

Birmingham

ALABAMA



43rd

ANNUAL MEETING

AMERICAN ASSOCIATION
OF ENDOCRINE SURGEONS

APRIL 29 - MAY 1,
2023



Program Chair:
Anthony Yang, MD

Local Arrangements Co-Chairs:
Jessica Fazendin, MD and Brenessa Lindeman, MD, MEHP

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for attending the
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We hope to see you next year in DALLAS!

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**43RD Annual Meeting
April 29 - May 1, 2023**

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

Year	President	Vice President	Secretary	Recorder
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2000-2001	Barbara K. Kinder	Martha A. Zeiger	Christopher R. McHenry	Michael J. Demeure
1999-2000	Jay K. Harness	John S. Kukora	Paul LoGerfo	Michael J. Demeure
1998-1999	George L. Irvin, III	Barbara K. Kinder	Paul LoGerfo	Quan-Yang Duh
1997-1998	Blake Cady	E. Christopher Ellison	Paul LoGerfo	Quan-Yang Duh
1996-1997	Jon A. van Heerden	George L. Irvin, III	Jay K. Harness	Quan-Yang Duh
1995-1996	Richard A. Prinz	Jeffrey A. Norton	Jay K. Harness	George L. Irvin, III
1994-1995	John M. Monchik	Jon A. van Heerden	Jay K. Harness	George L. Irvin, III
1993-1994	Orlo H. Clark	Glen W. Geelhoed	Blake Cady	George L. Irvin, III
1992-1993	Robert C. Hickey	Patricia J. Numann	Blake Cady	Robert D. Croom, III
1991-1992	Stuart D. Wilson	Joseph N. Attie	Blake Cady	Robert D. Croom, III
1990-1991	Caldwell B. Esselstyn	Brown M. Dobyms	Richard A. Prinz	Robert D. Croom, III
1989-1990	Colin G. Thomas, Jr.	Carl R. Feind	Richard A. Prinz	Jon A. van Heerden
1988-1989	John R. Brooks	Melvin A. Block	Richard A. Prinz	Jon A. van Heerden
1987-1988	Edward Paloyan	Caldwell B. Esselstyn	Stuart D. Wilson	Jon A. van Heerden
1986-1987	Oliver 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, MD, Pathologist

Stuart D. Flynn, MD, Pathologist

Ian D. Hay, MD, PhD, Endocrinologist

Virginia A. LiVolsi, MD, Pathologist

Frank LoGerfo, MD, Surgeon

G. E. "Ace" Pearse, MD, Endocrinologist

Thomas S. Reeve, MD, Endocrine Surgeon

F. John Service, MD, PhD, Endocrinologist

Britt Skogseid, MD, PhD, Endocrinologist

R. Michael Tuttle, MD, Endocrinologist

William F. Young, MD, MSc, 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

2022

Omar Shariq, MD - University of Oxford

“Epigenetic targeting of bromodomain and extra-terminal domain proteins as a novel therapy for pancreatic neuroendocrine tumors”

Sara Ginzberg, MD - University of Pennsylvania

“Disparities in Appropriate Thyroid Cancer Treatment, Before and After the Release of the 2015 American Thyroid Association Guidelines”

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”

Omar 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 Affirma Xpression 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, MD – University of Michigan

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

Amin Madani, MD – Columbia University

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

POSTER: Frances T. Lee, MD – Northwestern University

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

POSTER: Wessel MCM Vorselaars, MD, PhD – University Medical Center Utrecht

“Geographic Validation of the Aldosteronoma Resolution Score”

2018

John Tierney, MD – Rush University Medical Center

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

Kristen Limbach, MD – Oregon Health & Science University

“Prospective Study of the Pathophysiology of Carcinoid Crisis”

POSTER: Sarah Fisher, MD – MD Anderson Cancer Center

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

POSTER: Wessel Vorselaars, MD, PhD – University Medical Center Utrecht

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

**For a complete list of past winners,
visit www.endocrinesurgery.org/competition-awards**

2022-2023 NEW MEMBERS

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Sophie Dream, MD
Jessica Fazendin, MD
Sarah Fisher, MD
Trenton Foster, MD
Claire Graves, MD
Ana Islam, MD
Monica Jain, MD
Colleen Kiernan, MD
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Henry Reinhart, MD
Carlos Gustavo Rivera Robledo, MD
Minerva Romero Arenas, MD, MPH
Anatoliy Rudin, MD
Scott Sherman, MD
Angelica Silva-Figueroa, MD
Erivelto Volpi, MD
Sean Wrenn, MD
James Wu, MD
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Gabriele Materazzi, MD

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PAST MEETINGS

The AAES Annual Meeting has been hosted in cities throughout the U.S., Canada and around the world since the first meeting in 1980. For a complete, historical list of all past AAES Annual Meeting locations, visit www.endocrinesurgery.org/past-meetings.

2022	Cleveland, Ohio Local Arrangements Chair: Vikram D. Krishnamurthy	2012	Iowa City, Iowa Local Arrangements Chair: Ronald Weigel
2021	Virtual Program Chair: Carrie Cunningham	2011	Houston, Texas Local Arrangements Chair: Nancy D. Perrier
2020	Canceled due to COVID-19 pandemic	2010	Pittsburgh, Pennsylvania Local Arrangements Chair: Sally E. Carty
2019	Los Angeles, California Local Arrangements Co-Chairs: Michael Yeh, Masha Livhits	2009	Madison, Wisconsin Local Arrangements Chair: Herbert Chen
2018	Durham, North Carolina Local Arrangements Co-Chairs: Sanziana Roman, Julie Ann Sosa	2008	Monterey, California Local Arrangements Chair: Quan-Yang Duh
2017	Orlando, Florida Local Arrangements Chair: Mira Milas	2007	Tucson, Arizona Local Arrangements Chair: Michael J. Demeure
2016	Baltimore, Maryland Local Arrangements Chair: John A. Olson, Jr.	2006	New York, New York Local Arrangements Chair: Ashok R. Shaha
2015	Nashville, Tennessee Local Arrangements Chair: Carmen Solorzano	2005	Cancun, Mexico Local Arrangements Chair: Miguel F. Herrera
2014	Boston, Massachusetts Local Arrangements Chair: Richard A. Hodin	2004	Charlottesville, Virginia Local Arrangements Chair: John B. Hanks
2013	Chicago, Illinois Local Arrangements Chair: Peter Angelos		

SPECIAL SESSIONS

Attendees are welcome to attend any sessions unless specifically stated.

Lunch Session: Operating is a Pain in the Neck (and Other Places): What Every Surgeon Needs to Know About Ergonomics

Saturday, April 29, 2023, 1:00 PM – 2:00 PM

Do you have pain from operating? Are you worried that it will affect your career longevity and your finances? Then, this session is for you. Members of the Society of Surgical Ergonomics will lead a panel session addressing the incidence of work-related musculoskeletal disease in endocrine surgeons, factors contributing and exacerbating symptoms and share current ergonomic best practices. We hope to see you all there!

Breakfast Session: Challenging Endocrine Cases

Sponsored by the Clinical Practice Committee

Sunday, April 30, 2023, 7:00 AM – 8:00 AM

In this session, expert panelists and the audience will work through several cases highlighting challenges in evaluation and nuances in management.

Lunch Session: Endocrine Surgery in Latin America

Sunday, April 30, 2023, 12:15 PM – 1:15 PM

Co-Chairs of the Pan-American Task Force will introduce this session and several cases will be discussed. Cases will highlight similarities and differences in presentation or management between Latin America and North America that occur for a variety of reasons, with commentary from Distinguished Discussants and questions from the audience.

Breakfast Session: The Future of CESQIP

Monday, May 1, 2023, 7:00 AM – 8:00 AM

Lead by CESQIP Committee Chair, Aarti Mathur, this session will feature quick shot research presentations followed by an update from Barry Inabnet on the Endocrine Surgery Quality Foundation (ESQF) and the future of CESQIP. There will be time for open discussion and Q&A.

