaging, most commonly sestamibi scan, 93%. Fifty-six percent of the total cohort and 19% of the familial cohort underwent focused exploration. Single gland disease was identified in 65%, 19% for familial vs 85% sporadic, $p < 0.00001$. Fourteen percent of patients ($n=9$) lost follow-up immediately after surgery, and median follow-up was 81 months (Q1-12, Q3-151). Disease persistence occurred in 9% of cases, all sporadic ($p=0.11$); 80% having undergone bilateral exploration. Forty percent of persistences were due to ectopic mediastinal parathyroid glands. Surgical complication rate was 12%, most frequently transient hypocalcemia. Recurrence rate was 16.7%, 38% in familial vs 2% in sporadic, $p=0.0004$. Twenty percent of all recurrences occurred after unilateral exploration, all in patients with familial isolated hyperparathyroidism. All recurrences were treated: Eight patients underwent re-operation and two MEN-1 patients underwent ethanol ablation of parathyroid remnants. Median time to recurrence was 59 months (Q1-38, Q3-95), 61 months familial cohort vs 124 months sporadic, $p=0.001$.

Conclusions: Pediatric primary HPT may frequently be sporadic. However, 5% of cases without family history are ultimately attributed to genetic syndromes. Sporadic HPT is due to single adenoma at a rate similar to the sporadic adult population (85%). Familial cases have higher recurrence rates and with earlier onset of recurrence, requiring closer follow-up as re-interventions are often needed.

◆ 06. Pathological volume as a predictor of risk stratification for differentiated thyroid microcarcinoma

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Background: Differentiated thyroid cancers (DTC) management is undergoing evolution with DTC $\leq 1\text{cm}$ in greatest diameter (GD) regarded to follow a more indolent course. The American Thyroid Association (ATA) guidelines include risk stratification as part of treatment of DTC. As tumours are more ellipsoid in shape, tumour volume (TV) may better represent a tumour's size. We hypothesized that TV could be a better predictor of size; and assessed patients with T1 DTC (GD $\leq 2\text{cm}$) to determine if TV can be a better predictor of the ATA risk of recurrence.

Methods: Patients who underwent surgery for T1 DTC between 2007-2016 were retrospectively analysed. ATA high-risk patients and those without pathologically recorded three-dimension tumours were excluded. The primary endpoint was prediction of ATA intermediate risk category. TV was calculated assuming an ellipsoid shape; TV cut-off established by ROC analysis using lateral nodal disease (N1b) as the predictive factor; Odds ratio (OR) for TV and GD for relevant biology, and ATA risk by performing logistic regression.

Results: 523 patients were analysed; median age was 51 years and 81% were female.

TV ranged between 0.3 - 3780.4mm³. Regression showed greater variation in TV as GD increased. ROC analysis (AUC= 0.0193, P = 0.0193) established optimal TV cut-off of 350mm³ to classify a small volume cancer group (sensitivity = 41.6%, specificity = 78.3%). This TV cut-off enabled 9.4% of tumours be recategorized from the initial 1cm GD cut-off.

The larger volume group had a higher OR for predicting intermediate versus low risk in multivariate analysis (OR = 2.1 vs 1.8, P = <0.001 vs 0.004). Only TV cut-off was able to predict venous invasion in multivariate analysis (OR= 1.7 vs 1.3, P = 0.024 vs 0.255). Analysis of a subset of patients (excluding N1b patients) using the same TV cut-off showed the volume group was still able to predict ATA risk better than GD (OR =1.8 vs 1.6, P = 0.004 vs 0.022).

Conclusions: TV was a better indicator than GD for a tumour's risk category. As TV can be obtained pre-operatively by radiological assessment, routine TV measurements could allow clinicians to stratify patients more accurately.

♦ 07. Can we Predict Hypercalcemia Following Renal Transplant in Patients with Secondary Hyperparathyroidism and End Stage Kidney Disease?

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Background: Secondary hyperparathyroidism (2HPT) ultimately affects most patients with end stage kidney disease (ESKD) and is associated with morbidity and mortality. Treatment includes parathyroidectomy or calcimimetics. While renal transplant often offers a durable cure of hyperparathyroidism, a subset of patients develop post-transplant tertiary hyperparathyroidism (3HPT) with hypercalcemia. Since these patients have bone demineralization, calcimimetics are usually not appropriate treatment and parathyroidectomy is warranted. There are limited data to predict which 2HPT patients will develop post-transplant 3HPT and hypercalcemia. To guide surgical management, this study attempts to identify risk factors for development of post-transplant hypercalcemia.

Methods: A retrospective single centre study was performed at a high-volume transplant and endocrine surgery institution. Patients over 18 years-old with ESKD and established 2HPT, who received kidney transplants between 2011 and 2021 were included and those who had pre-transplant parathyroidectomy were excluded. Chart review identified clinical characteristics while on dialysis which were compared to post-transplant calcium values. A multivariable logistic regression identified independent variables associated with post-transplant hypercalcemia.

Results: Overall, 120 patients were identified and 99 met inclusion criteria. Median age of transplant was 52 (22-83 years) with 46 female and 53 male patients. Median pre-transplant months on dialysis was 52.2 (range 2.8-207.6). Overall, 18% of patients developed hypercalcemia post-transplant. Duration of dialysis (in months) and higher pretransplant calcium and PTH were associated with the development of hypercalcemia. Cinacalcet use was protective from developing hypercalcemia post-transplant, with an OR of 0.03 ($p=0.01$, 95%CI 0.002-0.48).

Conclusions: To guide surgical management, we identified risk factors for development of hypercalcemia after kidney transplant in patients with 2HPT. Duration of dialysis and elevated PTH prior to transplant was associated with development of 3HPT. Use of cinacalcet pre-transplant appears to be inversely associated with development of post-transplant hypercalcemia. This is the first description of calcimimetics influencing progression to hypercalcemia after transplant and could guide medical and surgical management of 2HPT during dialysis. Further, these data give insight on predicting which ESKD patients may eventually need parathyroidectomy and support calcimimetic therapy pretransplant, potentially decreasing likelihood of post-transplant hypercalcemia.

◆ **08. Altered clinically significant REDOX homeostasis in adrenocortical cancer is associated with the FOXM1/β-catenin pathway and overexpression of DNA damage repair genes**

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Background: To survive cellular oxidative stress, cancer cells commonly upregulate antioxidant enzymes. In contrast to many solid cancers, we reported downregulated mRNA expressions of several reduction and oxidation (REDOX) enzymes and the associations with shorter overall and recurrent-free survival (OS and RFS, respectively). In this study, we aim to identify the molecular processes involved in clinically significant altered (REDOX) enzymes.

Methods: Using the data from The Cancer Genome Atlas and the Gene Expression Omnibus, we analyzed the mRNA expression, mutation profile, and clinicopathologic features of the ACC cohort and the relationship of genes involved in oxidative stress, DNA damage repair, and ACC cell proliferation.

Results: In addition to a previously reported downregulation of TXNRD1, PRDX3, and PRDX4, patients with ACC and downregulated GSS, SOD2, and GPX3 had significantly shorter OS and RFS. We found significant inverse correlations between TXNRD1, SOD2, and GPX3 mRNA expressions and those of MKI67 and CCNB1 ($p < 0.001$ to $p = 0.048$), suggesting the effect on ACC cell proliferation. The downregulated REDOX genes in ACC had significant correlations with mRNA overexpressions of DNA damage (H2AX) and DNA repair genes (ATM, ATR, BRCA1/2, and CHEK1/2) ($p < 0.001$ to $p = 0.03$). The upregulation of several DNA repair genes (BRCA1/2, CHEK1/2, and PARP1/2) strongly correlated with those of MKI67 ($p < 0.001$ to $p = 0.022$), BIRC5 ($p < 0.001$), and FOXM1 ($p < 0.001$), suggesting the involvement of Survivin and Wnt/FOXM1/β-catenin pathway. In addition, the upregulation of FOXM1 and DNA repair genes was associated with significantly shorter OS and RFS ($p = 0.02$ to $p < 0.01$).

Compared to the wild-type samples, ACC with CTNNB1 mutations had significantly lower mRNA expressions of SOD2 ($p < 0.01$), PRDX3 ($p < 0.01$), TXNRD1 ($p = 0.016$), and TXNIP ($p < 0.01$). The mRNA overexpression ATR was associated with CTNNB1 mutation ($p < 0.01$).

In ACC with TP53 mutations, the DNA damage and repair genes H2AX ($p = 0.02$), CHEK1 ($p < 0.01$), CHEK2 ($p < 0.01$), and BRCA1 ($p < 0.01$) were upregulated. ATM was downregulated in ACC with TP53 mutations ($p = 0.014$). Downregulation of GSS was associated with TP53 mutations ($p = 0.041$) and shorter OS ($p = 0.022$) and RFS ($p = 0.019$).

Conclusions: The downregulation of clinically significant REDOX genes in ACC involves DNA damage, upregulation of multiple DNA repair genes, and activation of FOXM1/β-catenin signaling pathway with increased cyclin-dependent ACC cell proliferation.

◆ 09. Characterization of High-Risk Features in 2-4cm Papillary Thyroid Cancers and Limitations in Preoperative Decision for Surgical Extent

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Background:The 2015 American Thyroid Association (ATA) guidelines proposed thyroid lobectomy as an acceptable option for 1-4cm papillary thyroid cancers (PTC) without extrathyroidal extension (ETE) or clinically-evident lymph node (LN) metastasis. However, appropriate surgical extent for PTC remains controversial, and the recent exclusion of an indolent subset of tumors called noninvasive follicular neoplasm with papillary-like nuclear features (NIFTP) further necessitates re-evaluation of optimal management strategies. We examined the frequency of preoperatively- and postoperatively-detected high-risk features in 2-4cm PTCs in order to assess appropriate surgical extent.

Methods:All patients who underwent an index thyroid surgery at a large tertiary center between January 2015 and December 2020 with 2-4cm PTC (including conventional PTC, follicular-variant PTC, tall cell variants, and diffuse sclerosing variants) on final pathology were included. Patients with noninvasive follicular-variant PTC with complete encapsulation were considered to have NIFTP and were excluded. Demographics, preoperative findings, perioperative course, and surgical pathology were retrospectively reviewed and analyzed.

Results: A total of 424 patients met the inclusion criteria. Of these patients, 232 (54.7%) had at least one of the following high-risk features: gross ETE (n=79, 18.6%), distant metastasis (n=5, 1.2%), >3 LN involvement with extranodal extension (n=105, 24.8%), any LN >3cm (n=2, 0.5%), positive margin (n=56, 13.2%), TERT mutation (n=11, 2.6%), vascular invasion (n=11, 2.6%), cN1 disease (n=121, 28.5%), and >5 LN involvement (n=129, 30.4%). A total of 259 (61.1%) patients had at least one LN involvement. On preoperative imaging, 200 (47.2%) had neither ETE nor LN metastasis and would have been eligible for lobectomy. However, on final pathology, 51/200 (12.0%) patients had at least one of the aforementioned high-risk features, and 69 (34.5%) had a pN1 disease. Preoperative imaging had sensitivities of 50.5% and 44.4% for detecting ETE and LN metastasis, respectively.

Conclusions: A significant portion of patients with 2-4cm PTCs, including those who preoperatively met the criteria for lobectomy, were found to have high-risk features on final pathology that warrant a total thyroidectomy. Given the limitations in preoperative determination of high-risk features, lobectomy may not be the optimal surgical extent for many 2-4cm PTCs and should only be considered in carefully- selected cases.

◆ 10. Association of Medicaid Expansion of the Affordable Care Act with Access to Surgery for Benign Endocrine Surgical Disease

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Background: The Affordable Care Act's Medicaid Expansion (ME) increased insurance coverage in participating states. Prior work showed that ME was associated with increased Medicaid patients undergoing thyroid cancer surgery, but the impact of ME on patients with benign endocrine disease remains unclear.

Methods: The Vizient National Database was queried for Inpatient and Outpatient benign thyroid, parathyroid, and adrenal operations from 2011-2017. The data was then categorized by ME status in January 2014. States that expanded before or after January 1, 2014 were excluded. Descriptive statistics and difference-in-differences (DD) analyses were performed to analyze the association of ME with insurance status at time of surgery, adjusted (Adj) by age, sex, race, comorbidities, and state and year fixed effects. Adjusted odds of undergoing thyroid, parathyroid, or adrenal surgery were performed via logistic regression.

Results: 137,655 patients were analyzed. Patients in expansion states (ES) were younger and more likely to be non-white compared to non-expansion states (NES) (both $p < 0.001$). ME was associated with an increase in Medicaid coverage for those undergoing benign thyroid (Adj DD: 6.28% [95% CI: 5.17%-7.40%] $p < 0.001$), parathyroid (Adj DD: 4.27% [CI: 3.13%-5.41%] $p < 0.001$), and adrenal operations (Adj DD: 5.38% [CI: 2.62%-8.26%] $p < 0.001$) in ES compared to NES. There was an associated decrease in the proportion of uninsured patients undergoing thyroid (Adj DD: -3.92% [CI: -4.64%- -3.20%] $p < 0.001$) and parathyroid operations (Adj DD: -1.53% [CI: -2.07%- -0.99%] $p < 0.001$) and in privately insured patients undergoing thyroid (Adj DD: -2.60% [CI: -4.00%- -1.21%] $p < 0.001$) and adrenal operations (Adj DD: -4.04% [CI: -7.66% - -0.41%] $p = 0.029$). Medicaid patients had increased odds of undergoing thyroid surgery (OR 1.66 [CI: 1.56-1.78] $p < 0.001$) and decreased odds of undergoing parathyroid (OR 0.71 [CI: 0.68-0.75; $p < 0.001$]) or adrenal surgery (OR 0.70 [CI: 0.64-0.76; $p < 0.001$]) compared to privately insured patients, even after ME.