Presidential Invited Lecture: The Honorable Doug Jones, US Senator (AL)

Monday, May 1, 2023, 9:30 AM – 10:30 AM

A former US Attorney for the Northern District of Alabama who brought long-overdue justice to the victims of the 16th Street Baptist Church bombing, Senator Jones has built his career on fighting impossible battles. In 2017, he won a special election to fill a U.S. Senate seat in Alabama. On Capitol Hill, he quickly built a reputation as a well-regarded and effective legislator, passing more than two dozen bipartisan bills into law in just three years. He is one of only two senators to win both the Jefferson-Hamilton Award for Bipartisanship and the Abraham Lincoln Leadership for America award. Since retiring from the US Senate, he has focused his work on issues of racial justice, equality, and voting rights.

Presidential Panel: Challenges in Providing Equitable Surgical Care in our Diverse Healthcare Systems

Monday, May 1, 2023, 10:30 AM – 11:30 AM

Past-Presidents Janice Pasieka, Miguel Herrera, and Peter Angelos will discuss the challenges to provide endocrine surgical care in the health system in their home countries. They will highlight challenges and wins but also gaps and barriers to achieving equitable healthcare delivery. Potential solutions that are within our sphere of influence will be proposed and discussed.

UCSF CAROL & ORLO H. CLARK DISTINGUISHED LECTURE



Keith Heller, MD

*Retired, Professor of Surgery at NYU Langone
Medical Center*

Saturday, April 29, 2023, 9:00 AM – 10:00 AM

Dr. Keith Heller is a senior member of the AAES. He was the founder and chief of the Division of Endocrine Surgery at NYU Langone Medical Center and Professor of Surgery until his retirement in 2013. He attended medical school and trained in surgery at NYU and in surgical oncology and head and neck surgery at MSKCC. Prior to returning to NYU, he had been chief of Head and Neck Surgery at Long Island Jewish Medical Center. He is a past-president of the American Head and Neck Society. His research interests were focused on diseases of the thyroid and parathyroid glands.

Dr. Keith Heller is a docent at the Metropolitan Museum of Art in New York City. As a volunteer at the “Met”, Dr. Heller gives tours of Museum Highlights, American Art, and Great Sculpture. He is Chair of the Museum Highlights Tour group. He is one of the volunteer leaders of the initiative to “Expand the Narrative” providing ways for the museum’s diverse visitors to feel represented and to see themselves in the works of art. On reflection, Dr. Heller does see parallels between talking about art and performing surgery: “They’re both visual, seeing below the surface, seeking out the context.”

UCSF CAROL & ORLO CLARK LECTURESHIP AT RECENT MEETINGS

- 2022 **Thomas J. Giordano, MD, PhD**, University of Michigan
What Have We Learned From the Genomic Investigation of Endocrine Tumors?
- 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



William E. Rainey, PhD
University of Michigan

Sunday, April 30, 2023, 3:00 PM – 4:00 PM

Dr. Rainey (Bill) is a research endocrinologist and the Jerome W. Conn Professor in the Departments of Molecular and Integrative Physiology and Internal Medicine at the University of Michigan.

Bill graduated from UT Southwestern and followed with post-doctoral training in France before being recruited to Southwestern where he was faculty for almost 15 years. He subsequently was director of the Medical College of Georgia Adrenal Research Program before moving to Michigan to join its internationally recognized team of adrenal researchers.

For almost 40 years Bill's group has researched the cellular, biochemical, and molecular mechanisms that regulate adrenal steroid hormone and associated diseases. Over his career, Rainey has published over 300 peer-reviewed or invited articles focused on adrenal steroidogenesis and adrenal disease.

His recent research has focused on defining the mechanisms regulating normal and excess production of aldosterone with particular interest in the hypertension-causing disease, primary aldosteronism (PA). In the process of researching aldosteronism his team has developed first-in-field combined application next generation sequencing of DNA and RNA from formalin-fixed paraffin embedded patient adrenal tissue. This approach has allowed multicenter studies of archived pathologic samples and led to the discovery of novel genetic causes of primary aldosteronism.

Related to today's seminar Rainey will discuss the historic aspects surrounding Jerome Conn's description of the index case of primary aldosteronism as well as an update on the recent work defining the genetic causes of this disease.

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

- 2022 **Christopher McHenry, MD**, MetroHealth
A Historical Look at Cleveland: Its Healthcare Institutions and Contributions to Endocrine Surgery
- 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. Recognize racial and gender disparities in the diagnosis and management of endocrine diseases.
2. Describe the feasibility and outcomes of newly developed protocols, techniques, and guidelines in the management of thyroid disease
3. Compare and contrast protocols for the management of thyroid, parathyroid and adrenal diseases.

Award of CME credits by ACS is based on compliance of the program with the ACCME accreditation requirements and does not imply endorsement by ACS of the content, the faculty, or the sponsor of the program.

Successful completion of this CME activity, which includes participation in the evaluation component, enables the learner to earn credit toward the CME and Self-Assessment requirements of the American Board of Surgery's Continuous Certification program.

CONTINUING MEDICAL EDUCATION CREDIT INFORMATION

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AMA PRA Category 1 Credits™

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

Of the *AMA PRA Category 1 Credits™* listed above, a maximum of **9.25** credits meet the requirements for Self-Assessment.



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CME CERTIFICATES AND EVALUATIONS

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

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

Credit Summary	CME	Self-Assessment
AAES Opening Session	1.00	
UCSF Carol & Orlo H. Clark Distinguished Lecture	1.00	
Scientific Session I (Papers 1-4, with DM)	1.25	1.25
Lunch Session: Operating is a Pain in the Neck (and Other Places): What Every Surgeon Needs to Know About Ergonomics	1.00	
Scientific Session II (Papers 5-8)	1.00	1.00
Scientific Session III (Papers 9-12)	1.00	1.00
Presidential Address	1.00	
Breakfast Session: Challenging Endocrine Cases	1.00	
Scientific Session IV (Papers 13-16)	1.00	1.00
Scientific Session V (Papers 17-20)	1.00	1.00
Health Equity Session (Papers HE 1-5, with Co-DMs)	1.50	1.50
Lunch Session: Endocrine Surgery in Latin America	1.00	
Scientific Session VI (Papers 21-25, with DM)	1.50	1.50
Medical College of Wisconsin Stuart D. Wilson, M.D. Historical Lecture	1.00	
Breakfast Session: The Future of CESQIP	1.00	
Scientific Session VII (Papers 26-29)	1.00	1.00
Presidential Invited Lecture: The Honorable Senator Doug Jones	1.00	
Presidential Panel: Challenges in Providing Equitable Surgical Care in our Diverse Healthcare Systems	1.00	
Interesting Cases Session	1.00	
	20.25	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.

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Kyla Wright
Masashi Yamamoto
Linwah Yip
Samuel M. Zuber



AGENDA

AGENDA

THURSDAY, APRIL 27, 2023

7:30 am – 4:00 pm	Endocrine Surgery University (UAB)
8:00 am – 12:00 pm	AAES Council Meeting (invitation only) (UAB)
1:30 pm – 8:00 pm	Course: Competitive Strategies and Leadership Tactics for Endocrine Surgery (UAB)
6:00 pm – 8:00 pm	Endocrine Surgery University, Fireside Chat and Dinner (UAB)

FRIDAY, APRIL 28, 2023

8:00 am – 11:30 am	Endocrine Surgery University, continued (UAB)
8:00 am – 12:00 pm	Course: Competitive Strategies and Leadership Tactics for Endocrine Surgery, continued (UAB)
8:00 am – 1:00 pm	Thyroid Radiofrequency Ablation (RFA) Course (UAB)
2:00 pm – 6:00 pm	AAES Fellows' Ultrasound Course (UAB)
5:00 pm – 8:00 pm	Annual Meeting Registration Open (Sheraton Birmingham Hotel)
6:30 pm – 8:30 pm	AAES Council Dinner (invitation only)
8:30 pm – 10:30 pm	Young Surgeon's Social (Monday Night Brewing Co.)