Conclusions: Medicaid Expansion was associated with an increase in Medicaid coverage for surgical patients with benign endocrine disease in expansion states. There was an associated decrease in privately insured patients undergoing thyroid and adrenal surgery and uninsured patients undergoing thyroid and parathyroid surgery. Medicaid patients remained at decreased odds of undergoing parathyroid and adrenal operations, which may indicate underdiagnosis in this population.

◆ 11. The Obesity Paradox in Thyroid Surgery: Is Higher BMI Protective Against Hypoparathyroidism?

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Background: An association has been demonstrated between adiposity and parathyroid hormone (PTH) levels. It is also well- documented that parathyroid manipulation can lead to blood supply disruption and compromised function. We hypothesized that patients with a higher body mass index (BMI) would have lower rates of post-operative hypoparathyroidism following total thyroidectomy, whether due to higher pre-operative PTH values (pre-PTH) or factors inherent to central neck adiposity.

Methods: A retrospective review was performed of prospectively-collected data from all patients undergoing total thyroidectomy by five surgeons at one institution from 2015-2021. Patients undergoing concurrent parathyroid surgery were excluded. Patient demographics, BMI, surgical indications, and clinical and biochemical data including pre-PTH and post-operative PTH (post-PTH) values were examined. Kruskal-Wallis, Chi-square, and multivariable regression modeling were used for analysis, as appropriate. PTH reference range 12-88 pg/mL, with hypoparathyroidism defined as PTH <12 pg/mL.

Results: Inclusion criteria were met for 418 patients; 352 had complete clinicopathologic data. Most patients were female (n=324, 77.7%) and had Graves' disease (n=164, 44.0%). BMI categorized as overweight (25-29.99) was most common (n=125, 31.5%), but 11.8% (n=47) were considered morbidly obese (BMI >40). Surgical indication, pre-operative PTH and vitamin D levels were not significant predictors of post-operative hypoparathyroidism (p>0.05 for all). Increasing BMI was significantly associated with higher mean post-PTH levels (19.3 vs. 46.0pg/mL) in the BMI<18.5 vs. >40 group, respectively (p=0.001). Number of parathyroid glands visualized (p=0.28) and auto-transplanted (p=0.42) were not associated with post-PTH values. Patient race/ethnicity was significantly associated with pre-PTH and post-PTH (p=0.03, p=0.004), with mean pre-PTH vs post-PTH for Black, Hispanic, and White patients 68.2 vs 33.8, 46.6 vs 41.1, and 52.7 vs 23.6pg/mL, respectively. On multivariable analysis, race and BMI were independent predictors of post-PTH (p=0.001 for both).

Conclusions: Patients with higher BMIs have relative protection from post-operative hypoparathyroidism independent of other factors including surgical indication or pre-operative PTH values. Consistent with other population data, race was also associated with both pre- and post-operative PTH levels, though both race and BMI remained independent predictors on multi-variable analysis.

◆ 12. Risks of Central Neck Dissection in the Re-operative Setting: a CESQIP Database Analysis

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Background: Prior reports on the risks of central neck dissection (CND) in a reoperative setting (CND-r) have been mixed and are limited to single-institution series. We hypothesize that at a multi-institutional level, patients undergoing CND-r experience higher rates of complications, as compared to those undergoing CND with their primary thyroid surgery (CND-p).

Methods: Adult patients (age ≤ 18 yrs) with thyroid cancer who underwent CND were selected from the CESQIP database from January 2014 – September 2021. Baseline characteristics and outcomes were compared for patients undergoing CND-p vs CND-r. Patients were matched on gender and cancer stage using propensity scores in a 2:1 CND-p:CND-r allocation. Multivariable logistic regression was used to estimate the association of treatment group with incidence of any complication, which included transient/permanent hypocalcemia, vocal cord dysfunction, recurrent laryngeal nerve (RLN) transection, infection, hematoma, and seroma, after adjustment for covariates.

Results: After patient matching, there were 674 patients (66.7%) undergoing CND-p, and 337 (33.3%) undergoing CND-r. Overall median age was 45 yrs and 70.3% of patients were female; 76.0%, 12.2%, 4.2%, and 7.7% had Stage I-IV thyroid cancer respectively, with an overall distribution of 83.1% papillary, 2.3% follicular, 1.6% Hurthle cell, and 5.8% medullary cancer. CND-p patients were more likely to undergo bilateral CND (63.6% vs 38.9%, $p < 0.001$), but less likely to undergo concurrent lateral ND (29.8% vs 44.5%, $p < 0.001$). There were no significant differences in intraoperative RLN transection (2.5% CND-p vs 1.2% CND-r, $p = 0.24$) and postoperative vocal cord dysfunction (4.0% CND-p vs 5.9% CND-r, $p = 0.17$), however, CND-p experienced higher rates of hypocalcemia (12.3% vs 7.7%, $p = 0.03$). After adjustment, CND-r was not associated with risk of complication ($p = 0.39$), however, annual surgeon volume (top 25% whose thyroid surgery volume > 50 cases/yr vs lowest 25% whose annual volume was < 8 cases/yr) was associated with decreased risk of complication (OR 0.20, 95% CI: 0.05-0.80, $p = 0.02$).

Conclusions: Patients undergoing reoperative CND have similar risks to those undergoing CND at the primary operation. High surgeon volume was significantly associated with lower risk of complication following CND. These findings suggest that CND should be performed by high-volume surgeons to minimize complication risk.

◆ 13. Surgical Treatment of Secondary Hyperparathyroidism Decreases Rates of Post-Transplant Tertiary Hyperparathyroidism and Need for Intervention

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Background: Secondary hyperparathyroidism (sHPT) affects the majority of end-stage renal patients and can be treated medically or surgically. Some patients go on to develop tertiary hyperparathyroidism (tHPT) after kidney transplantation despite functioning allografts. We aimed to assess the impact of pre-transplant sHPT treatment on post-transplant outcomes.

Methods: We reviewed kidney transplant patients between 2010 and 2020 treated with parathyroidectomy or cinacalcet for sHPT prior to transplantation. Patients with biochemical values pre- and post-sHPT treatment as well as post-kidney transplant were included. We compared clinical parameters and outcomes based on type of sHPT treatment. Controlled sHPT was defined as a PTH less than 264pg/mL (3 times the upper limit of normal) the week of transplant. We defined tHPT as a PTH greater than 88pg/mL (the upper limit of normal) and a calcium of greater than 10.4mg/dL at 1 to 2 years after functioning transplant.

Results: A total of 41 patients were included: 18 patients underwent parathyroidectomy and 23 patients received cinacalcet prior to transplantation. There were no significant differences between demographics, co-morbidities, allograft characteristics or pre-sHPT intervention PTH and calcium levels. Patients that underwent parathyroidectomy were on dialysis for longer, although not significantly (71.9 vs 42.3 months, $p=0.051$). At time of transplantation, patients treated by parathyroidectomy had increased rates of controlled sHPT (88.9%; 16/18 vs 47.8%; 11/23, $p=0.008$). Patients treated by parathyroidectomy had decreased development of tHPT (5.9%; 1/17; vs 42.1%; 8/19, $p=0.020$) as well as decreased rates of post-transplant treatment with cinacalcet (11.1%; 2/18 vs 52.2%; 12/23, $p=0.008$). Three patients treated with cinacalcet underwent parathyroidectomy after transplantation. Median PTH after transplant remained lower in patients treated by parathyroidectomy prior to transplant compared to those treated with cinacalcet (60.7 [IQR 39.7- 133.4] vs 170.0 [IQR 128.4-292.7], $p=0.001$). Allograft function and survival were similar for parathyroidectomy and cinacalcet, with median follow-up after transplantation of 56.7 and 34.2 months, respectively.

Conclusions: Treatment of sHPT by parathyroidectomy is associated with controlled PTH levels at time of transplantation, and decreased rates of tHPT and need for cinacalcet after transplantation. Short-term allograft outcomes are similar in both groups but should be studied further on a larger scale.

◆ **14. Can we predict distant recurrence after complete resection of non-metastatic adrenocortical carcinoma?**

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Background: Distant recurrence following complete (R0) resection of adrenocortical carcinoma (ACC) is common. Identifying factors associated with recurrence of non-metastatic ACC following R0 resection may help guide the use of adjuvant therapy.

Methods: A single institution study included adults undergoing R0 resection of TNM 8th stage I, II and III ACC (1997-2019). The first recurrence diagnosis after R0 resection was categorized as locoregional or distant. Hormonal hypersecretion was grouped as cortisol- secreting vs other. Analysis was performed using Chi square, Wilcoxon rank sum tests, Kaplan-Meier analysis, multivariable logistic regression, and Cox proportional hazards regression models.

Results: Out of 161 patients with R0 resection for non-metastatic ACC, 69% developed recurrence. Half of patients with recurrence presented with locoregional while half presented with distant metastatic disease; this varied by stage: 27% of stage I were distant and 73% locoregional, 41% of II were distant and 59% locoregional, and 66% of stage III were distant and 34% were locoregional, $P < 0.01$. Median disease-free survival (DFS) was 21 months. There was no difference in DFS between patients presenting with locoregional or distant recurrence, $P = 0.78$. Age, female sex, cortisol secretion, and stage III (vs II) were associated with higher recurrence risk after adjusting for operative bed radiation and mitotane treatment, $P < 0.05$. Stage III (vs I/II) was associated with higher distant recurrence rate after adjusting for age, sex, cortisol secretion, and adjuvant treatment, $P < 0.05$.

Conclusions: Distant recurrence following R0 resection of ACC is common among all stages of non-metastatic ACC, suggesting that sub-radiographic metastatic disease is frequently present at the time of initial resection, even in early stage disease. The role for adjuvant and potentially neoadjuvant cytotoxic systemic chemotherapy for patients with early stage ACC should be investigated.

◆ 15. Disparities in Appropriate Thyroid Cancer Treatment, Before and After the Release of the 2015 American Thyroid Association Guidelines

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Background: Racial and ethnic disparities in the treatment of thyroid cancer have been well-described. Uniform uptake of new management guidelines is essential to promoting more equitable treatment for all patients. The goal of this study was to assess whether the 2015 American Thyroid Association (ATA) guideline changes differentially affected appropriate treatment of thyroid cancer patients by race and ethnicity.

Methods: This retrospective cohort study included non-Hispanic White, non-Hispanic Black, and Hispanic patients with well-differentiated thyroid cancer from the National Cancer Data Base (2010-2018). The primary outcomes were appropriateness of surgical and radioactive iodine (RAI) therapy based on the ATA guidelines. Multivariable logistic regression was used to evaluate the association between race and ethnicity and appropriate treatment before and after the 2015 ATA guideline changes.

Results: 287,056 patients included, 82% were White, 8% were Black, and 9% were Hispanic. The median age was 51 years (IQR: 39, 62).

Before the guideline changes, 2.8% of patients underwent inadequate extent of surgery, 18.0% were not treated with RAI when indicated, and 3.7% received unindicated RAI. Compared to White patients, Black patients underwent lower rates of adequate surgery (OR 0.66, $p < 0.001$) and appropriate RAI (OR 0.75, $p < 0.001$). In contrast, Hispanic patients underwent higher rates of adequate surgery (OR 1.17, $p = 0.008$) and appropriate RAI therapy (OR 1.13, $p < 0.001$) compared to White patients.

After 2015, both White and Black patients had increased rates of inadequate surgery (White 2.4% to 2.6%, $p < 0.001$; Black 3.7% to 4.6%, $p = 0.001$). All groups experienced an increase in inappropriate RAI, with increases in both undertreatment (White 17.4% to 23.8%, $p < 0.001$; Black 20.7% to 30.2%, $p < 0.001$; Hispanic 21.7% to 26.3%, $p < 0.001$) and overtreatment (White 3.9% to 11.4%, $p < 0.001$; Black 2.6% to 7.2%, $p < 0.001$; Hispanic 3.3% to 9.1%, $p < 0.001$). Subset analysis in patients diagnosed in 2018 only demonstrated similar disparities.

Conclusions: Between 2010 and 2015, Black patients had the lowest rates of guideline-concordant care, while Hispanic patients had the highest rates of appropriate care. After the 2015 ATA guidelines changes, Black patients experienced the largest increases in the rates of inappropriate therapy.

16. A prospective assessment on intra-operative trans-laryngeal ultrasound as a real-time method to assess vocal cord function during radiofrequency ablation of the thyroid gland

Man Him Matrix Fung¹, Brian Hung Hin Lang¹

¹University of Hong Kong

This poster has withdrawn from the AAES 2022 Meeting.

17. QUANTIFICATION OF INTRAOPERATIVE AUTOFLUORESCENCE SIGNALS FROM NORMAL AND ABNORMAL PARATHYROID GLANDS IN PRIMARY HYPERPARATHYROIDISM: A MULTI-SURGEON VALIDATION STUDY.

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Background: Using a first-generation near infrared imaging (NIFI) system, we previously demonstrated that autofluorescence (AF) signals of parathyroid glands (PGs) were different, with normal PGs exhibiting a bright and homogenous pattern and abnormal glands an exhibiting darker and heterogeneous pattern. Since then, higher-resolution second generation NIFI systems with faster frame rates have become available. The aim of this study was to validate previous observations with a multi-surgeon prospective design.

Methods: This was an institutional review board-approved prospective study between November 2019 and December 2021. A second-generation visual NIFI system was used to intraoperatively assess PGs in primary hyperparathyroidism. Brightness intensity and heterogeneity of parathyroid AF signals were calculated using a third-party software. Statistical analysis was performed using t-test. Continuous data are given as mean \pm standard deviation.

Results: All 177 patients had sporadic primary hyperparathyroidism, with the final diagnosis of single adenoma in 124 patients, double adenoma in 33 patients and multi gland disease in 20 patients. The patients were followed up with biochemical testing for a median of 3.5 months (range 1-6 months) and there was no persistent or recurrent disease. There was a total of 407 normal and 274 abnormal PGs analyzed in vivo. Normalized AF intensity of normal versus abnormal PGs was 3.8 ± 1.6 and 3.0 ± 1.6 pixels, respectively, $p < 0.01$. Heterogeneity index (HI) of normal versus abnormal PGs was 0.09 ± 0.08 and 0.18 ± 0.10 , respectively, $p < 0.01$. 96 of abnormal PGs overlapped with normal glands in terms of volume. For this cohort, normalized AF intensity was 4.01 ± 1.8 and 0.09 ± 0.1 , $p < 0.01$ and HI was 3.2 ± 1.22 and 0.16 ± 0.08 , $p < 0.01$ for normal versus abnormal glands, respectively.

Conclusions: Using a prospective multi-surgeon design, this study validates previous single-surgeon observation of the intraoperative differences in AF signals between normal and abnormal PGs. Our results support the incorporation of AF pattern as a new adjunctive parameter into intraoperative assessment of PGs in primary hyperparathyroidism.

18. Efficacy and safety of single-session ultrasound-guided radiofrequency ablation for multiple benign thyroid nodules

Brian Hung Hin Lang¹, Man Him Matrix Fung¹

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This poster has withdrawn from the AAES 2022 Meeting.

◆ 19. Multi-omic sequencing exposes genomic variants in paired primary and metastatic small bowel carcinoid tumors

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Background: Small bowel carcinoids are insidious tumors that often have metastatic spread at the time of diagnosis. Limited studies of the mutational landscape of carcinoid tumors report loss of chromosome 18q, and loss of CDKN1B in a minority of tumors. The identification of driver mutations in carcinoid tumors could elucidate mechanisms of pathogenesis and enable the development of targeted therapies.

Methods: The DNA exomes of four matched sets of normal tissue, primary small intestine carcinoid tumors, and liver metastases were investigated; additionally, the RNA transcriptomes were analyzed for the tumor samples. Germline variants and somatic mutations were called using the consensus of three variant callers (Strelka, MuTect, and Seurat), and included: single nucleotide variants (SNVs), insertions/deletions (indels), structural variants, and copy number alterations (CNAs). The functional impact of mutations was predicted using Ensembl Variant Effect Predictor. Transcriptome analysis consisted of fusion prediction, variant calling, and gene expression quantification.

Results: Large-scale CNAs were observed, most consistently loss of chromosome 18, in all metastases and in half of the primary tumors. Certain somatic SNVs were metastasis-specific; these included: a pathogenic frameshift mutation in CDKN1B (rs797044482) with corresponding presence of the indel in mRNA, a deleterious missense mutation in MXRA5 leading to the activation of a cryptic splice site and loss of mRNA, a missense mutation in SMARCA2 (rs752254994) confirmed in mRNA, and the loss of UBE4B via combined CNA and splicing mutation (observed as intron retention in the mRNA). Alterations observed in both primary and metastatic tumors included mutations in ATRX (leading to loss of mRNA transcripts), and splice site loss of PYGL (rs74464749) leading to intron retention (confirmed through mRNA expression of alternative splice variants).

Conclusions: We observed novel mutations in primary and metastatic carcinoid tumor pairs, some of which have been observed in other types of neuroendocrine tumors. We confirmed a previously observed loss of chromosome 18 and CDKN1B. Transcriptome sequencing added relevant information that would not have been appreciated with DNA sequencing alone. The detection of several splicing mutations on the DNA level, and of their consequences at the RNA level, suggest RNA splicing aberrations as a potentially unique mechanism underlying carcinoid tumors.

(V) 20. Routine Next Generation Sequencing of Papillary Thyroid Cancers: A Single Institution Experience

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Background: The clinical relevance of routine next generation sequencing (NGS) as an adjunct to standard pathologic analysis and the implications of detecting gene variants and mutations that are not classically associated with papillary thyroid cancers (PTC) are poorly understood. Starting in 2015, all thyroid cancers at our institution have undergone targeted NGS for cancer related genes. Here we analyze variant frequency in a PTC surgical cohort and identify those with potential clinically significant clinicopathologic associations.

Methods: We retrospectively reviewed all PTC samples sequenced with the 50-gene AmpliSeq Cancer Hotspot Panel V2 in a prospectively maintained database from 2015–2019. Genomic variants were analyzed for association with clinicodemographic variables, cytologic variants, and risk stratification for recurrence following 2015 ATA guidelines, which currently only include BRAF mutations.

Results: A total 253 PTCs were sequenced, and 205 (81.0%) had at least one detected mutation while 42 (16.6%) had more than one mutation. The most common mutations were BRAF (162;64.0%), RAS (28;11.1%), JAK (12;4.7%), MET (10;4.0%), APC (9;3.6%) and ATM (9;3.6%). Rarer mutations (<2%) included AKT1, PIK3CA, PTEN, TP53, CDKN2A, FGFR3 and MLH1.

BRAF was the most common mutation in all variants except for a poorly differentiated variant sample, which harbored both RAS and JAK mutations. Most NSG PTCs were stratified as low-risk (47.8%) per the 2015 ATA guidelines while 32.4% and 19.4% were intermediate and high-risk, respectively. BRAF was the most common mutation in all recurrence risk groups (low: 71/122;58.2%, intermediate: 56/82;68.3%, and high: 35/49;71.4%). Other common mutations were RAS (low: 21/122;17.2%, intermediate: 5/82;6.1%, and high: 2/49;4.0%), JAK (low: 3/122;2.5%, intermediate: 6/82;7.3%, and high: 3/49;6.1%), ATM (low: 4/122;3.3%, intermediate: 1/82;1.2%, and high: 4/49;8.2%) and MET (low: 8/122;6.6%, intermediate: 2/82;2.4%, and high: 0/49;0%). Compared to non-JAK mutated PTCs, PTCs harboring JAK mutations were associated with vascular invasion (3/8;37.5% vs 3/106;2.8%, $p=0.004$) and poorly differentiated variant (1/12;7.7% vs 0/241;0.0%, $p=0.047$).

Conclusions: BRAF and RAS are the most prevalent mutations in PTC tumors undergoing routine NGS. However, routine NGS for a broad cancer panel has identified additional variants that are potentially associated with aggressive features, and JAK mutations in particular warrant further study in the pathogenesis of aggressive variants of PTC.

(V) 21. Racial Disparities in Thyroid Cancer in California, 1999-2017

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Background: Previous studies revealed worse outcomes for Black thyroid cancer patients in California. We hypothesized that disparities in thyroid cancer would be attributable to quality of initial surgery and subsequent reoperation rate.

Methods: A retrospective cohort study (1999-2017) was conducted on patients with well-differentiated thyroid cancer using the California Cancer Registry and California Office of Statewide Health Planning and Development data. Reoperations were defined as any neck dissection or partial thyroidectomy 6 months or more following initial surgery.

Results: The study cohort included 66,908 patients diagnosed with differentiated thyroid cancer. Among these patients, 51.9% were non-Hispanic white (white), 26.9% Hispanic, 16.3% Asian/Pacific Islander (API), 3.7% non-Hispanic Black (Black), and 0.5% American Indian/Alaska Native (AIAN).

Black patients were more likely to die from their thyroid cancer (4.5%) than white patients (3.5%), (hazard ratio (HR)=1.33 [CI, 1.10- 1.62], p=0.04). Even after adjusting for tumor stage in multivariate analysis, Black patients had lower disease-specific survival than white patients (HR=1.26 [CI, 1.02-1.50], p=0.03) as well as lower overall survival (HR=1.33 [CI, 1.20-1.47], p<0.01). After controlling for quintile of socioeconomic status, outcome disparity between Black and white patients was no longer significant.

Despite having decreased disease-specific survival, Black patients underwent reoperation less frequently (1.4%) (HR=0.70 [CI, 0.50- 0.99], p=0.04) than white patients (2.0%). However, in subgroup analysis, the disparity in disease-specific survival was only seen among patients with local disease at presentation (HR=1.64 [CI, 1.03-2.61], p=0.04), with no significant difference in patients with regional or distant disease on presentation.

Conclusions: When diagnosed with thyroid cancer, Black patients have worse disease-specific survival than white patients, though overall mortality rates are low. Differences in outcomes appear to be driven more by socioeconomic status than by structural recurrences requiring reoperation.

♦ 22. Adrenal Incidentalomas at a Single Level-One Trauma and Tertiary Care Institution: Are There Disparities in Care?

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Background: The prevalence of adrenal incidentalomas is 1-6%. Guidelines recommend all incidentalomas receive clinical, laboratory, and radiographic evaluation to determine if the lesion is malignant or producing excessive hormone in order to guide further treatment. However, the majority of patients do not receive this evaluation. We undertook this study to understand factors associated with appropriate evaluation.

Methods: All computed tomography (CT) reports of the chest, abdomen, and/or pelvis from 2015-2019 at a single tertiary referral and level 1 trauma hospital were queried for the terms “adrenal incidentaloma/mass/lesion/tumor/nodule/adenoma,” “adreno-,” and “incidental adrenal.” Charts with any of these terms were reviewed. Demographic information, CT scan indication, ordering care team and setting, nodule size and laterality, radiology report characteristics, and information on how the mass was evaluated after diagnosis (referral to specialist including endocrinology/endocrine surgery/urology, biochemical studies, and dedicated imaging) were collected. Complete evaluation was defined as undergoing all indicated hormonal studies and dedicated adrenal imaging according to established guidelines. Univariable analyses and multivariable logistic regression determined factors associated with completion of evaluation.

Results: Of the 60,512 CT scans queried, 1,373 patients had a new adrenal incidentaloma. Of these patients, 742 (54.0%) were Black and 283 (20.6%) were White. 156 (11.4%) patients completed clinic follow-up with an appropriate subspecialist, 92 (6.7%) completed a thorough laboratory workup, and 228 (16.6%) underwent dedicated adrenal imaging. A complete evaluation was performed in 44 (3.2%) patients. Factors associated with seeing an appropriate specialist in clinic were increasing age, primary care provider ordering the index CT scan, an order placed for appropriate referral, and the incidentaloma noted in the summary of the radiology report. Factors associated with a complete evaluation included outpatient setting for the index CT and a surgical subspecialty as the ordering care team of the index CT.

Conclusions: A minority of patients with adrenal incidentalomas receive appropriate evaluation or are referred to a specialist. Clinical setting, ordering care team, and language used in the radiology report greatly influence the rate of adequate work-up in these patients. Because the vast majority of patients are not appropriately evaluated, systems-based improvements may be indicated to improve the evaluation of these patients.

♦ 23. A Novel Algorithm to Predict Likelihood of Primary Hyperparathyroidism Among Patients with Hypercalcemia

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Background: Primary hyperparathyroidism remains significantly underdiagnosed and undertreated. The key to addressing this problem is developing an effective and scalable screening program to determine which patients with hypercalcemia are likely to have hyperparathyroidism and would benefit from further evaluation. We hypothesized that a machine learning model (random forest) could be trained to accurately identify hypercalcemic patients who are likely to have primary hyperparathyroidism.

Methods: A panel of expert surgeons and endocrinologists prospectively screened clinical, demographic, pharmacologic, and laboratory data from electronic medical records on 469 patients at our institution with serum calcium ≥ 0.5 mg/dl above normal and normal renal function. Each patient was assigned a score from 1 to 10 which indicated their likelihood of having hyperparathyroidism, with 10 indicating the highest probability of hyperparathyroidism. We then developed a random forest model to predict the expert score. The dataset was divided into an 80% training and 20% validation cohort for model development and validation. The model was fit across 1000 bootstrap samples from the training set to identify significant predictors and optimize functional forms. Model performance was then evaluated on the validation set.

Results: The median age of patients screened in our cohort was 70 years old (IQR 61-75) with median calcium 11mg/dl (IQR 10.8- 11.3). The median score from our expert panel was 6 (IQR 3-8). The predicted score from our random forest model matched the expert reviewer score for 86% of cases and was within 1 point of the reviewer for 92% of cases and within 2 points for 95% of cases. The algorithm correctly classified patients as likely to have hyperparathyroidism (score ≥ 6) in 97% of cases with overall discrimination (c-statistic) of 0.82, indicating excellent discrimination between patients with and without hyperparathyroidism.

Conclusions: We successfully developed a predictive model that mimics expert assessment of whether hypercalcemic patients are likely to have primary hyperparathyroidism. Our model can be used to rapidly screen hypercalcemic patients to identify individuals likely to benefit from further evaluation and referral to endocrine surgeons. This represents an easily scalable screening method that is less labor-intensive than manual review by experts.

♦ 24. Assessing Benefits of Near Infrared Autofluorescence (NIRAF) Detection for Identifying Parathyroid Glands during Total Thyroidectomy – a randomized single-center clinical trial

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Background: Identifying parathyroid glands (PGs) and preserving their perfusion during total thyroidectomy is essential. Failure to do so can lead to postoperative hypocalcemia and associated complications. Near-infrared autofluorescence (NIRAF) detection has been previously demonstrated to accurately identify PGs in real-time. We present the first randomized clinical trial to evaluate the benefit of NIRAF detection in patients undergoing total thyroidectomy, using the probe-based NIRAF detection device called PTeye™.

Methods: Patients undergoing total thyroidectomy were prospectively enrolled by two endocrine surgeons, and were randomly allocated to the test (PTeye™) or control arm. During surgery, intraoperative data were collected from each patient, which included (i) number of PGs identified with 'high' confidence by the surgeon and resident, (ii) number of PG frozen sections performed and (iii) total thyroidectomy duration. After surgery, blood calcium levels were obtained for each patient at (i) 24 hours after surgery, (ii) 1st postoperative visit (5–14 days after surgery) and (iii) 6 months after surgery if necessary. The rate of postoperative hypocalcemia was determined for both groups. PG detection rate and performance accuracy of PTeye™ were additionally calculated.