SATURDAY, APRIL 29, 2023

(all program sessions will take place at the Sheraton Birmingham Hotel unless otherwise noted)

6:30 am – 5:00 pm	Registration Open
7:00 am – 7:45 am	New Member Breakfast (invitation only) (Westin Hotel – Camellia Room)
8:00 am – 9:00 am	AAES Opening Session
9:00 am – 10:00 am	UCSF Carol & Orlo H. Clark Distinguished Lecture in Endocrine Surgery, Keith Heller, MD
10:00 am – 11:30 am	Poster Judging (presenter and judges only) and Sponsor Walk-around
11:30 am – 12:45 pm	Scientific Session I (Papers 1-4), with Distinguished Moderator
12:45 pm – 2:15 pm	Lunch Break
1:00 pm – 2:00 pm	Lunch Session: Operating is a Pain in the Neck (and Other Places): What every surgeon needs to know about ergonomics
2:15 pm – 3:15 pm	Scientific Session II (Papers 5-8)
3:15 pm – 3:45 pm	Break – Exhibits and Poster Viewing
3:45 pm – 4:45 pm	Scientific Session III (Papers 9-12)
4:45 pm – 5:45 pm	Presidential Address, Cord Sturgeon, MD, MS
6:30 pm – 8:30pm	President's Reception (Birmingham Civil Rights Institute)

SUNDAY, APRIL 30, 2023

7:00 am – 5:00 pm	Registration Open
7:00 am – 8:00am	Breakfast Session: Challenging Endocrine Cases <i>Sponsored by the Clinical Practice Committee</i>
8:00 am – 9:00 am	Scientific Session IV (Papers 13-16)
9:00 am – 9:30 am	Break – Exhibits and Poster Viewing
9:30 am – 10:30 am	Scientific Session V (Papers 17-20)
10:30 am – 12:00 pm	Health Equity Session (HE Papers 1-5), with Distinguished Co-Moderators
12:00 pm – 1:30 pm	Lunch Break
12:15 pm – 1:15 pm	Lunch Session: Endocrine Surgery in Latin America
1:30 pm – 3:00 pm	Scientific Session VI (Papers 21-25), with Distinguished Moderator
3:00 pm – 4:00 pm	MCW Stuart Wilson, M.D. Historical Lecture William E. Rainey, Ph.D.
4:00 pm – 5:00 pm	Sponsor + Poster Walk-around
4:00 pm – 5:00 pm	AAES Business Meeting (Active, Allied Specialist, Corresponding, and Senior members may attend)
6:30 pm – 7:00 pm	Meet and Greet Socials: Latin American members Affiliate Provider members Mentor Program participants
7:00 pm – 8:00 pm	Gala Reception Cocktail Hour Silent Auction Begins
8:00 pm – 10:00 pm	Gala Reception

MONDAY, MAY 1, 2023

7:00 am – 12:00 pm	Registration Open
7:00 am – 8:00 am	Breakfast Session: The Future of CESQIP
8:00 am – 9:00 am	Scientific Session VII (Papers 26-29)
9:00 am – 9:30 am	Break – Exhibit and Poster Viewing
9:30 am – 10:30 am	Presidential Invited Speaker: The Honorable Senator Doug Jones (AL)
10:30 am – 11:30 am	Presidential Panel: Challenges in Providing Equitable Surgical Care in Our Diverse Healthcare Systems
11:30 am – 12:30 pm	Interesting Cases Session
12:30 pm	Meeting Adjourned



SCIENTIFIC PROGRAM

- ◆ Denotes Resident/Fellow Research Competition Paper
- Denotes Health Equity Competition Paper

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

The Scientific Program includes only sessions that are eligible for CME credit. Credit amounts for each session are listed on page 35.

SCIENTIFIC PROGRAM

Saturday, April 29, 2023

8:00 AM – 9:00 AM

AAES OPENING SESSION

- Welcome – Cord Sturgeon, MD, MS
- In Memoriam – Cord Sturgeon, MD, MS
- Welcome to Birmingham, Brenessa Lindeman, MD, MEHP and Jessica Fazendin, MD
- Introduction of 2022 New Members – Shaghayegh Aliabadi, MD
- Research Award Presentations -
 - Paul LoGerfo Research Award Winner – Priya H. Dedhia, MD, PhD
 - Paul LoGerfo Research Award Winner – Brenessa Lindeman, MD, MEHP
 - The Thyroid Cancer (ThyCa) Survivors' Association Award for Thyroid Cancer Research Winner – Benjamin C. James, MD, MS

9:00 AM – 10:00 AM

UCSF CAROL & ORLO H. CLARK DISTINGUISHED LECTURE IN ENDOCRINE SURGERY

Keith S. Heller, MD

11:30 AM – 12:45 PM

SCIENTIFIC SESSION I (PAPERS 1-4, WITH DISTINGUISHED MODERATOR)

MODERATORS:

Erivelto M. Volpi, MD, Oswaldo Cruz German Hospital – Sao Paulo, Brazil

Anthony D. Yang, MD, MS, Indiana University School of Medicine

◆01. The Impact of Social Determinants of Health on Thyroid Cancer Mortality and Time to Treatment

Reagan A Collins¹, Catherine M McManus², Eric J Kuo², Rachel Liou², James A Lee², Jennifer H Kuo²

¹*Surgical Oncology, Institute of Technology Assessment, Massachusetts General Hospital,* ²*Section of Endocrine Surgery, Columbia University*

◆02. Radioactive Iodine is not Associated with Improved Disease-Specific Survival in Classic Papillary Thyroid Carcinoma Greater Than 4cm Confined to the Thyroid

Federico Palacardo¹, Yeon J Lee¹, Jacques A Greenberg¹, Caitlin E Egan¹, Toni Beninato², Rasa Zarnegar¹, Thomas J Fahey¹, Brendan M Finnerty¹

¹*Department of Surgery, Weill Cornell Medicine,* ²*Department of Surgery, Rutgers-Cancer Institute of New Jersey*

◆03. Age-Stratified Comparison of Active Surveillance vs Radiofrequency Ablation for Papillary Thyroid Microcarcinoma: A Decision-Analysis Approach

Kendyl Carlisle¹, Jessica P Brown¹, Justin Kim¹, Douglas J Turner², Julia F Slejko³, Jennifer H Kuo⁴, C. Daniel Mullins³, Yinin Hu²
¹University of Maryland School of Medicine, ²Department of Surgery, University of Maryland School of Medicine, ³University of Maryland School of Pharmacy, ⁴Columbia University Irving Medical Center

◆04. Comparison Between Thyroidectomy and Thyroid Surgery Following Radiofrequency Ablation of Benign Thyroid Nodules: A Propensity Score-matched Analysis of Surgical Outcomes and Safety

Mahmoud Omar¹, Mohammad H Hussein¹, Mohamed Aboueisha¹, Peter Issa², Katherine Cironi¹, Christopher Carnabatu¹, Mohamed Shama¹, Eman Toraih¹, Emad Kandil¹
¹Surgery, Tulane University, School of Medicine, ²Louisiana State University School of Medicine

1:00 PM – 2:00 PM

LUNCH SESSION: OPERATING IS A PAIN IN THE NECK (AND OTHER PLACES): WHAT EVERY SURGEON NEEDS TO KNOW ABOUT ERGONOMICS

SPEAKERS: Geeta Lal, MD, MSc – University of Iowa Carver College of Medicine, Philip Haigh, MD – Kaiser Permanente Los Angeles Medical Center, Andrea Merrill, MD – Boston Medical Center

3:15 PM – 4:30PM

SCIENTIFIC SESSION II (PAPERS 5-8)

MODERATORS:

Insoo Suh, MD, NYU Langone Health

Sophie Dream, MD, Medical College of Wisconsin

◆05. Development of a Risk Prediction Model for Primary Aldosteronism in Veterans with Hypertension

Sara P Ginzberg¹, Saiesh Kalva¹, Christopher J Wirtalla¹, Jesse E Passman¹, Jordana B Cohen², Heather Wachtel¹
¹Surgery, University of Pennsylvania Health System, ²Medicine, Perelman School of Medicine, University of Pennsylvania

◆06. Generating a Multimodal Artificial Intelligence Model to Differentiate Benign and Malignant Follicular Neoplasms of the Thyroid

Ann C Lin¹, Zelong Liu², Justine Lee³, Gustavo Fernandez-Ranvier¹, Aida Taye¹, Randall P Owen¹, Xueyan Mei², Denise Lee¹
¹Department of Surgery, Icahn School of Medicine at Mount Sinai, ²BioMedical Engineering and Imaging Institute, Icahn School of Medicine at Mount Sinai, ³Department of Diagnostic, Molecular, and Interventional Radiology, Icahn School of Medicine at Mount Sinai

◆07. Costs and Utilization of Same-Day Surgery Versus Overnight Admission for Total Thyroidectomy: A Multi-State, All-Payer Analysis

Caitlin B. Finn¹, James E. Sharpe¹, Lauren N. Krumeich², Sara P. Ginzberg¹, Jacqueline M. Soegaard Ballester¹, Jason K. Tong¹, Heather Wachtel¹, Douglas L. Fraker¹, Rachel R. Kelz¹

¹*Department of Surgery, University of Pennsylvania*, ²*Massachusetts General Hospital and Brigham and Women's Hospital*

◆08. Early Observations with an ERAS Pathway for Thyroid and Parathyroid Surgery: Moving the Goalposts Forward

Nikita Machado¹, Courtney Gibson², Jaime Hyman³, Jennifer Ogilvie²

¹*Yale New Haven Hospital*, ²*Endocrine Surgery, Yale New Haven Hospital*, ³*Anesthesia, Yale New Haven Hospital*

3:45 PM – 4:45 PM

SCIENTIFIC SESSION III (PAPERS 9-12)

MODERATORS:

Kristin Long, MD, MPH, University of Wisconsin

Adam Kabaker, MD, Loyola University Medical Center

◆09. Diagnostic Performance of Current Molecular Tests in Indeterminate Thyroid Nodules with Hurthle Cell Cytology

Rajam S. Raghunathan¹, Xochitl R. Longstaff², Elena G. Hughes¹, Shanpeng J. Li³, Vivek R. Sant¹, Chi-Hong Tseng⁴, Jianyu Rao⁵, James X. Wu¹, Michael W. Yeh¹, Masha J. Livhits¹

¹*Department of Surgery, University of California, Los Angeles*, ²*David Geffen School of Medicine, University of California, Los Angeles*, ³*Department of Biostatistics, University of California, Los Angeles*, ⁴*Division of General Internal Medicine and Health Services Research, University of California, Los Angeles*, ⁵*Department of Anatomic Pathology, University of California, Los Angeles*

◆10. Clinical Utility of a microRNA Classifier in Cytologically Indeterminate Thyroid Nodules with RAS Mutations: A Multi-Institutional Study

Abhinay Tumati¹, Caitlin E Egan¹, Yeon J Lee¹, Teagan E Marshall¹, Daniel Hubbs¹, Joyce Lee¹, Kavita Jain², Jonas J Heymann³, Hamza Gokozan³, Sara Abou Azar⁴, Jason Schwarz⁴, Xavier M Keutgen⁴, Amanda M Laird², Toni Beninato², Rasa Zarnegar¹, Thomas J Fahey III¹, Brendan M Finnerty¹

¹*Surgery, Weill Cornell Medical Center*, ²*Surgery, Rutgers Robert Wood Johnson Medical School*, ³*Pathology and Laboratory Medicine, Weill Cornell Medical Center*, ⁴*Surgery, The University of Chicago Medicine*

◆11. Primary Hyperparathyroidism in Patients with Multiple Endocrine Neoplasia Type 1: Impact of Genotype and Surgical Approach on Long-term Postoperative Outcomes

Omar A Shariq¹, Vitor B Abrantes¹, Lauren Y Lu¹, Peter J Tebben², Trenton R Foster¹, Benzon M Dy¹, Melanie L Lyden¹, William F Young, Jr.², Travis J McKenzie¹

¹*Department of Surgery, Mayo Clinic*, ²*Division of Endocrinology, Diabetes, Metabolism, and Nutrition, Mayo Clinic*

◆12. Is There a Role for Liquid Biopsy in the Surveillance of Parathyroid Carcinoma?

Thomas Szabo Yamashita¹, Aditya Shirali¹, Salyna Meas¹, Vanessa Sarli¹, Uriel Clemente-Gutierrez¹, Danica Vodopivec¹, Sarah Fisher¹, Paul Graham¹, Elizabeth Grubbs¹, Anthony Lucci¹, Naifa Busaidy¹, Nancy Perrier¹
¹MD Anderson Cancer Center

4:45 PM – 5:45 PM

PRESIDENTIAL ADDRESS

Cord Sturgeon, MD, MS

Sunday, April 30, 2023

7:00 AM – 8:00 AM

BREAKFAST SESSION: CHALLENGING ENDOCRINE CASES

Sponsored by the CLINICAL PRACTICE COMMITTEE

MODERATOR: Kristin Wagner, MD, Surgical Specialists of Charlotte

PRESENTERS: Gerard Doherty, MD, Brigham and Women's Hospital;

James Broome, MD, Heritage Medical Associates -- Endocrine Surgery; and Marybeth Hughes, MD, Eastern Virginia Medical School

8:00 AM – 9:00 AM

SCIENTIFIC SESSION IV (PAPERS 13-16)

MODERATORS:

Toni Beninato, MD, MS, Rutgers Cancer Institute of New Jersey

William Mendez, MD, University of Puerto Rico

◆13. A Comparison of Incidental Parathyroid Rates Associated with Total Thyroidectomy Performed with or Without Near-Infrared Autofluorescence Imaging

Seyma N Avci¹, Onuralp Ergun¹, Gizem Isiktas¹, Ege Akgun¹, Liudmila Muraveika¹, Vikram Krishnamurthy¹, Joyce Shin¹, Judy Jin¹, Allan Siperstein¹, Katherine B Heiden¹, Eren Berber¹
¹Cleveland Clinic

◆14. Efficacy and Safety of Near Infrared Fluorescence Identification of the Thoracic Duct During Left Lateral Neck Dissection

Nicci Owusu-Brackett¹, Priya Dedhia¹, Barbra Miller¹, Christopher Gilliam¹, Stephen Kang¹, Amit Agrawal¹, Jeffery Chakedis¹, John Phay¹
¹The Ohio State University

15. Incidental 68Ga-DOTATATE Uptake in Thyroid Nodules: is Guideline-Directed Management Still Appropriate?

Kyla Wright¹, Jason C. Fisher², Gary Rothberger³, Jason Prescott², John Allendorf⁴, Kupal Patel², Insoo Suh²

¹NYU Grossman School of Medicine, ²Department of Surgery, NYU Grossman School of Medicine, ³Department of Medicine, NYU Grossman School of Medicine, ⁴Department of Surgery, NYU Long Island School of Medicine

◆16. Thyroid Stimulating Hormone (TSH) Receptor as a Target for Imaging of Thyroid Cancer

Grayson R Gimblet¹, Hailey A Houson², Jason Whitt³, Herbert Chen³, Diana Lin⁴, Andrea Gillis³, John A Copland⁵, Saad S Kenderian⁶, Ricardo V Lloyd⁷, Mariusz W Szkudlinski⁸, Suzanne E Lapi², Renata Jaskula-Sztul³

¹Medical Scientist Training Program, University of Alabama at Birmingham,

²Radiology, University of Alabama at Birmingham, ³Surgery, University of Alabama at Birmingham, ⁴Pathology, University of Alabama at Birmingham,

⁵Cancer Biology, Mayo Clinic Jacksonville, ⁶Hematology, Mayo Clinic

Rochester, ⁷Pathology, University of Wisconsin, ⁸Trophogen, Inc.

9:30 AM – 10:30 AM

SCIENTIFIC SESSION V (PAPERS 17-20)

MODERATORS:

Jennifer H. Kuo, MD, MS, Columbia University

Lindsay E. Y. Kuo, MD, MBA, Temple University Lewis Katz School of Medicine

◆17. Primary Hyperparathyroidism Causes Objectively Measurable Cognitive Dysfunction Which Is Improved by Parathyroidectomy

William Lightle¹, Feibi Zheng¹, Konstantinos Makris¹, Raymon Grogan¹, James Suliburk¹

¹Department of Endocrine Surgery, Baylor College of Medicine

◆18. Do Men Improve Their Bone Mineral Density One Year After Parathyroidectomy for Primary Hyperparathyroidism? Results of a Prospective Study.