Results: One hundred and two patients were randomly recruited to the test (n=52) and control group (n=50), with 331 PGs visualized by both surgeons. In the test group, the PG detection rate was 100% with an overall accuracy of 95.5%. Using plain visual examination, surgeons identified 2.8 and 2.7 PGs/patient with 'high' confidence in the test and control group respectively (p=0.55). With NIRAF detection in the test group, PGs identified by the attending surgeons considerably increased to 3.4 PGs/patient (p<0.001), while that of the residents improved significantly from 1.0 to 3.2 PGs/patient (p<0.001). However, there was no significant difference between both groups for number of frozen sections (p=0.76), autotransplanted PGs (p=0.22), inadvertent parathyroidectomy (p=0.55), surgery duration (p=0.84) or rate of postoperative hypocalcemia (p=0.10).

Conclusions: NIRAF detection with PTeye™ can be a valuable technology to improve a surgeon's confidence in discriminating between parathyroid and non-parathyroid tissues, while the device can be a useful educative tool for residents to improve their confidence in PGs identification during total thyroidectomy.

◆ 25. Initial Extent of Surgery for Thyroid Cancer Among Low- and High-Volume Surgeons: A Statewide Analysis of Surgical and Patient-Reported Outcomes

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Background: Surgical overtreatment of thyroid cancer is a well-described phenomenon. The American Thyroid Association (ATA) guidelines in 2015 established that hemithyroidectomy is appropriate as a definitive treatment for patients with low-risk thyroid cancer. Previous research has demonstrated the relationship between surgeon thyroidectomy volume and complications; however, the relationship between surgeon volume and extent of surgery has not been established.

Methods: A statewide database was used to identify patients with thyroid cancer who underwent initial thyroidectomy from 2012-2020. The extent of thyroidectomy was determined via CPT codes. High-volume surgeons were defined as those who performed >25 thyroid procedures per year. The extent of surgery in low- and high-volume surgeons and their postoperative clinical and patient-reported outcomes were compared pre- and post-2015 ATA guidelines using multivariable logistic regression.

Results: We identified 3,199 patients with thyroid cancer who underwent initial thyroidectomy by 402 surgeons. Only 24 (6%) surgeons were considered high-volume. Low-volume surgeons, however, performed 1,850 (58%) of thyroidectomies during the study period. There were no significant differences in patient demographics between low- and high-volume surgeons. After the release of 2015 ATA guidelines, the rate of hemithyroidectomy increased, but not significantly for low- (23% to 27%, $p=0.218$) and high-volume surgeons (21% to 22%, $p=0.576$). Throughout the entire study period, low-volume surgeons had significantly higher rates of readmission ($p=0.008$), complications ($p<0.001$), and emergency room visits ($p=0.002$). Patients with low-volume surgeons were more likely to undergo re-operation due to a complication or completion thyroidectomy ($p=0.030$). Low-volume surgeons also had longer operative times ($p<0.001$) with fewer same-day discharges ($p<0.001$). There was no difference in patient-reported satisfaction with care, decision regret, or return to daily activities between low- and high-volume surgeons.

Conclusions: The majority of thyroid cancer operations continue to be performed by low-volume thyroid surgeons. The extent of initial thyroidectomy for thyroid cancer did not significantly change after the release of the 2015 ATA guidelines among both low- and high- volume thyroid surgeons. Low-volume surgeons had higher rates of readmission, re-operations, complications, longer operative times, and increased length of stay. Despite these differences, there was no significant variance noted in patient-reported outcomes among those operated on by low- and high-volume surgeons.

26. Primary Hyperparathyroidism after Radioactive Iodine Therapy: Is it a Distinct Clinical Entity?

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Background: Radioactive iodine treatment (RAI) has been considered a rare cause of primary hyperparathyroidism (pHPT). The purpose of this study was to evaluate the incidence of RAI induced pHPT and determine if clinical differences exist between pHPT patients with or without prior RAI treatment.

Methods: We completed a multi-institutional retrospective review of patients with sporadic pHPT who underwent parathyroidectomy during the period from 1990-2020. The incidence and average latency time to development of RAI induced pHPT were determined. Patients were divided into two groups: pHPT with or without a history of RAI treatment. Demographic, clinical, biochemical and pathologic outcome data were compared.

Results: 1941 patients with sporadic pHPT underwent parathyroidectomy. 47 (2.4%) had prior RAI treatment, while 1894 (97.6%) did not. Average latency time to development of pHPT after RAI was 23 years (range 3-59 years). Indication for RAI was the treatment of thyrotoxicosis in 42 (89%) patients. Patients with prior RAI treatment were significantly more likely to be female ($p < 0.001$) and had lower preoperative serum calcium ($p < 0.0001$) and serum PTH levels (< 0.0001). In addition, RAI-treated patients showed a trend towards increased double adenoma ($p = 0.05$). No significant differences were observed in age (60 vs. 60 years), preoperative symptoms, number of organ systems involved (2 vs. 2), rate of ectopic glands resected (4 vs. 14%) and cure (98% VS. 97%) for patients with or without RAI treatment ($p > 0.05$).

Conclusions: The results of our study provide additional evidence that RAI is a causative factor for pHPT, accounting for 2.4% of sporadic pHPT in our cohort. RAI induced pHPT is a less severe form of sporadic pHPT as evidenced by significantly lower serum PTH and calcium levels. Double adenomas are more common in patients with pHPT and prior RAI treatment and thus should prompt surgeons to council patients on a possible need for bilateral neck exploration. Our multi-institutional study provides the largest experience to date characterizing RAI induced pHPT.

(V) 27. Postoperative Voice Quality Outcomes after Transoral versus Transcervical Thyroid Surgery

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Background: The transoral endoscopic thyroidectomy vestibular approach (TOETVA) is a scarless technique for thyroid surgery that has been shown to offer both cosmetic and quality of life benefits. This study aims to compare subjective voice outcomes of patients who underwent thyroid surgery via TOETVA versus conventional transcervical approach (TCA).

Methods: Study participants were asked to complete one of two voice-related surveys: the voice handicap index (VHI) or the voice-related quality of life (V-RQOL) questionnaire. Assessments were performed preoperatively and at the first postoperative follow-up appointment. Non-parametric Mann-Whitney U-tests were performed to evaluate VHI and V-RQOL scores for patients undergoing TOETVA vs TCA.

Results: Two hundred and eighty-three patients were included in this study (93 TOETVA and 190 TCA). There were no significant differences in postoperative VHI scores between TOETVA (average VHI: 2.30) and TCA (average VHI: 3.7; $p = 0.082$) groups. Subset analysis of fifty-six patients (23 TOETVA and 33 TCA) who had preoperative VHI scores showed no significant difference in postoperative change in VHI scores (average change in VHI for TOETVA: 3.22 vs TCA: -0.42; $p = 0.078$). Finally, subset analysis of sixty-four patients (TOETVA 39 and 25 TCA) showed no difference in postoperative V-RQOL scores (average V-RQOL score for TOETVA: 10.59 vs TCA: 10.84; $p = 0.097$).

Conclusions: Voice-related outcomes are similar between TOETVA and TCA. These results, in combination with previous quality of life and cosmetic outcomes literature show that outcomes after TOETVA are comparable to those after standard-of-care TCA.

28. Association of surgical approach with stage migration and survival in adrenocortical cancer

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Background: Adrenocortical Carcinoma (ACC) is a rare primary adrenal malignancy. Surgery, when possible, is best treatment with debate about laparoscopic/robotic adrenalectomy (LRA) versus open adrenalectomy (OA). Clinical tumor (cT) stage may dictate operative approach; however, final surgical pathology (pT) stage can differ. We aim to determine association of surgical approach with stage migration and its impact on overall survival (OS).

Methods: The National Cancer Database (NCDB) was analyzed from 2010-2016. Patient demographics, operative approach, tumor-specific characteristics, rate of lymphadenectomy, cT and pT stage, and OS were included in analysis. Patients missing cT or pT were excluded. Groups were compared using t-tests, Chi2, and Kaplan-Meier survival estimates.

Results: Of 744 patients with complete operative approach data, 66.5% had OA, and 24.5% had a lymphadenectomy. cT differed from pT in 21.9% with 77.0% of those upstaged. cT1 tumors were upstaged in 38.1%, cT2 in 20.7%, and cT3 in 5.8% ($p < 0.0001$). T-stage change vs. no T-stage change groups had similar age, sex, race, and comorbidities. Upstaged patients were more likely to have OA (62.8% vs. 55.1%, $p = 0.0481$). OA were younger (53.8+15.1 vs. 57.2+14.3 years, $p = 0.0034$), more likely to have surgery at an academic hospital (64.8% vs. 50.2%, $p = 0.0023$), have a lymphadenectomy (31.2% vs. 11.6%, $p < 0.0001$), with higher pT, $p < 0.0001$. OA and LRA were compared using Kaplan-Meier Curves to evaluate OS by pT, pN, and overall stage. Surgical approach was not associated with differences in OS by pT-stage (pT1; $p = 0.7985$), (pT2; $p = 0.4154$), (pT3; $p = 0.3160$), or (pT4; $p = 0.3650$). OA pN0 patients had longer median OS, 50.2 vs 32.7 months, $p = 0.3860$, and OA pN1 patients had shorter, but not significant, median OS, 13.7 vs 21.5 months, $p = 0.5690$. Stage III LRA patients had worse OS compared to OA ($p = 0.0251$) with no difference in stage I, II, or IV disease.

Conclusions: ACC is upstaged in nearly one-fifth of patients, more often with OA. OA pN0 patients had improved, but not significant, median OS versus LRA possibly due to less frequent lymphadenectomy in LRA patients. OA has a survival advantage in stage III patients. Survival may be worse in LRA due to inadequate staging. The role of lymphadenectomy should be studied in ACC.

♦ **29. Patients 50 years and older with asymptomatic primary hyperparathyroidism: Should we expand criteria for surgery?**

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Background: Primary hyperparathyroidism (pHPT) can negatively impact bone mineral density, renal function, and be associated with musculoskeletal and/or neurocognitive symptoms. Parathyroidectomy is the only cure, but referral for surgery is largely based on societal clinical practice guidelines. This study included patients ≥50 years who underwent surgery and examined what proportion of patients did not meet guideline criteria for operation as well as the bone health and symptom profile of these patients.

Methods: This is a retrospective review of patients ≥50 years who underwent initial parathyroidectomy for sporadic pHPT at a single high-volume center from 2012-2020. Patients were categorized into 3 age groups (AG, by years): AG1:50-59; AG2:60-69; AG3:≥70. Demographic and clinical data were collected, including 8 possible indications for surgery, per existing guidelines. Patients with nephrolithiasis and/or non-traumatic fractures were defined as 'symptomatic.' Neurocognitive symptoms included patient-reported symptoms of fatigue, memory/concentration deficits, or mood swings.

Results: The cohort included 1,182 patients with a median age of 65 years (IQR 58,71); 352 patients (29.8%) were in AG1, 480 (40.6%) in AG2 and 350 (29.6%) in AG3. Median serum calcium was 10.8 mg/dL (IQR 10.4,11.2), median PTH was 93 pg/mL (IQR 70,124), and median number of indications for surgery was 1 (IQR 1,2; range 0-5). Overall, 367 (31.0%) symptomatic and 660 (55.8%) asymptomatic patients met criteria for surgery. Of the remaining 155 (13.1%) asymptomatic patients who did not meet guideline criteria, the median age was 61 (IQR 56, 67). Younger patients more frequently underwent parathyroidectomy (AG1,17.3%; AG2,13.1%; AG3,8.9%; p=0.02). Most (77.4%) reported neurocognitive symptoms (AG1,82%; AG2,77.8%; AG3,67.7; p=0.30); 61.9% had osteopenia (AG1,52.5%; AG2,68.3%; AG3,67.7%; p=0.34), and 52.4% reported musculoskeletal symptoms (AG1,58.9%; AG2,50.8%; AG3,43.3%; p=0.37). If the age criterion of <50 years was expanded to 55, 60 or 65 years, an additional 30 (19.4%), 71 (45.8%), and 102 (65.8%) patients in this group would meet guideline criteria for surgery, respectively.

Conclusions: The majority of asymptomatic patients who underwent parathyroidectomy for pHPT, despite not meeting current published criteria for surgery, experienced neurocognitive symptoms and had osteopenia. Expanding current guidelines to include a broader age range and osteopenia would allow for earlier surgical referral and evaluation for definitive treatment.

◆ 30. Outcomes of Aggressive Variants of Differentiated Thyroid Carcinoma in California (1999-2017)

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Background: Aggressive variants of differentiated thyroid cancer (DTC) are a heterogeneous mix of pathological subtypes that behave more aggressively than classic DTC. We hypothesized that aggressive variants would benefit from care at high-volume centers, and localized disease could be managed with thyroid lobectomy.

Methods: The California Cancer Registry (CCR) and the Office of Statewide Health Planning and Development (OSHPD) databases were queried from 1999-2017. We included all thyroid cancer patients with histology codes that encoded for columnar (tall) cell carcinoma, non-encapsulated sclerosing carcinoma, or insular carcinoma. High-volume institutions were defined as performing > 25 thyroid surgeries per year. Primary outcome was disease specific survival (DSS). Secondary outcomes included recurrence rate, time to reoperation and overall survival (OS), and multivariate analysis was performed.

Results: In 1999-2017, 617 patients were diagnosed with aggressive variants of DTC. On presentation, 223 (36%) had local disease, 312 (51%) had regional disease, and 82 (13%) had distant disease. DSS at 5 years was 92%, with OS of 87%. Structural recurrence requiring reoperation occurred in 8.3% of patients, with median time to reoperation 22.8 months. Multivariate analysis found no significant association between DSS or structural recurrence with extent of initial surgery or high- vs low-volume center. Out of 484 centers in California, 37 were considered high-volume. Despite being a small proportion of centers overall, high-volume centers performed surgery on 291 (47%) patients. In all patients, 63% received postoperative RAI. Postoperative RAI was associated with improved 5-year DSS than patients that did not receive RAI (12% vs 15%; HR 0.621; 95% CI 0.390-0.988, p=0.044). Tumor size was predictive of poorer survival, with a 3% mortality rate among patients with tumors ≤ 2 cm, compared to 20% if > 2 cm (HR 7.31; 95% CI 3.63-14.7, p=2.39x10⁻⁸).

Conclusions: Extent of initial surgery and treatment at a high-volume center did not have a significant impact on DSS or structural recurrence rates in aggressive variants of DTC. Total thyroidectomy should be considered in patients with tumors > 2 cm in size to allow administration of RAI.

◆ 31. Influence of Center Volume on Survival in Anaplastic Thyroid Cancer

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Background: Anaplastic thyroid carcinoma (ATC) is an aggressive malignancy with high mortality. We aim to determine whether survival with ATC is influenced by treatment at high vs. low volume centers.

Methods: The NCDB 2004-2017 was queried for patients with ATC. High volume centers (HVC) were defined as >18 patients per study period and low volume centers (LVC) were defined as <9 patients per study period. Clinical, pathologic, and treatment factors were compared. Kaplan Meier survival analysis was performed.

Results: 2,553 patients at 833 centers had a diagnosis of ATC. There were 376 patients treated at 14 HVC and 2,079 patients treated at 819 LVC. Comparing HVC and LVC, there was no difference between patient gender or race. HVC patients were younger, more privately insured, and had lower Charlson Comorbidity Index. HVC were more likely to be academic centers. There was no difference in tumor size, use of surgery, or margin positivity between HVC and LVC. Time from diagnosis to treatment initiation was higher at HVC (Median Days [Q1-Q3] 15 [7-31] vs 9 [0-22], $p < 0.01$). At HVC lymph nodes were examined more frequently (71.3% vs 52.2%, $p < 0.01$). Greater number of lymph nodes were examined (Median [Q1-Q3] 4 [0-22] vs 1 [0-5], $p < 0.01$) and more lymph nodes were positive at HVC (Median [Q1-Q3] 2 [0-7], 1 [0-3], $p=0.01$). HVC patients received chemotherapy and chemoradiation more often (56.6% vs. 38.1%, $p<0.01$; 47.9% vs 33.1%, $p<0.01$). 30-day readmission was lower at HVC (2.6% vs 9.0%, $p=0.01$), as was 90-day mortality (26.5% vs 38.0%, $p=0.01$). Followup was longer at HVC (Median Months [Q1-Q3], 6.1 [2.7 - 20.8] vs 4.6 [1.9 - 11.2], $p<0.01$). Overall survival at 36 months was higher at HVC (16.6% vs 7.8%, $p<0.01$).

Conclusions: Patients with ATC treated at HVC receive chemotherapy and chemoradiation more often, have greater examination of lymph nodes, lower 30-day readmission, lower 90-day mortality, and increased overall survival.

◆ 32. Endocrine Surgeons Are Performing More Thyroid Lobectomies for Low-Risk Differentiated Thyroid Cancer Since Implementation of the 2015 ATA Guidelines

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Background: The 2015 revised ATA guidelines recommended either total thyroidectomy or thyroid lobectomy for surgical treatment of intrathyroidal low-risk differentiated thyroid cancers (DTC) and de-escalated recommendations for central neck dissections (CNDx). We aimed to investigate how practice patterns among endocrine surgeons have changed since 2015.

Methods: Using CESQIP data (2014-2021), we identified adult patients with low-risk DTC (T1-T2, N0/Nx, M0/Mx). Joinpoint regression analysis was used to calculate the annual percent change (APC) in the proportion of lobectomies and CNDx. Multivariable logistic regression was used to compare postoperative outcomes between patients undergoing lobectomy versus total thyroidectomy.

Results: In total, 5,617 patients with low-risk DTC were identified. More patients who underwent lobectomy (n=1,805) were younger (mean, 48.1 v. 50.4 years; p<0.001) and male (23.7% v. 17.1%; p<0.001). After adjustment for clinical and demographic factors, patients undergoing surgery after 2015 had higher odds of undergoing lobectomy both for tumors ≤1cm (n=2,276, 33.7% v. 19.6%; OR 2.69; 95%CI 2.01-3.60) and tumors >1 and <4cm (n=3,018, 35.8% v. 24.8%; OR 2.22; 95%CI 1.73-2.85), as compared to patients before 2015. There was a significant increase in the proportion of lobectomies from 2014-17 (APC 19.6, 95%CI: 7.8-32.5) followed by a slowing in the rate of change from 2017-21 (APC 2.7, 95%CI: -2.7-8.4). Patients undergoing surgery after 2015 had lower odds of undergoing CNDx (15.1% v. 16.4%; OR 0.61; 95%CI 0.50-0.75), with an APC of -1.4% (95%CI -5.5-2.9). Compared to total thyroidectomy, lobectomy was associated with more outpatient surgery (OR 5.18; 95%CI 4.48-5.98), fewer emergency department visits (OR 0.64; 95%CI 0.42-0.95), and less hypoparathyroidism (OR 0.017; 95%CI 0.0043-0.070). There were no differences in hematoma, surgical site infection, or recurrent laryngeal nerve injury. With an estimated 35,000 low-risk DTC diagnoses annually in the U.S., lobectomy instead of total thyroidectomy may lead to population-level benefits including 13,440 fewer hospitalizations, 490 fewer emergency department visits, and 630 fewer cases of hypoparathyroidism.

Conclusions: Since publication of the 2015 ATA guidelines for low-risk DTC, the proportion of lobectomies performed by endocrine surgeons for oncologically-appropriate tumors has increased. This has implications for reduced health care utilization and costs, with potential population-level benefits.

◆ 33. Environmental Chemicals and their Association with Hyperparathyroidism

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Background: The incidence of primary hyperparathyroidism has significantly increased in the United States in the past few decades. Previous work from our institution detected environmental chemicals including polychlorinated biphenyls and pesticides within hyperplastic parathyroid tumors. The National Health and Nutrition Examination Survey (NHANES) is a program designed to assess the health and nutritional status of people in the United States and is part of the Centers for Disease Control and Prevention. The NHANES dataset includes measurements of environmental chemicals within laboratory serum specimens. Our aim was to determine if there are any environmental chemicals associated with elevated parathyroid hormone (PTH) levels in NHANES.

Methods: NHANES was queried from 2003-2006, which are the only years that include laboratory data on PTH. Subjects with elevated PTH and normal Vitamin D levels were identified. Student's T-Tests were used to analyze levels of environmental chemicals with elevated PTH in a univariate analysis. Categories of environmental chemicals included pesticides and insecticides, polychlorinated biphenyls (PCB), flame retardants, dioxins, furans, and environmental phenols. All environmental chemicals with $p < 0.05$ were then included in separate multivariate models adjusting for serum vitamin D and creatinine.

Results: There were 14,681 subjects analyzed, and of these 9.4% (1,377) had elevated PTH (>65 pg/mL) and normal Vitamin D (>30 ng/mL). Calcium was elevated >10.2 mg/dL in 2.8% (359) of subjects. Eighteen different PCBs were found to be associated with elevated PTH (PCB 74, 138, 146, 153, 158 170, 172, 177, 178, 180, 183, 187, 194, 195, 196, 203, 206, 209; all $p < 0.05$). Additionally, the pesticides dimethylphosphate, transnonachlor, hexachlorobenzene, oxychlorodane, heptachlor, and dichlorodiphenyldichloroethylene (DDE) were also associated with elevated PTH ($p < 0.05$).

Conclusions: In NHANES, twenty-four environmental chemicals were found to be associated with elevated PTH levels. These chemicals may lead us towards a causal link between environmental factors and the development of hyperparathyroidism and should be the focus of future studies looking at chemical levels within specimens.

34. Overexpression of Human DNA Polymerase Theta (POLQ) in DNA Repair Deficient and Aggressive Thyroid Cancers

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Background: Targeting DNA repair genes in DNA repair stressed cancers can result in synthetic lethality. Polymerase Theta (POLQ) repairs double-strand DNA breaks in a process called Theta Mediated End Joining (TMEJ) when first-line DNA repair mechanisms fail in cancer (e.g. homologous recombination). POLQ is overexpressed in several cancer types and increased expression portends a poor prognosis. Preclinical studies demonstrate that ablating POLQ function increases drug sensitivity to agents that cause DSBs, including certain chemotherapies and ionizing radiation. POLQ's role in thyroid cancer (TC) remains poorly understood and is examined here.

Methods: POLQ gene expression and the expression levels of DNA repair genes of 513 well differentiated thyroid cancers (WDTCs) and 37 anaplastic thyroid cancers (ATCs) were analyzed in The Cancer Genome Atlas (TCGA) and the Gene Expression Omnibus (GEO, <https://www.ncbi.nlm.nih.gov/geo/>), respectively. TCGA RNA sequencing reads were queried by the Xena platform (<https://xenabrowser.net>) and GEO expression levels were manually downloaded and tabulated. The Recombination Proficient Score (RPS), a composite score of gene expression of genes involved in DNA repair, measured DNA repair deficiency in TCs. A univariate analysis was performed. A 2-tailed t-test assessed differences in 2 groups with continuous distribution. For variables with greater than 2 dependent values, ANOVA was used. Pearson correlation was used to compare matched continuous variables. Survival data were assessed by the Kaplan-Meier method. Statistical analyses were performed using GraphPad Prism 8 and Xena platform associated statistical analyses. A P value < 0.05 was considered statistically significant.

Results: POLQ was overexpressed in WDTCs and ATCs compared to normal thyroid tissue ($p < 0.05$). POLQ expression levels also inversely correlated with RPS levels in WDTC and ATC samples ($p < 0.05$). In WDTCs, POLQ expression was highest in tall cell papillary thyroid cancers and metastases and was associated with dedifferentiation, BRAF signaling, and shorter disease free interval ($p < 0.05$).

Conclusions: POLQ is overexpressed in TCs with DNA repair deficiency, and is associated with high risk and aggressive TC variants and shorter disease free interval. These findings suggest that increased POLQ expression could serve as a valuable clinical marker and provides strong rationale for additional study as a novel therapeutic target.

◆ 35. Socioeconomic Disparity in the Association Between Air Pollution Exposure and Thyroid Cancer

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Background: Cumulative exposure to air pollution in the form of fine (diameter ≤ 2.5 mm) particulate matter (PM_{2.5}) has been associated with papillary thyroid carcinoma (PTC). The purpose of this study was to evaluate subgroups of patients at highest risk.

Methods: Under IRB approval, adult patients (age ≥ 18) newly diagnosed with PTC between 1/2013-12/2016 across a single health care system were identified using electronic medical records. These patients were compared to a control group of patients without any evidence of thyroid disease. Cumulative PM_{2.5} exposure was calculated for each patient using a deep learning neural networks model, which incorporated patients' residential zip codes and both meteorological and satellite-based measurements. Adjusted multivariate logistic regression was used to quantify the association between cumulative PM_{2.5} exposure and PTC diagnosis. We tested whether this association differed by gender, race, BMI, smoking history, current alcohol use, and median household income.

Results: A cohort of 1,990 patients with PTC and a control group of 6,919 patients without PTC were identified during the study period. Compared to the control group, patients with PTC were more likely to be older (51.2 vs. 48.8 years), female (75.5% vs 46.8%), White (75.2% vs. 61.6%), and never smokers (71.1% vs. 58.4%) (all $p < 0.001$). After adjusting for age, sex, race, BMI, current alcohol use, median household income, current smoking status, hypertension, diabetes, COPD, and asthma, 3-year cumulative PM_{2.5} exposure was associated with a 1.41-fold increased odds of PTC diagnosis (95%CI: 1.23-1.62). This association varied by median household income (p -interaction=0.03). Among patients with a median annual household income between \$50,000 and $< \$100,000$ there was a 43% increased risk of PTC diagnosis (aOR=1.43, 95%CI: 1.19-1.72), and patients with median household income $\geq \$100,000$ had a 77% increased risk of PTC diagnosis (aOR=1.77, 95%CI: 1.37-2.29).

Conclusions: Cumulative exposure to PM_{2.5} over 3 years was significantly associated with the diagnosis of PTC. This association was most pronounced in those with a high median household income, suggesting a difference in access to care among socioeconomic groups.

◆ **36. Utility of Intraoperative Parathyroid Hormone Measurement in Single Adenoma Normohormonal Primary Hyperparathyroidism May Be Limited**

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Background: Current guidelines suggest that intraoperative parathyroid hormone (ioPTH) drop of >50% of baseline at 10 minutes following parathyroidectomy predicts surgical cure. Previous studies suggest that patients with normohormonal primary hyperparathyroidism (NPHPT) have a slower ioPTH degradation and lower likelihood of cure. This study evaluates the likelihood of achieving intraoperative as well as long term biochemical cure in patients with NPHPT vs. Classic PHPT (CPHPT).

Methods: This is a retrospective review of the endocrine surgery database at two quaternary care academic medical centers including 1578 patients undergoing parathyroidectomy between 2000 and 2017. Chi-squared and ANOVA were employed for bivariate analysis and multivariable logistic regression was used for adjusted outcome analyses. Only patients with a single adenoma removed were included in the study.

Results: Four hundred seventy-five NPHPT and 1103 CPHPT patients underwent parathyroidectomy. Mean PTH for NPHPT and CPHPT were 67 pg/mL +/- 0.71 and 161 pg/mL +/- 3.41 (p<0.001). There was no difference between groups with regard to sex or age. At 5 minutes post removal of adenoma, 59.9% NPHPT patients had a 50% drop in ioPTH vs. 66.2% of CPHPT [OR 0.76 (0.61-0.96) p= 0.019]. At 10 minutes, 75.9% of NPHPT patients had a 50% drop vs. 82.6% of CPHPT patients [OR 0.66 (0.5-0.87) p=0.003]. At 15 minutes, 83.7% of NPHPT patients had a 50% drop in ioPTH vs. 87.8% of the CPHPT group [OR 0.71(0.52-0.99) p=0.04]. There was no statistically significant difference in rate of persistence of disease (3% for NPHPT vs. 2.2% for CPHPT, p= 0.365) or recurrent hyperparathyroidism (2% for NPHPT vs. 2% for CPHPT, p= 0.997). Excluding patients with a 5 minute ioPTH > than baseline PTH did not significantly alter results. With those patients excluded, 94.3% of overall patients achieved biochemical cure at 15 minutes.