Samuel Frey¹, Pascale Guillot², Matthieu Wargny³, Maxime Gérard⁴, Edith Bigot-Corbel⁵, Kalyane Bach-Ngohou⁶, Cécile Caillard¹, Bertrand Cariou⁷, Eric Mirallié¹, Claire Blanchard¹

¹Chirurgie Cancérologique, Digestive et Endocrinienne, Institut des Maladies de l'Appareil Digestif, CHU de Nantes, Nantes, France, Nantes University Hospital,

²Service de Rhumatologie, CHU Nantes, Nantes Université, ⁴000 Nantes, France, Nantes University Hospital, ³CHU de Nantes, INSERM,

CIC¹⁴¹³, Pôle Hospitalo-Universitaire¹¹: Santé Publique, Santé au Travail,

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Nantes University Hospital, ⁵Laboratoire de biochimie, Centre hospitalier universitaire de Nantes, Hôpital Guillaume et René Laënnec, Nantes, France,

Nantes University Hospital, ⁶Nantes Université, CHU Nantes, Department

of Biochemistry and INSERM, The enteric nervous system in gut and brain

disorders, IMAD, F-4400 Nantes, France, Nantes University Hospital, ⁷Nantes Université, CHU Nantes, CNRS, INSERM, l'institut du thorax, F-44000 Nantes,

France., Nantes University Hospital

◆19. Prevalence and Risk Factors for Dysphagia in Older Adults Following Thyroid and Parathyroid Surgery

Philip K Crepeau¹, Whitney Sutton¹, Zeyad Sahli², Tatiana Fedorova

¹, Jonathon O Russell³, Lilah Morris-Wiseman¹, Aarti Mathur¹

¹Department of Surgery, Johns Hopkins University School of Medicine, ²Department of Surgery, University of Virginia Health System, ³Department of Otolaryngology-Head and Neck Surgery, Johns Hopkins University School of Medicine

◆20. The Impact of Hormonal Secretion on Survival in Adrenocortical Carcinoma

Alaa Sada¹, Trenton R. Foster¹, Ruaa Al-Ward², Sahar Sawani³, HElaine Charchar⁴, Reza Pishdad⁵, Benzon M. Dy¹, Melanie L. Lyden¹, Emily Bergsland⁶, Sina Jasim⁷, Nitya Raj⁸, Jessica B. Shank⁹, Oksana Hamidi¹⁰, Amir H. Hamrahian⁶, José L Chambó¹¹, Victor Srougi¹¹, Maria CBV Fragoso¹², Paul H. Graham¹³, Mouhammed Amir Habra², Irina Bancos¹⁴, Travis J. McKenzie¹

¹Surgery, Mayo Clinic, ²Endocrine Neoplasia and Hormonal Disorders, The University of Texas MD Anderson Cancer Center, ³Medicine, Baylor College of Medicine, ⁴Unidade de Suprarrenal, Hospital das Clínicas da Faculdade de Medicina da Universidade de São Paulo, ⁵Endocrinology, Diabetes and Metabolism, Johns Hopkins University, ⁶Medicine, University of California San Francisco, ⁷Endocrinology, Metabolism and Lipid Research, Washington University in St. Louis, ⁸Medicine, Memorial Sloan Kettering Cancer Center, ⁹Surgical Oncology, University of Nebraska Medical Center, ¹⁰Endocrinology and Metabolism University of Texas Southwestern Medical Center, ¹¹Urology, Hospital das Clínicas da Faculdade de Medicina da Universidade de São Paulo, ¹²Instituto do Câncer do Estado de São Paulo da Faculdade de Medicina da Universidade de São Paulo, ¹³Surgical Oncology, The University of Texas MD Anderson Cancer Center, ¹⁴Endocrinology, Mayo Clinic

10:30 AM – 12:00 PM

HEALTH EQUITY SESSION (PAPERS HE 1-5, WITH DISTINGUISHED CO-MODERATORS)

MODERATORS:

Sanziana A. Roman, MD, University of California, San Francisco

Fiemu E. Nwariaku, MD, MBA, Department of Surgery, University of Utah

●HE 01. Association of Patient and Provider Sex Concordance with Specialist Referral in Primary Hyperparathyroidism

Jordan M. Broekhuis¹, Maria P. Cote¹, Reagan A. Collins², Jorge L. Gomez-Mayorga¹, Natalia Chaves¹, Benjamin C. James¹

¹Surgery, Beth Israel Deaconess Medical Center, ²Surgical Oncology, Institute for Technology Assessment, Massachusetts General Hospital

●HE 02. Social Vulnerability and Time to Surgeon Evaluation for Primary Hyperparathyroidism

Reagan A Collins¹, Jordan M Broekhuis², Maria P Cote², Jorge L Gomez-Mayorga², Natalia Chaves², Benjamin C James²

¹Institute of Technology Assessment, Massachusetts General Hospital; Surgery, Beth Israel Deaconess Medical Center, ²Surgery, Beth Israel Deaconess Medical Center

●HE 03. Widening Regional Inequalities among Decreasing Utilization of Parathyroidectomy in US Dialysis Patients

Adriana G Ramirez¹, Vignesh Muralidharan¹, Collin Weber¹, Snehal Patel¹, Rachel Patzer¹, Joe Sharma¹, Neil D Saunders¹

¹Emory University

●HE 04. Who Serves Where: A Geospatial Analysis of Access to Endocrine Surgeons in the United States and Puerto Rico

Maeve M Alterio¹, Michele Tobias², Arthur Koehl², Kiyomi A Sun², Michael J. Campbell², Claire E Graves²

¹WSU Elson S. Floyd College of Medicine, ²University of California Davis

●HE 05. Disparities in Emergency Department Utilization Following Outpatient Thyroidectomy Across Three States

Michael R Visenio¹, Susheel Reddy², Cord Sturgeon³, Dina M Elaraj³, Hadley E Ritter⁴, Alexandria D McDow⁴, Ryan P Merkow³, Karl Y Bilimoria¹, Anthony D Yang¹

¹Surgical Outcomes and Quality Improvement Center (SOQIC), Department of Surgery, Indiana University School of Medicine, ²Division of Infectious Diseases, Department of Medicine, Northwestern University Feinberg School of Medicine, ³Department of Surgery, Northwestern University Feinberg School of Medicine, ⁴Department of Surgery, Indiana University School of Medicine

12:15 PM – 1:15 PM

LUNCH SESSION: ENDOCRINE SURGERY IN LATIN AMERICA

SPEAKERS: Evandro Cezar Guerreiro de Vasconcelos, MD, Scientia Médicos Associados; Nayvi Espana-Gomez, MD, Hospital Angeles Leon; and Rafael Humberto Perez-Soto, MD, Instituto Nacional de Ciencias Médicas y Nutrición Salvador Zubirán

DISTINGUISHED DISCUSSANTS: Carmen C. Solórzano, MD, Vanderbilt University Medical Center; Miguel F. Herrera, MD, PhD, Instituto Nacional Ciencias Médicas y Nutrición Salvador Zubirán; and Ashok R. Shaha, MD, Memorial Sloan Kettering Cancer Center

1:30 PM – 3:00 PM

SCIENTIFIC SESSION VI (PAPERS 21-25, WITH DISTINGUISHED MODERATOR)

MODERATORS:

Sareh Parangi, MD, Massachusetts General Hospital

Benjamin James, MD, MS, Harvard Medical School, Beth Israel Deaconess Medical Center

◆21. Disparities in Access to High-Volume Parathyroid Surgeons in the United States – A Call to Action

Kyla Wright¹, Sam Squires², Robin Cisco³, Amber Trickey⁴, Electron Kebebew³, Insoo Suh⁵, Carolyn D Seib³

¹NYU Grossman School of Medicine, ²Brigham Young University,

³Department of Surgery, Stanford University School of Medicine,

⁴Stanford-Surgery Policy Improvement Research and Education Center, ⁵Department of Surgery, NYU Grossman School of Medicine

◆22. A Multi-Institutional Study from the US ROPE Consortium Examining Factors Associated with Endocrine Surgery Exposure for General Surgery Residents

Stephanie Sisak¹, Adam D Price¹, Darci C Foote², Kelsey Montgomery³, Brenessa Lindeman³, Nancy L Cho⁴, Alexander R Cortez¹, Tammy M Holm¹
¹Cincinnati Research on Education in Surgical Training (CREST), University of Cincinnati, ²Department of Surgery, Beaumont Health, ³Department of Surgery, University of Alabama at Birmingham, ⁴Department of Surgery, Brigham and Women's Hospital

◆23. Malpractice Litigation Following Thyroid Surgery: What Factors Favor Surgeons?