Conclusions: NPHPT patients demonstrated lower odds of having a 50% drop of ioPTH from baseline PTH at 5, 10, and 15 minutes post single adenoma removal when compared to CPHPT patients, suggesting slower time to biochemical cure intraoperatively. This did not significantly affect rates of persistence or recurrence of disease.

37. Reassessing the Risk of Thyroid Malignancy in the Bethesda Classification System: A NSQIP Analysis

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Background: The Bethesda System for Reporting Thyroid Cytopathology (TBSRTC) was formalized in 2007 and updated in 2017 in part to risk stratify the risk of malignancy of thyroid nodules based upon cytopathology. Over time, several single-center studies have reported significant variations with respect to institutional rate of malignancy (ROM) as compared to those implied based upon TBSRTC. The objective of this study was to determine the national ROM for Bethesda III (BIII), Bethesda IV (BIV), and Bethesda V (BV) thyroid nodules.

Methods: From 2016-2019, patients with preoperative cytopathology and pathology results in The American College of Surgeons National Surgical Quality Improvement (NSQIP) targeted thyroid database were identified. The ROM and patient factors associated with malignancy were assessed for BIII, BIV, and BV specimens.

Results: 13,121 patients with preoperative cytopathology and post-resection pathology results were identified. Compared to TBSRTC- 2017, the rate of malignancy was significantly higher than the median implied risk of malignancy for BIII, BIV, and BV thyroid nodules. For BIII, 36.2% were malignant as compared to 12% ($p < 0.001$). For BIV, the ROM was 36.7% as compared to 25% ($p < 0.001$), and for BV the rate of malignancy was 91.1% as compared to 52.5% ($p < 0.001$). Male sex significantly associated with malignancy in BIII, BIV, and BV nodules (BIII, OR: 1.20, 95% CI: 1.01-1.42; BIV, OR: 1.47, 95% CI: 1.27-1.71; BV, OR: 1.28, 95% CI: 1.03-1.58). Age was also associated with malignancy with BIII patients under 55 (OR: 1.23, 95% CI: 1.07-1.42), BIV patients under 42 (OR: 1.23, 95% CI: 1.06-1.43), and BV patients aged less than 47 (OR: 1.39, 95% CI: 1.15-1.67).

Conclusions: To our knowledge, this the largest study examining the rate of malignancy for Bethesda III, IV, and V nodules in the United States. The results of this work reveal that the overall ROM is significantly higher than the implied risk of malignancy commonly reported to patients and providers. We recommend counseling patients regarding this increased ROM in order to set appropriate expectations following surgery.

◆ 38. Hürthle Cell Carcinoma and Follicular Thyroid Carcinoma: Are They as Similar as We Treat Them?

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Background: Hürthle cell carcinoma (HCC) has been shown to be histologically and molecularly distinct from follicular thyroid carcinoma (FTC) resulting in separate classification in 2017 by the World Health Organization. However, controversy persists on whether HCC exhibits more aggressive behavior with worse outcomes than FTC. We aimed to use pooled data to analyze and compare tumor-specific outcomes of HCC to those of FTC.

Methods: A comprehensive systematic review of multiple online databases was performed. Key bibliographies were reviewed. Studies comparing HCC and FTC were included for analysis. Pooled mean differences (MD), odds ratios (OR), and risk ratios (RR) with 95% confidence intervals (CI) were calculated. Study bias and heterogeneity were assessed, and study quality was analyzed using MINORS criteria with higher scoring studies evaluated in subgroup analysis.

Results: Eight studies were included comparing 463 patients with HCC to 1668 patients with FTC. Patients with HCC were older (MD 6.93 years; CI 6.05-7.81; $P < 0.001$). There was no difference in patient gender between groups. More patients with HCC had tumors larger than 4 cm (OR 3.59; CI 2.77-4.65; $P < 0.001$). Fewer patients with HCC presented with distant metastases (OR 0.45; CI 0.29- 0.69; $P < 0.001$). Rates of total thyroidectomy were similar between the groups (OR 0.89; CI 0.64-1.23; $P = 0.47$). There were no significant differences in tumor invasion (OR 1.21; CI 0.93-1.58; $P = 0.16$) or lymph node metastases (OR 0.87; CI 0.49-1.54; $P = 0.64$) between the groups. Patients with HCC had higher rates of disease recurrence (OR 3.96; CI 2.53-6.18; $P < 0.001$) and lower rates of 10-year disease-free survival (DFS) (RR 0.89; CI 0.84-0.94; $P < 0.001$). Analysis of studies that included overall survival data revealed no difference between the groups (RR 0.96; CI 0.81-1.15; $P = 0.66$). Median MINORS score was 15.5. Subgroup analysis of higher- scoring studies revealed lower rates of female sex in patients with HCC (OR 0.70; CI 0.52-0.93; $P < 0.05$). All other outcomes of the subgroup analysis were congruent with the original pooled analysis.

Conclusions: Despite similar rates of local invasion and lymph node metastasis, HCC recurs more often and has worse 10-year DFS than FTC. However, these findings did not translate into differences in overall survival.

◆ 39. Longitudinal Experience of Patients with Post-Thyroidectomy Vocal Cord Paralysis: A Mixed Methods Evaluation

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Background: Background: Unilateral vocal cord paralysis (VCP) after thyroidectomy can lead to dysphonia, dysphagia, and dyspnea. Most prior studies of post-thyroidectomy VCP have been cross-sectional. We sought to comprehensively assess the experience of patients with VCP post-thyroidectomy over time.

Methods: Methods: Patients with thyroid cancer were prospectively studied through a larger clinical trial. Patients underwent laryngoscopy preoperatively and 2-weeks post-operatively, with additional if VCP identified; VCP was confirmed by an independent laryngologist. Patients with VCP were compared to all patients without postoperative complications for quantitative analysis, and age- and sex-matched 1:1 for qualitative analysis.

Quantitative outcomes included the Voice Handicap Index (VHI), Eating Assessment Tool (EAT-10), and 12-Item Short Form Survey (SF-12) filled out preoperatively, and 2-weeks, 6-weeks, 6-months, and 1-year postoperatively. Measures were compared with the Wilcoxon-Mann-Whitney test. Semi-structured interviews were conducted at the same time points and directed content analysis performed.

Results: Results: Of 45 patients included, 7 (15.6%) had documented postoperative VCP. VCP resolved within a year for 6 patients, taking an average of 3.8 months (SD 2.4).

Preoperative VHI was similar for both groups (4.7 VCP vs. 4.9 no complication, $p=0.94$). VHI for patients with VCP increased to 32.6 (SD 20.3) at 2-weeks and 31.0 (SD 33.3) at 6-weeks (vs. 6.3 and 4.4 no complication, both $p<0.01$). VHI approached preoperative levels (7.0, SD 5.8) by 6-months. No significant differences between groups were seen in SF-12 or EAT-10 scores at any point (all $p>0.05$).

Interviews 2-weeks postoperatively demonstrated that while many reported VCP related symptoms, they attributed these to their cancer treatment rather than a complication. By 6-weeks, VCP patients saw symptoms as related to a complication, and the impact on their lifestyle outweighed their concerns about cancer. At 6-months postoperatively, no perceived difference in disability was reported between groups.

Conclusions: Conclusion: Voice function was the major driver of disability for those with post-thyroidectomy VCP. Surprisingly, VCP had minimal effect on swallowing or overall quality-of-life. VCP patients' major focus was on their cancer in the immediate postoperative period, but by 6-weeks their concern shifted to VCP symptoms. Understanding the longitudinal experience of VCP can help providers tailor counseling for these patients.

40. Cost-effectiveness and outcome of robot-assisted vs laparoscopic lateral transabdominal adrenalectomy: a propensity score matching analysis from an high-volume center

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Background: Laparoscopic adrenalectomy (LA) is the gold standard treatment for adrenal lesions. Robot-assisted adrenalectomy (RAA) is a safe approach associated with higher costs in absence of clear-cut benefits. Several series reported some advantages of RAA over LA in challenging cases, but definitive conclusions are lacking. We evaluated the cost-effectiveness and the outcome of robot-assisted (RA-LTA) and laparoscopic (L-LTA) lateral transabdominal adrenalectomy in a high-volume Center.

Methods: Among 356 minimally invasive adrenalectomies (January 2012 - August 2021), 286 were performed with a lateral transabdominal approach: 191 L-LTA and 95 RA-LTA. The RA-LTA and L-LTA patients were matched for lesion side and size, hormone secretion and BMI with propensity score matching (PSM) analysis. Postoperative complications, operative time (OT), post-operative stay (POS), and costs were compared.

Results: PSM analysis identified 184 patients, 92 in RA-LTA and 92 in L-LTA group. The two groups were well matched. The median lesion size was 4 cm in both groups ($p=0.533$). Hormonal hypersecretion was detected in 55 and 54 patients of RA-LTA and L-LTA group, respectively ($p=1$). Median OT was significantly longer in RA-LTA group (90.0 Vs 65.0 minutes) ($p<0.001$). No conversion was registered. Median POS was similar (4.0 Vs 3.0 days in the RA-LTA and L-LTA) ($p=0.467$). No difference in postoperative complications was found ($p=1$). The cost margin analysis showed a positive income for both procedures (2405.0 Vs 4150.0 € for RA-LTA and L-LTA). In the multiple logistic regression analysis, independent risk factors for postoperative complications were hypercortisolism (OR=24,197, $p=0.028$), OT >75 min (OR=12,441, $p=0.026$), lesion size >6 cm (OR=24,298, $p=0.032$). In the subgroups analysis the median OT of RA-LTA and L-LTA was 90.0 Vs 75.0 minutes ($p=0.545$) and 90.0 Vs 89.0 minutes ($p=0.620$) for hypercortisolism and lesion size >6 cm, respectively.

Conclusions: The postoperative outcome of RA-LTA and L-LTA was similar in our experience. Despite the higher cost, RAA appears to be cost-effective and economically sustainable in a high-volume center (60 adrenalectomies/year), especially if performed in challenging cases, including patients with large (> 6 cm) and/or functioning tumors.

◆ 41. Time to Resolution of Neurocognitive Symptoms after Parathyroidectomy

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Background: Symptoms of hyperparathyroidism are diverse and negatively affect patients' quality of life. Parathyroidectomy is a safe and effective treatment for parathyroid disease with proven long-term reduction of symptoms. Little is known regarding the timing of resolution of neurocognitive symptoms, and this study tracks symptomatic improvement following parathyroidectomy.

Methods: We performed a prospective study of patients undergoing parathyroidectomy at a single institution from 2019-2021. Common neurocognitive symptoms associated with parathyroid disease including anxiety, depression, memory loss, fatigue, concentration deficits, brain fog, joint pain, and bone pain were assessed. Patients were interviewed in-person or by phone preoperatively, at 2-weeks postop, and monthly for up to 1 year. The primary endpoint was the resolution of symptoms. Additional metrics recorded included patient demographics, preoperative calcium, and parathyroid hormone (PTH). Results were analyzed with Kaplan-Meier tests and compared by log-rank analysis. Significance was defined as $p < 0.05$.

Results: A total of 100 patients completed pre and postoperative follow-up surveys. The majority (78%) were female with a median age of 63 (range: 10-84). Most patients (67%) identified as White. The most common preoperative symptoms were fatigue ($n=78$) and anxiety ($n=50$). The median time to resolution for each symptom was 1 week, while the median time to resolution for all patient-reported symptoms in any given patient was 3 weeks. Only 2 patients had any symptoms present 12 months after surgery: fatigue, anxiety, and depression. There were no significant differences between time to resolution by age, race, gender, or preoperative PTH; however, memory loss resolved quicker in normocalcemic patients versus hypercalcemic patients ($p=.046$).

Conclusions: Cognitive symptoms improved rapidly after parathyroidectomy, with a median time to resolution of less than a month. Memory loss resolved quicker in normocalcemic patients than hypercalcemic patients. These findings will help surgeons in counseling patients and assist in managing expectations post parathyroid surgery.

◆ **42. Parenchymal-sparing resections with microwave ablations for neuroendocrine tumor liver metastases: analysis of safety profile and perioperative outcomes**

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Background: Surgical debulking of neuroendocrine tumors (NETs) is used as a therapeutic approach for metastatic NETs in selected centers. Reported outcomes after parenchymal-sparing liver resections (PSR) for NETs are sparse and postoperative trends in liver function and serum tumor markers have not been reported.

Methods: Patients with NET liver metastases that underwent surgical debulking were included from 2019 to 2021. All patients underwent preoperative and serial postoperative imaging every 3 months with MRI Abdomen plus hepatobiliary contrast. Trends in perioperative liver function and serum tumor markers were examined, as well as morbidity, mortality and progression free survival.