Joshua C Chao¹, Alexander Manzella¹, Marin C Kheng¹, Marco T Santos², Toni Beninato³, Amanda M Laird³
¹Rutgers Robert Wood Johnson Medical School, ²Rutgers New Jersey Medical School, ³Rutgers Cancer Institute of New Jersey

◆24. Lithium-Associated Primary Hyperparathyroidism: An Evaluation of Screening and Referral Patterns in a Southeastern Veteran Population

Leah E. Hendrick¹, Andrew M. Fleming¹, Lisa S. Usdan², Richard D. Childress², Hooman Oktaei², Sudha R. Kode², Paxton V. Dickson¹, Olivia M. DeLozier¹
¹University of Tennessee Health Science Center, Department of Surgery, ²Memphis VA Medical Center, Medical Service, Section of Endocrinology

◆25. Gender Differences in Patients With Primary Hyperparathyroidism

Katherine A Baugh¹, Linwah Yip¹, Jason Liu¹, Kelly L McCoy¹, Sally E Carty¹, Kimberly M Ramonell¹
¹Surgery, University of Pittsburgh

3:00 PM – 4:00 PM

MCW STUART WILSON, M.D. HISTORICAL LECTURE

William E. Rainey, Ph.D.

Monday, May 01, 2023

7:00 AM – 8:00 AM

BREAKFAST SESSION: THE FUTURE OF CESQIP

MODERATORS:

Aida Taye, MD, Mount Sinai Hospital New York
Paul Graham, MD, MD Anderson Cancer Center
Eyas Alkhalili, MD, Texas Tech University HSC El Paso
Robin Cisco, MD, Stanford University

SPEAKERS: Alaa Sada, MD, MS, Mayo Clinic, Patricia C. Conroy, MD, University of California, San Francisco, Sara Cartwright, DO, University of

Nebraska Medical Center, Lauren N. Krumeich, MD, MS, Harvard University, William B. Inabnet III, MD, MHA, University of Kentucky College of Medicine, and David Schneider, MD, MS, University of Wisconsin

8:00 AM – 9:00 AM

SCIENTIFIC SESSION VII (PAPERS 26-29)

MODERATORS:

Carmen Solórzano, MD, Vanderbilt University Medical Center

Courtney Gibson, MD, Yale University

26. Impact of Parathyroidectomy on Insulin Resistance in Patients with Primary Hyperparathyroidism

Claire Nomine-Criqui¹, Florence Bihain¹, Phi-Linh Nguyen-thi², Nicolas Scheyer³, Lea Demarquet³, Marc Klein³, Bruno Guerci³, **Laurent Brunaud¹**

¹Departement of Surgery (CVMC, 7eme étage), University Hospital Nancy (CHU Brabois), ²Department of Medical Informatics and Evaluation, University Hospital Nancy (CHU Brabois), ³Departement of Endocrinology, Diabetology, and Nutrition (EDN), University Hospital Nancy (CHU Brabois)

27. A Prospective Comparison of Octreotide to Vasopressors as First Line Treatment of Intraoperative Carcinoid Crisis.

Belinda McCully¹, Rodney H Pommier², SuEllen J Pommier²

¹Oregon Health & Science University, ²Department of Surgery, Oregon Health & Science University

28. Radiofrequency Ablation of Thyroid Nodules; A Prospective Multi-Institutional North American Experience

Emad Kandil¹, Julia Noel², **Jonathon O Russell³**, Lisa Orloff², Mahmoud Omar⁴, Samantha Wolfe³, Richard Harbison³, Vaninder Dillon³, Mohammad Hussein¹, Eman Toraih¹

¹Surgery, Tulane University, School of Medicine, ²Otolaryngology - Head & Neck Surgery, Stanford University, School of Medicine, ³Otolaryngology - Head & Neck Surgery, Johns Hopkins University, ⁴Tulane University, School of Medicine

29. Normocalcemic Hyperparathyroidism: Intervention to Differentiate Primary from Secondary Hyperparathyroidism

Linwah Yip¹, Katherine A Baugh¹, Sally E Carty¹, Janet H Leung², Meghan L Kelley¹, Kelly L McCoy¹, Kimberly M Ramonell¹

¹Surgery, University of Pittsburgh, ²Endocrinology and Metabolism, University of Pittsburgh

9:30 AM – 10:30 AM

PRESIDENTIAL INVITED SPEAKER

The Honorable Senator Doug Jones (AL)

10:30 AM – 11:30 AM

PRESIDENTIAL PANEL SESSION: CHALLENGES IN PROVIDING EQUITABLE SURGICAL CARE IN OUR DIVERSE HEALTHCARE SYSTEMS

MODERATOR: Cord Sturgeon, MD, MS

SPEAKERS: Janice Pasieka, MD, University of Calgary, Miguel F. Herrera, MD, PhD, Instituto Nacional Ciencias Médicas y Nutrición Salvador Zubirán, and Peter Angelos, MD, PhD, University of Chicago

11:30 AM – 12:30 PM

INTERESTING CASES SESSION

MODERATOR: Mira Milas, MD – University of Arizona College of Medicine – Phoenix and Banner Health

- **Enhancing Mass in the Retroperitoneum**
Joy Zhou Done, MD – Johns Hopkins University Department of Surgery
- **The Many “Masks” of Hyperparathyroidism**
Anee Sophia Jackson, MD – University of Michigan
- **QUICKSHOT: Incidental and Unusual Lesion of the Piriform Sinus**
Tessa Henry, MD – Memorial Healthcare System
- **QUICKSHOT: The Magical Thyroid Malady that Vanished into a Starry Night**
Ana Irma Vargas, MD – UTRGV-DHR Health
- **QUICKSHOT: The Christmas Miracle**
Rosemarie Metzger, MD - University of Arizona - Phoenix/Banner Health
- **QUICKSHOT: Tract Seeding: Just a theory?**
Saba Kurtom, MD – University of Pittsburgh
- **Prolific, Persistent, Pesky, Pernicious, Pigheaded, Problematic, Preposterous Parathyroid**
Eileen R. Smith, MD – Washington University in Saint Louis
- **A Rare Cause of Satiety**
Avital Harari, MD – University of California, Los Angeles
- **QUICKSHOT: Anaplastic Thyroid Carcinoma Patient with Lung Metastases and Skin Invasion is Alive 2.5 Years After Targeted Therapy and Surgical Treatment**
Ilya Slepstov, MD – Saint Petersburg State University Hospital

12:30 PM

MEETING ADJOURN



ABSTRACTS

- ◆ Denotes Resident/Fellow Competition Paper
- Denotes Health Equity Competition Paper

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

◆01. The Impact of Social Determinants of Health on Thyroid Cancer Mortality and Time to Treatment

Reagan A Collins¹, Catherine M McManus², Eric J Kuo², Rachel Liou², James A Lee², Jennifer H Kuo²

¹*Surgical Oncology, Institute of Technology Assessment, Massachusetts General Hospital*, ²*Section of Endocrine Surgery, Columbia University*

Background: While racial disparities in thyroid cancer care are well established, the role of social determinants of health (SDOH) including socioeconomic status, insurance, and education, as well as their cumulative influence is less clear. We aimed to assess the cumulative impact of SDOH on mortality and time-to-treatment (TtT) among patients with thyroid cancer.

Methods: SDOH data were collected on thyroid cancer patients from the National Cancer Database (NCDB) from 2004-2017. SDOHs collected included income, education, and insurance status. TtT was defined as the time from diagnosis to first treatment. A count variable was created for patients in the lowest quartile of each SDOH (i.e., low income, low education, and no insurance). The association of SDOH with mortality and TtT, and the association between cumulative SDOH count and TtT were assessed using Cox regression.