Results: 940 liver lesions were debulked from 48 patients with a combination of PSR (47%) and ultrasound navigation-guided microwave ablations (MWA) (53%). Most patients had a small bowel (63%) or pancreatic (29%) neuroendocrine tumor primary and had a median of 16.5 (6.3-25.8) vs. 21.5 (14.5-35.8) lesions debulked, respectively. Post-operative transaminitis and thrombocytopenia correlated with number of lesions debulked (median POD1 AST/ALT 639/ 434 IU/L for 1-15 vs. 1270/1072 IU/L for >15 lesions, $p=0.02/0.05$ and median POD2 platelets $148 \times 10^9/L$ for 1-15 vs. $104 \times 10^9/L$ for >15 lesions, $p = 0.05$). Synthetic liver function measured by postoperative INR (median peak 1.37) and total bilirubin (median peak 1.25 mg/dL) did not differ according to number of lesions debulked. 15% of patients sustained a Clavien-Dindo grade 3/4 complication. 30-day mortality was 0%. Bile leak occurred in 4 patients with a leak-to-resected lesion ratio of 0.9%. Elevated preoperative chromogranin A (60%; 408 ng/mL) and serotonin (41%; 1065 ng/mL) levels dropped by 50% in 61% and 80% of cases, respectively, after debulking. Reduction of serotonin levels yielded improvement or resolution of symptoms in all patients. Hazard regression analysis showed that PNET (compared to SBNET, $p=0.003$) and grade 2 (compared to grade 1, $p=0.01$) tumors, but not number of resected liver lesions, correlated with a higher risk of disease progression.

Conclusions: PSR with MWA for NET liver metastases is safe and does not affect synthetic liver function. Transaminitis and thrombocytopenia are proportionate to the amount of liver lesions debulked. All symptomatic patients had improvement of symptoms after PSR with MWA.

43. Paradoxical Effects of Autophagy Inhibition in Thyroid Cancer

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Background: Autophagy, a highly conserved process of self-digestion, is an important player in the pathogenesis of cancer with evidence supporting both pro-tumorigenic and tumor suppressor functions. We previously demonstrated that high dose (20uM) autophagy inhibition with a potent and specific lysosomal autophagy inhibitor, Lys05, attenuated cancer stem cell (CSC) viability, cell migration, invasion, and epithelial-to-mesenchymal transition (EMT) across multiple thyroid cancer subtypes. Given potential toxicity and efficacy concerns associated with high dose autophagy inhibition, we sought to evaluate the biologic response to low dose Lys05.

Methods: The CCK-8 assay was utilized to calculate both cell proliferation and LC50 for Lys05 in validated papillary (BCPAP) and anaplastic (8505c) human thyroid cancer cells per standard protocol. Scratch migration and Matrigel invasion assays were performed with low dose Lys05, 10uM. CSC viability was assessed by thyrosphere formation. Evidence of EMT was determined by Western blot.

Results: The LC50 for BCPAP and 8505C cells was 14uM and 17uM respectively. Cell proliferation was reduced by 35%(Lys05 10uM, $p < 0.0004$) and 62%(Lys05 20uM, $p < 0.0001$) in 8505C cells as compared to an 18% reduction (Lys05 10uM, $p < 0.0006$) and 83%(Lys05 20uM, $p < 0.0001$) in BCPAP. Cell migration was reduced by 38% in BCPAP cells and paradoxically increased by 31% in 8505C cells when treated with 10uM Lys05 ($p < 0.0001$, 0.001). Invasion assays demonstrated a 95% reduction in the presence of 10uM Lys05 in BCPAP cells as compared to a nonsignificant difference in invasion in 8505C cells at the same dose ($p < 0.0001$, ns). Thyrosphere formation was eradicated with 10uM Lys05 in both BCPAP and 8505C cells ($p < 0.0005$, 0.002). We found no difference in vimentin expression in BCPAP or 8505C cells treated with 10uM Lys05.

Conclusions: Low-dose autophagy inhibition with 10uM Lys05 reduces cell proliferation and thyrosphere formation in BCPAP and 8505C cells. While cell migration and invasion are inhibited with 10uM Lys05 in BCPAP cells, more aggressive anaplastic cells(8505C) exhibit augmented cell migration with no effect on invasion or EMT in response to low dose Lys05. These results suggest both a dose- and cell-type specific response to autophagy inhibition. Clarifying the mechanisms driving these differential responses to therapy will aid in the development of rational therapeutics.

◆ 44. Late versus early administration of radioiodine therapy for patients with differentiated thyroid cancer: a systematic review and meta-analysis

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Background: Radioiodine (RAI) therapy is an important adjuvant therapy for differentiated thyroid carcinoma (DTC) patients. Several studies have demonstrated the efficacy of RAI in reducing the risk of thyroid cancer recurrence and mortality; however, the ideal timing to initiate RAI after surgery is debatable. This systematic review evaluates the risk of achieving excellent response and mortality when comparing late versus early administration of RAI in patients with DTC.

Methods: We searched Medline, Embase, Scopus, and Cochrane databases from inception to April 2021 to identify experimental and observational studies evaluating the impact of the different timings of RAI after surgery (<3months vs. >3months, <6months vs. >6months, <9months vs. >9months) on the risk of excellent response (ER) and thyroid-specific mortality in DTC patients with low, intermediate, and high-risk of recurrence. We used a random-effects model to pool dichotomous variables with odd ratios (OR) and confidence intervals (95%CI). Risk of bias was evaluated using the Newcastle-Ottawa Scale.

Results: We included 12 retrospective cohort studies with 34,833 patients. In patients at low-to-intermediate risk of recurrence, there were no differences in ER (OR 0.76, 95%CI: 0.34-1.68, I2: 78.00%, n=1099) and mortality (OR 1.00, 95%CI: 0.84-1.19, I2: 0.00%, n=21450), in late group (>3months) compared to early. Likewise for patients who underwent RAI at 6months (ER, OR 1.26, 95%CI: 0.94-1.69, I2: 0.00%, n=880) and 9months cut-offs (ER, OR 0.78, 95%CI: 0.32-1.91, I2: 0.00%, n=597; mortality, OR 1.28, 95%CI: 0.74-2.23, I2: 0.00%, n=327). As far for patients with high-risk of recurrence, there were no differences in ER (OR 0.82, 95%CI: 0.61- 1.11, I2: 0.00%, n=720) and mortality (OR 1.04, 95%CI: 0.74-1.47, I2: 62.50, n=10426, respectively) in late group (>3months) compared to early. Similarly for patients who underwent RAI at 6months cut-off (ER, OR 1.04, 95%CI: 0.64-1.68, I2: 58.90%, n=72). However, mortality was higher in late group (>6months) compared to early (OR 6.55, 95%CI: 2.92-14.67, I2: 0.00%, n=198). Risk of bias was moderate in 7 studies and high in 5.

Conclusions: Low-to-moderate quality of evidence suggests increased mortality with delayed RAI (>6months) in DTC patients at high- risk of recurrence. Timing for RAI for other risk categories has little or no effect. Further experimental studies are needed to confirm these results and draw robust conclusions.

◆ **45. General surgery training does not adequately prepare residents to perform adrenalectomy in practice**

Hannah McDonald¹, Dan Davenport¹, Cortney Lee¹, Shari Meyerson¹, Joseph Zwischenberger¹, William B Inabnet¹

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This poster has withdrawn from the AAES 2022 Meeting.

46. Cost-Effectiveness of Parathyroidectomy versus Cinacalcet Among Patients with Secondary Hyperparathyroidism in the United States

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Background: Cinacalcet or parathyroidectomy (PTX) can be used to treat patients with severe secondary hyperparathyroidism (sHPT). Because treatment with PTX implies a one-time treatment cost, and treatment with cinacalcet can be assumed to occur over a patient's lifetime, parathyroidectomy may be a more cost-effective treatment option. The objective of this study is to conduct a cost-effectiveness analysis comparing parathyroidectomy versus cinacalcet in patients with sHPT on dialysis in the United States.

Methods: A 2-year decision tree model was developed to assess the cost-effectiveness of PTX compared to cinacalcet in adult patients with chronic kidney disease (CKD) on hemodialysis with sHPT uncontrolled on standard of care treatment from the public payer perspective. Treatment response was defined using parathyroid hormone levels from cinacalcet, randomized controlled trials, and from published literature for PTX. We assessed model sensitivity to variations in individual inputs and overall design uncertainty through probabilistic sensitivity analyses (PSA).

Results: PTX is more effective (96% of patients controlled vs 51% controlled on cinacalcet) but more expensive (\$69,540 vs \$10,871) than cinacalcet. The incremental cost-effectiveness ratio (ICER) of PTX compared to cinacalcet was \$129,920 per treatment success. PSA suggested a 100% chance that cinacalcet would be both less expensive and less effective. The model was most sensitive to the cost of cinacalcet. Considering PTX is a one-time cost, when considering treatment costs using a 5-year time horizon, the cost of cinacalcet increases to \$25,545 and the ICER comparing PTX to cinacalcet becomes \$97,767 per treatment success.

Conclusions: PTX is a more effective treatment option compared to cinacalcet, but at a higher cost. PTX may be cost-effective compared to cinacalcet depending on a healthcare payer's willingness to pay. Over time, PTX becomes a more cost-effective option given the one-time treatment costs. Because of the short timeframe, this model does not consider long-term outcomes like reduction in CV events, mortality, and re-surgery among PTX failures which may impact results.

(V) ♦ 47. PRESENTATION PREVIEW: PERFORMANCE OF AFIRMA AND INTERPACE MOLECULAR TESTING IN PREOPERATIVE DIAGNOSIS OF INDETERMINATE THYROID NODULES

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Background: Indeterminate thyroid nodules (ITN) represent 20-30% of biopsied nodules. The risk of Malignancy in ITN is 25-35%. The 2015 American Thyroid Association guidelines adopted diagnostic lobectomy to determine the final pathology. Molecular testing can stratify risk of malignancy among ITN and subsequently reduce the need for diagnostic surgery. We aim to assess the performance of tests developed by Afirma and Interpace Diagnostics in an academic medical Center.

Methods: We identified patients with ITN which underwent molecular testing using Afirma Gene Expression Classifier (GEC), Afirma Genomic Sequencing Classifier (GSC), Afirma Xpression Atlas (XA), Interpace Diagnostics mutation panel (ThyGenX/ThyGeNEXT), and microRNA classifier test (Thyramir) between 2014 and 2021. Patients' electronic medical records were used to extract patient demographics, nodule characteristics and final surgical pathology. The gene testing results were assessed against the final surgical pathology. IBM SPSS Statistics 27 was used for statistical analysis as well as sub-group analysis.

Results: We included 475 ITN, with 102 (21.4%) proven malignant by surgical pathology. The Sensitivity (SE), Specificity (SP), Positive Predictive Value (PPV), Negative Predictive Value (NPV) and Accuracy of Afirma were (77.6%, 52.4%, 32.3%, 88.8%, and 58.1%) respectively. The SE, SP, PPV, and NPV and Accuracy of Interpace Diagnostics were (40.7%, 87.4%, 42.3%, 86.7%, and 78.8%) respectively. Interpace diagnostics accuracy was higher significantly compared to Afirma, $P < 0.01$. In a subgroup analysis comparing the diagnostic performance of Afirma GEC and GSC vs Afirma XA, the new version had a higher SP (93% vs. 45.4%), AUC (86.5% vs. 61.4%), PPV (57.1% vs. 31.2%), NPP (97.6% vs. 86.3%), and Accuracy (91.7% vs. 53.1%). $P < 0.001$ for all. The new Afirma panel alone also outperformed Interpace Diagnostic panel, $P < 0.01$ for all.

Conclusions: Interpace diagnostics outperformed Afirma, the new and the old panel collectively, in its ability to rule out malignancy. However, the newer Afirma panel, separately, outperformed Interpace diagnostics due to its updated molecular panel.

◆ 49. Utility of 4DCT in predicting single gland parathyroid disease – Can we abandon intraoperative parathyroid hormone monitoring?

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Background: Four-dimensional computed tomography (4DCT) is routinely utilized to localize parathyroid disease. Improvements in technology and protocols have shown to improve localization rates and predict gland weights. This study was conducted to determine if the incorporation of 4DCT results with other preoperative clinical variables can accurately predict single gland disease (SGD) in primary hyperparathyroidism (PHPT) without intraoperative parathyroid hormone (ioPTH) monitoring during parathyroidectomy.

Methods: Patients with PHPT who underwent both 4DCT imaging and parathyroidectomy between January 2018 – September 2021 at a large academic health system were included. Patient demographics, preoperative clinical characteristics, and peri- and postoperative data were collected and used to assess accuracy of 4DCT with and without preoperative calcium and PTH levels in identifying patients with SGD based on operative outcomes. Confirmed SGD was defined both biochemically by ioPTH decrease (>50%) and pathologically by confirmation of a single hypercellular gland.

Results: Of 255 patients meeting inclusion criteria, 173 had 4DCT results suggesting SGD, 28 had indeterminate results, and 34 reported concern for multigland disease (MGD). One hundred fifty-one patients (87%) were predicted correctly to have confirmed SGD. Twenty-two patients (13%) predicted to have SGD were found to have MGD of which 17 patients (77%) were identified by failure of adequate ioPTH decrease. The predictive accuracy of suspected SGD on 4DCT increased when stratifying patients by preoperative calcium (≥ 10.5 mg/dL, ≥ 11 mg/dL, and ≥ 12 mg/dL) and PTH levels (≥ 65 pg/mL, ≥ 100 pg/mL, and ≥ 200 pg/dL) both independently and when stratified using both calcium and PTH levels together. The accuracy was further increased when stratifying patients by age (≤ 50 years). Suspected SGD on 4DCT was associated with 100% accuracy when combined with any of the following scenarios: 1) calcium ≥ 12 mg/dL alone, 2) PTH ≥ 200 alone, or 3) calcium ≥ 11 mg/dL and PTH ≥ 100 pg/dL in patients ≤ 50 years old.

Conclusions: Use of 4DCT alone accurately predicts SGD in 87% of patients with PHPT, and when combined with preoperative calcium and PTH values as well as age thresholds, increases predictive accuracy of SGD to levels approaching 100%. Given the high likelihood of SGD in these scenarios, clinicians may consider offering focused unilateral parathyroidectomy without ioPTH monitoring in selected patients.

◆ 50. Features of Mixed Medullary Thyroid Tumors: an NCDB Analysis of Clinicopathologic Characteristics and Survival

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Background: Mixed medullary-papillary thyroid carcinoma (MMPTC) and mixed medullary-follicular thyroid carcinoma (MMFTC) are rare variants of thyroid cancer known to represent <1% of all thyroid malignancies. In the current literature, there is controversy surrounding the biological behavior of these mixed medullary tumors (MMT). Some prior studies have associated MMTs with higher rates of aggressive pathologic features, while others have shown no difference when compared to differentiated thyroid cancer (DTC). Thus, we aimed to compare the clinicopathologic characteristics and long-term survival of patients with MMPTC and MMFTC to those with papillary thyroid carcinoma (PTC), follicular carcinoma (FTC), and medullary carcinoma (MTC).

Methods: Using the National Cancer Database (NCDB), patients with MMPTC and MMFTC were retrospectively compared to those with PTC, FTC and MTC between 2004 and 2018. Data collected included patient demographics, clinicopathologic features, treatment, and overall survival (OS).

Results: A total of 296,101 patients were analyzed including 421 MMPTC (0.14%), 133 MMFTC (0.04%), 263,140 PTC (88.87%), 24,208 FTC (8.18%) and 8,199 MTC (2.77%). When compared to patients with PTC, those with MMPTC and MMFTC were older ($p < 0.001$) with a higher Charleston-Deyo comorbidity index ($p < 0.001$). MMTs exhibited lower rates of N1 disease, yet had a higher frequency of distant metastases when compared to PTC ($p < 0.001$). Additionally, higher rates of positive margins were seen in both MMFTC and MMPTC when compared to PTC (13.53% and 12.11% vs. 10.45%, $p < 0.001$). Moreover, MMPTC demonstrated lower survival rates than PTC and FTC (64.14% vs. 78.13% and 69.74%, $p < 0.001$), yet higher survival rates than MTC (64.14% vs. 58.75%, $p < 0.001$). MMFTC had a worse overall survival when compared to all groups (36.11%, $p < 0.001$).

Conclusions: This largest series to date identifies MMFTC as having significantly worse OS when compared to DTC and thus portends a worse prognosis. The medullary component of MMTs may drive their behavior and prognosis.

◆ 51. Machine Learning Identified Clinical Factors Influencing the Dose of Levothyroxine After Total Thyroidectomy

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Background: Weight-based adjustment of levothyroxine dosing after total thyroidectomy is inaccurate in the majority of patients. Previous studies have found body mass index (BMI), sex, and age to influence the dose of levothyroxine. Machine learning (ML) is a powerful tool capable of uncovering associations difficult to discern in conventional statistical methods. We employed ML to evaluate the potential influence of additional clinical factors including race/ethnicity, lifestyle habits and comorbidities on the replacement dosage requirements of levothyroxine.

Methods: We conducted a retrospective chart review of patients who underwent total or completion thyroidectomy between 2013 and 2020 for benign conditions. Patients who had achieved an euthyroid state determined by levels of thyroid stimulating hormone (TSH) were included. Fifteen variables including age, sex, weight, BMI, race/ethnicity, alcohol and tobacco use, and various comorbidities were analyzed using selected ML algorithms.

Results: Of the 487 patients included in final analysis, the mean age was 54.1 ±14.1 years and 86.0% were females. Thirty nine percent were White, 53.0% Black, 2.7% Hispanic, 1.4% Asian, and 3.9% Other. In respect to alcohol use, 18.3% identified as routine drinkers, 32.4% as rare/social drinkers, and 45.4% never drinkers. In regard to comorbidities, 6% were diagnosed with osteoarthritis (OA) and 47.0% were with hypertension. The XGBTree and FeedForward Neural Network algorithms both achieved 61.9% accuracy in predicting the adequate dosage, compared to 47.0% based upon a standard of 1.6mcg/kg/day. The Poisson Regression algorithm suggested that race/ethnicity was not a significant predictor. However, alcohol use (routine drinker, coefficient=-3.01, SEM=1.12, p=0.007), hypertension (coefficient=-0.20, SEM=0.09, p=0.03), and OA (coefficient=-0.87, SEM=0.32, p=0.007) in addition to known significant variables such as age (coefficient=-0.03, SEM=0.01, p=0.001), sex (female, coefficient=-0.35, SEM=0.10 p<0.001), weight (coefficient=0.02, SEM=0.004, p<0.001), and BMI (coefficient=-0.08, SEM=0.03, p=0.01) all were associated with the dosing requirements of levothyroxine to achieve euthyroid state.

Conclusions: Along with sex, age, and BMI, lifestyle and comorbidity factors may impact levothyroxine dosing in patients who underwent total thyroidectomy with benign conditions. Further investigation of these findings is warranted to refine the dosing algorithm for levothyroxine replacement after total thyroidectomy.

◆ 52. Thyroid Cancer Disparities Decreased but Persist for Appalachian Patients Despite Improved Access to Health Insurance Coverage Under the Affordable Care Act

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Background: Patients from Appalachia lack access to healthcare, have a higher incidence of thyroid cancer, and present at older age with more aggressive pathology. The Affordable Care Act (ACA) is a landmark federal statute that increased access to health insurance starting in 2014. The aim of this study is to analyze the impact of increased access to coverage on thyroid cancer disparities in a rural healthcare market.

Methods: A retrospective review of the Kentucky Cancer Registry (KCR) was performed to include all cases of differentiated thyroid cancer diagnosed from 2010 through 2018. Cases were matched by census tract to socioeconomic status data as well as urban versus rural status.

Results: A total of 4563 cases were identified with equivalent cohorts 2010-2014 (pre-ACA) and 2015-2018 (post-ACA). Insurance coverage varied significantly after ACA implementation with decreased uninsured and private insurance and increased Medicaid ($p < .001$). The proportion of patients who underwent operation within the same month as diagnosis fell significantly following ACA implementation (80.2 to 75.9%, $p < .001$). There was a statistically significant change in initial treatment combinations of surgery, hormone therapy, and radiation by stage pre- and post-ACA. The percentage of patients with stage IV disease was higher in rural populations (2.8% metropolitan, 4.0% rural, $p = .137$) but the difference fell following ACA (3.9% metropolitan, 4.4% rural, $p = .642$). The percent census tract population without a high school diploma increased with disease stage (14.0% stage I-III, 15.5% stage IV, $p = .125$) but trended slightly less post-ACA (14.3% stage I-III, 15.6% stage IV, $p = .183$). The percent census tract population in poverty increased with disease stage (17.2% stage I-III, 19.3% stage IV, $p = .096$) but improved post-ACA (17.7% stage I-III, 18.7% stage IV, $p = .404$).

Conclusions: Healthcare disparities for thyroid cancer in education, poverty, and rurality have reduced following ACA implementation with an increased time from diagnosis to operation. We postulate this is a consequence of earlier diagnosis in the primary care setting. Additional work is needed to assess the American Thyroid Association risk stratification by region and insurance status to determine appropriateness of therapy regarding extent of index operation, thyroid stimulating hormone suppression, and radioactive iodine administration.

(V) 53. The Role of Second Review of Thyroid Cytopathology at a Tertiary Center

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Background: The Bethesda System for Reporting Thyroid Cytopathology (Bethesda) standardizes terminology for cytopathology of thyroid fine needle aspiration (FNA); however, accuracy in thyroid cytopathology requires significant experience and subjectivity in interpretation and interobserver variability still exist. This study examines the role of secondary review of outside FNAs by an expert thyroid cytopathologist at a single, large tertiary center with a dedicated thyroid cancer management program.

Methods: Our institutional thyroid cytopathology database was used to identify all reports in which outside cases underwent secondary review by one of our expert thyroid cytopathologists. A novel keyword search algorithm programmed in MATLAB (R2021a) extracted FNA Bethesda category from ~7,000 cytopathology reports for ~10,000 biopsies performed between 2006 and 2021. Quality control demonstrated consistent accuracy of the algorithm of 97%. A total of 498 specimens in 439 cytopathology reports underwent secondary review. Histopathology was available on 266 specimens (53%).

Results: The concordance rates for cytologic diagnosis on original and secondary review for all, thyroid, and lymph node specimens were 63.5%, 61.6%, and 71.8%, respectively. For thyroid nodule specimens, the interobserver agreement rate was highest for Bethesda II and VI (58.5% and 68.2%, respectively) and lowest for Bethesda III and V (27.0% and 20.9%, respectively). Significant Bethesda downgrades (any Bethesda → II) occurred in 44/132 cases (33%). Most changes were from Bethesda III/IV → II (40/132, 30%). Histopathology was available for 10 specimens and 9/10 (90%) were benign yielding a negative predictive value (NPV) of 0.9. Significant Bethesda category upgrades (Bethesda I/III/III/IV → V/VI) occurred in 12/132 (9.1%) times. Histopathology was available on 10 specimens and 9/10 (90%) were malignant yielding a positive predictive value (PPV) of 0.9

Conclusions: This study shows that review of outside thyroid nodule FNA specimens by an expert cytopathologist specializing in thyroid disease frequently (~40%) changed the original diagnosis and clinical management. This secondary review resulted in excellent NPV and PPV of 0.9 for nodules re-classified as benign and malignant, respectively.

IN MEMORIAM

Written by Steven A. De Jong, MD

Edward Paloyan, MD

1932 – 2021



Our friend and colleague, Dr. Edward Paloyan passed away on October 13, 2021, peacefully at his home in Oak Brook, Illinois at the age of 89. Dr. Paloyan was a Professor of Surgery and Chief of Endocrine Surgery at Loyola from 1973 until 1994. He also served as Associate Chief of Staff for Research and Development at Hines VA Hospital.

Ed was born in Paris, France on March 19, 1932, and had an incredible life story. In his early years, he was an accomplished concert violinist in France. His parents were orphans who survived the Armenian Genocide of World War I and the entire Paloyan family immigrated to the United States in 1948.

Dr. Paloyan spent 22 years at the University of Chicago in medical school, internship, surgical residency, and faculty, reaching the rank of Associate Professor of Surgery with tenure. Dr. Paloyan was recruited to Loyola from the University of Chicago in 1973 and, over the next 20 years, Dr. Paloyan built an endocrine surgery program that was recognized nationally as one of the very best in treating the entire spectrum of endocrine surgical disease. He was a founding member and past president of the American Association of Endocrine Surgeons from 1987-1988 and he was also a founding member of the American Association of Clinical Endocrinologists.

After a long career in academic surgery, he left Loyola in 1994 and moved to private practice in the western suburbs until his retirement in June 2020. Dr. Paloyan had an incredible career and treated tens of thousands of patients. On a personal note, he was a kind and gentle man who rarely spoke about himself or his past life experiences and accomplishments, but he loved his work and deeply enjoyed caring for others.

Dr. Paloyan will be remembered as a giant in American surgery with an inquisitive spirit who taught precision, humility, respect, and patience to his many trainees. He will be greatly missed and a visitation service for family and friends was held on October 15, 2021.

IN MEMORIAM

*Written by Martha A. Zeiger, MD, Fred Radke, MD, Mike Starks, MD,
Peter Mazzaglia, MD, and Leslie Wu, MD*

Walter B. Goldfarb, M.D., FACS

1933 - 2021



It is with tremendous sadness as we remember, honor, and celebrate the life of Walter Goldfarb. Walter was born on Sept. 2, 1933, in Boston; the oldest of four children of Daniel C. Goldfarb, M.D., and Helen Fish. He was graduated from Brookline High School in 1951 and with honors from Brown University in 1955, majoring in American and English literature, and a member of Phi Beta Kappa. It was at college that he met and subsequently married his classmate Marcia Finberg of Portland. She predeceased him in 2013 after 58 years of marriage.

After receiving his medical degree from Tufts University School of Medicine in 1959 he began six years of surgical residency training at Barnes Hospital/Washington University School of Medicine in St. Louis, Missouri, where he was an instructor in surgery from 1963-1965. In July 1965 he and his family moved to Portland, his wife's hometown, to begin the practice of surgery at Maine Medical Center and Mercy Hospital. In 1966 he was drafted into the U.S. Army and served two years during the Vietnam conflict.

In 1968 he and the family returned to Portland to resume his surgical practice which continued for the next 35 years. He retired in 2003 after many years as chief of General Surgery at Maine Medical Center (MMC). It was there that he became "the endocrine surgeon"; he was a quintessential clinician, a fast and efficient surgeon and, taught us many, many surgical skills and "moves" as he would call them in the operating room. He was a member of the AAES from 1995.

Over the years he was a member of the staff at MMC serving in a variety of leadership positions including President of the medical staff from 1978-1980. He was a longtime trustee of MMC and a founding trustee of MaineHealth for 12 years. He was an active member of the New England Surgical Society, serving in leadership roles over the years including society President in 2004.

A true Renaissance man, Walter regaled us with myriad information on surgical history, art, medical knowledge, politics, literature, everything, and anything in and out of the operating room. And all with truly magnificent humor, beautiful prose, and style. He was an expert in 19th century American art and was an avid collector. He was also a donor of major American paintings to the Portland Museum of Art, including works by John Frederick Peto, William Michael Harnett, John Haberle, Fitz Henry Lane, Martin Johnson Heade, J.F. Kensett, and Sanford R. Gifford.

His greatest pride and joy were his three children—all physicians: Jennifer Aronson MD of Cape Elizabeth, ME (Fred Aronson MD), Adam Goldfarb MD of Charlottesville, Va. (Erica), and Miriam Goldfarb MD of Williamstown, Mass. (Marc Vincenz) and 6 grandchildren.

Our greatest pride and honor were that we knew him, trained with him, admired him, and loved him. He was the sole reason many of us who trained at Maine Medical Center chose endocrine surgery as our lifelong profession. We will miss him dearly.



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Patient management decisions are based on the independent medical judgment of the physician and molecular test results should be taken into consideration in conjunction with all relevant imaging, clinical findings, patient and family history, as well as patient preference.

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