Results: The study analyzed 148,376 patients. On adjusted analysis, males, age ≥ 55 , non-Hispanic Black patients, a diagnosis of anaplastic, follicular or medullary thyroid cancer, and higher disease stage, had a greater risk of mortality ($p < 0.001$). Patients with longer TtT had greater mortality compared to patients treated within 90 days (90-180 days, adjusted hazard ratio [aHR] 1.21(CI 1.13-1.29, $p < 0.001$); > 180 days, aHR 1.57(CI 1.41-1.76, $p < 0.001$). Uninsured patients had a 25% longer TtT than patients with private insurance (aHR 0.75(CI 0.73-0.78, $p < 0.001$) and patients in the lowest education quartile had a 16% longer TtT than patients in the highest education quartile (aHR 0.84(CI 0.83-0.86, $p < 0.001$). Patients in the lowest income quartile received treatment more quickly (aHR 1.13(CI 1.11-1.16, $p < 0.001$), but still had a greater risk of mortality (aHR 1.38(CI 1.29-1.48, $p < 0.001$). When compared to patients with no SDOH, patients with 1, 2 or 3 SDOH had a 10%, 12%, and 34% longer TtT (1 SDOH, HR 0.90(CI 0.89-0.92, $p < 0.001$); 2 SDOH, HR 0.88(CI 0.87-0.90, $p < 0.001$); 3 SDOH, HR 0.66(CI 0.62-0.71, $p < 0.001$), respectively).

Conclusions: Our study shows that an increasing number of adverse SDOH leads to increasingly longer TtT for patients with thyroid cancer, which in turn increases risk for mortality. Understanding the SDOH that may serve as barriers to care for thyroid cancer patients is essential to improving disparities in care.

◆02. Radioactive Iodine is Not Associated With Improved Disease-Specific Survival in Classic Papillary Thyroid Carcinoma Greater Than 4cm Confined to the Thyroid

Federico Palacardo¹, Yeon J Lee¹, Jacques A Greenberg¹, Caitlin E Egan¹, Toni Beninato², Rasa Zarnegar¹, Thomas J Fahey¹, Brendan M Finnerty¹

¹Department of Surgery, Weill Cornell Medicine, ²Department of Surgery, Rutgers-Cancer Institute of New Jersey

Background: The use of radioactive iodine (RAI) therapy for intrathyroidal papillary thyroid carcinoma (PTC) greater than 4cm remains controversial. According to the 2015 American Thyroid Association guidelines, there is conflicting data regarding the effect of RAI on disease-specific survival (DSS) in this subset of tumors (N0, M0) larger than 4cm. We aimed to evaluate the association of RAI with DSS in this subset of tumors.

Methods: The Surveillance, Epidemiology, and End Results (SEER) database was queried for histologic codes for classic subtype PTC from 2004-2015. Tumors >4cm without extrathyroidal extension were included. Patient demographics, clinicopathologic characteristics, and outcomes were compared between those who received RAI versus those who did not. A multivariable Cox regression was performed to identify predictors of DSS. A Kaplan-Meier curve and log-rank test were performed to characterize the association of RAI with DSS.

Results: RAI was administered post-operatively to 740 of 1295 patients (57.1%) who met inclusion criteria. A higher proportion of those who received RAI had a total thyroidectomy compared to those who did not receive RAI (91.1% vs. 78.3%, $p<0.001$). Additionally, patients with multifocal tumors more commonly received RAI (30.8% vs. 26.5%, $p=0.012$). Patients ≥ 55 years old received RAI less frequently compared to patients <55 years old (50.8% vs. 60.8%, $p<0.001$). There was no difference in 10-year DSS between the RAI treated and untreated cohorts (97.2% vs. 95.8%, $p=0.39$). RAI administration after surgery was not associated with a significant DSS benefit (adjusted HR= 0.91, CI [0.46-1.82], $p=0.800$). Age ≥ 55 was associated with an increased risk of death (adjusted HR=3.46, CI [1.68-7.09], $p=0.001$). Larger tumor size was also associated with an increased risk of death due to the malignancy (adjusted HR=1.04, CI [1.02-1.06], $p<0.001$).

Conclusions: RAI administration in classic variant PTC greater than 4cm and confined to the thyroid did not have a significant impact on DSS compared to those who did not receive post-operative RAI treatment. Decision making regarding adjuvant therapy for larger intrathyroidal PTC should remain individualized and based on factors such as age and size of the tumor.

◆03. Age-Stratified Comparison of Active Surveillance vs Radiofrequency Ablation for Papillary Thyroid Microcarcinoma: A Decision-Analysis Approach

Kendyl Carlisle¹, Jessica P Brown¹, Justin Kim¹, Douglas J Turner², Julia F Slejko³, Jennifer H Kuo⁴, C. Daniel Mullins³, Yinin Hu²

¹University of Maryland School of Medicine, ²Department of Surgery, University of Maryland School of Medicine, ³University of Maryland School of Pharmacy, ⁴Columbia University Irving Medical Center

Background: Papillary thyroid microcarcinomas (PTMC) may be treated with radiofrequency ablation (RFA), active surveillance (AS), or surgery. Risk of progression under AS is higher in younger patients. The objective of this study was to use mathematical modeling to compare treatment alternatives for PTMC among patients who decline resection. We hypothesized that RFA would outperform AS in avoiding progression and eventual surgery, but that the effect size would be small for older patients.

Methods: We engaged stakeholders—community endocrinologists and thyroid cancer survivors—to identify meaningful long-term endpoints for PTMC treatment: 1) cancer progression/surgery, 2) need for thyroid hormone supplementation. A Markov decision analysis model was created to compare the probability of these endpoints following RFA or AS for PTMC. Complication, survival, and progression rates were extracted from published literature. Input variables were adjusted to reflect patient age at diagnosis ranging from 20 to 60+ years. Model outcomes were estimated to a 10-year time horizon.

Results: Across all age groups, RFA yielded a lower likelihood of progression/surgery or thyroid hormone replacement relative to AS. However, as patient age increased, the number needed to treat (NNT) by RFA to avoid progression/surgery increased from 9.1 (age 20s) to 24.4 (age 50-59) to 35.7 (age 60+). The NNT by RFA to avoid lifelong thyroid hormone supplementation also increased with age from 7.6 (age 20s) to 35.7 (age 50s) to 52.6 (age 60+). There was no meaningful difference in likelihood of treatment-related complications (permanent hypocalcemia or vocal cord paralysis) between strategies.

Conclusions: As an alternative to active surveillance for PTMC, RFA is most effective in younger patients. Among patients >50 years old, more than 20 RFAs must be performed to avoid one case of disease progression.

◆04. Comparison Between Thyroidectomy and Thyroid Surgery Following Radiofrequency Ablation of Benign Thyroid Nodules: A Propensity Score-matched Analysis of Surgical Outcomes and Safety
Mahmoud Omar¹, Mohammad H Hussein¹, Mohamed Aboueisha¹, Peter Issa², Katherine Cironi¹, Christopher Carnabatu¹, Mohamed Shama¹, Eman Toraih¹, Emad Kandil¹

¹*Surgery, Tulane University, School of Medicine,* ²*Louisiana State University School of Medicine*

Background: Radiofrequency ablation (RFA) is a safe and effective treatment option for benign thyroid nodules with minimal risk of procedural complications. RFA uses alternating current to generate local thermal energy resulting in tissue necrosis and inflammation. Although proven effective and safe, subsequent thyroidectomy is indicated for various reasons, including persistent symptoms and nodular regrowth. This study aimed to evaluate the safety and surgical outcomes of post-RFA thyroidectomy (PRT) compared to thyroidectomy with no prior RFA (non-RFA thyroidectomy, NRT).

Methods: We retrospectively reviewed all patients with non-cancerous thyroid nodules who had PRT (n = 30) or NRT (n = 179) from June 2019 to March 2022. We then performed 1:4 propensity score matching analysis, yielding 28 PRT and 112 NRT matched pairs. Operative time and surgical outcomes were compared in the two cohorts.

Results: In the post-RFA thyroidectomy group, four had received more than one RFA session. Preoperative fine needle aspiration showed 24 nodules to be benign, two were Bethesda III, and two were Bethesda IV. Twenty-four patients had post-RFA thyroid lobectomy, while four were elected for post-RFA total thyroidectomy. Compared with the matched controls, both post-RFA lobectomy (median=132, IQR=126-135 vs. 136, IQR=131-138, p=0.4) and post-RFA total thyroidectomy subgroups (median=151, IQR=117-184 vs. 145, IQR=110-164, p=0.2) showed similar operative time. There was no significant difference in complications, including blood loss (p=0.45) or hypothyroidism (p=0.8). None of the patients developed permanent recurrent laryngeal nerve (RLN) injuries. Apart from one patient who developed a temporary RLN injury and another who had a post-operative hematoma in the NRT group, none of these complications were reported in the PRT group. In addition, matched cohorts had similar lengths of hospital stay, p=0.84. All PRT patients and 94% of the UT group were discharged a day following the surgery, p=0.9.

Conclusions: This is the first study investigating the outcomes of thyroid surgery following RFA. PRT is safe and feasible when indicated with similar operative time and outcomes compared to NRT.

◆05. Development of a Risk Prediction Model for Primary Aldosteronism in Veterans with Hypertension

Sara P Ginzberg¹, Saiesh Kalva¹, Christopher J Wirtalla¹, Jesse E Passman¹, Jordana B Cohen², Heather Wachtel¹

¹Surgery, University of Pennsylvania Health System, ²Medicine, Perelman School of Medicine, University of Pennsylvania

Background: Primary aldosteronism (PA) is an underrecognized cause of hypertension (HTN), and rates of screening for PA in patients who meet criteria are exceedingly low (1-7%). To better understand which patients should be prioritized for screening, we developed a risk prediction model for PA based on known clinical criteria.

Methods: Using a national Veterans Health Administration dataset, we identified patients who met criteria for PA screening (2000–2019) due to treatment-resistant HTN or HTN with hypokalemia. Presence of other clinical factors associated with PA were noted for each patient, including obstructive sleep apnea, arrhythmia, and adrenal adenoma (identified via diagnosis code). A multivariable logistic regression model was developed to identify factors associated with positive PA testing. A risk scoring system was generated by assigning points based on the magnitude of the coefficients ($0 < \beta < 0.5 = 1\text{pt}$, $0.5 \leq \beta < 1 = 2\text{pts}$, $1 \leq \beta < 1.5 = 3\text{pts}$).

Results: Of 502,190 patients meeting criteria for PA screening, 7,786 (1.6%) were tested. Mean age was 57 ± 12 years, and 88% were male. 60% were White, and 32% were Black. Of the patients screened, 1,166 (15%) tested positive for PA.

In the multivariable regression model, age < 65 (OR 1.26, $p = 0.008$), supplemental insurance (OR 1.19, $p = 0.018$), Black race (OR 1.70, $p < 0.001$), absence of smoking history (OR 1.54, $p < 0.001$), resistant HTN (OR 1.66, $p < 0.001$), and recent hypokalemia (OR 2.84, $p < 0.001$) were associated with increased likelihood of testing positive for PA. A risk scoring system was developed with a total of 7 possible points based on weighted beta coefficients: age < 65 (1pt), absence of smoking history (1pt), resistant HTN (2pts), and recent hypokalemia (3pts).

The majority of patients received 3pts (30%) or 4pts (22%) based on clinical risk factors; only 3% received 7pts. Rates of positive screening for PA increased with number of points: 0pts: 6.1%; 1pt: 8.3%; 2pts: 9.8%; 3pts: 13%; 4pts: 19%; 5pts: 24%; 6pts: 31%; 7pts: 40%.

Conclusions: Rates of positive screening for PA range from 6.1%–40% in hypertensive patients who meet criteria for screening, depending on concomitant clinical characteristics. A risk prediction model incorporating clinical factors can identify patients with highest rates of PA. Patient identification via information available in the electronic medical record can flag these high-risk patients for high-priority screening and may inform patient counseling.

◆06. Generating a Multimodal Artificial Intelligence Model to Differentiate Benign and Malignant Follicular Neoplasms of the Thyroid

Ann C Lin¹, Zelong Liu², Justine Lee³, Gustavo Fernandez-Ranvier¹, Aida Taye¹, Randall P Owen¹, Xueyan Mei², Denise Lee¹

¹Department of Surgery, Icahn School of Medicine at Mount Sinai, ²BioMedical Engineering and Imaging Institute, Icahn School of Medicine at Mount Sinai,

³Department of Diagnostic, Molecular, and Interventional Radiology, Icahn School of Medicine at Mount Sinai

Background: Follicular thyroid neoplasms encompass both benign adenomas and malignant carcinomas, with follicular thyroid carcinomas comprising approximately 5-10% of differentiated thyroid cancers. Distinguishing between follicular adenoma and carcinoma has long posed a diagnostic conundrum, with ultrasound imaging and fine needle aspiration biopsy unable to provide a definitive diagnosis pre-operatively. An estimated 80-90% of follicular neoplasms are benign, resulting in a significant number of surgeries performed for benign disease. The field of artificial intelligence and machine learning has potential to unlock diagnostic features missed by manual analysis. This study aims to develop a multimodal machine learning model that utilizes clinical and radiographic data to predict malignancy in a follicular lesion.

Methods: This is a retrospective cohort study of patients diagnosed with follicular adenoma or carcinoma on pathology at a single tertiary institute between 2010 and 2022. Patient demographics, imaging, and perioperative variables were collected. The region of interest (ROI) was annotated on each thyroid ultrasound study and used to perform radiomics analysis that consisted of high statistical textual features. T-distributed stochastic neighbor embedding (t-SNE) was used to reduce the dimension of radiomics features with demographic variables. Imaging and clinical features were used to create a random forest classifier (RFC) to predict adenoma and carcinomas. Leave one out cross-validation was conducted to evaluate classifier performance using the metric of Area Under the ROC Curve (AUC).

Results: Patients with follicular adenomas (n=7) and carcinomas (n=11) with complete imaging and perioperative data were included. A total of 922 features were extracted from each image. t-SNE reduced the dimension from two represented components. The two t-SNE features were integrated with all clinical features for classification. The RFC achieved AUCs of 0.76 (clinical only), 0.29 (imaging only), and 0.79 (multimodal data).

Conclusions: Our machine learning model demonstrates promising results in predicting benign versus malignant follicular thyroid pathology. In particular, our cohort supports use of multimodal models that implement both clinical data and radiographic images to amplify their predictive power, and can be applied to generate models for pre-operative differentiation between other thyroid pathology. The field of artificial intelligence has huge potential in refining our pre-operative diagnosis of follicular thyroid neoplasms.

◆07. Costs and Utilization of Same-Day Surgery Versus Overnight Admission for Total Thyroidectomy: A Multi-State, All-Payer Analysis

Caitlin B. Finn¹, James E. Sharpe¹, Lauren N. Krumeich², Sara P. Ginzberg¹, Jacqueline M. Soegaard Ballester¹, Jason K. Tong¹, Heather Wachtel¹, Douglas L. Fraker¹, Rachel R. Kelz¹

¹Department of Surgery, University of Pennsylvania, ²Massachusetts General Hospital and Brigham and Women's Hospital

Background: Outpatient thyroidectomy is increasingly favored given evidence of safety and convenience for selected patients. However, definitions of “outpatient” often include overnight observation. The prevalence of true same-day discharge is unclear. We aimed to evaluate costs, hospital setting, and temporal trends in utilization of same-day discharge after total thyroidectomy in an all-payer, multi-state cohort.

Methods: We included patients aged ≥ 18 years who underwent a total thyroidectomy for benign or malignant disease between 2013–2018 in seven states (FL, IA, MD, NE, UT, VT, WI) using the Healthcare Cost and Utilization Project's State Inpatient Databases and State Ambulatory Surgery and Services Databases.

Admission type was defined as same-day, overnight, or inpatient based on length of stay. Same-day surgery patients were matched 1:1 with overnight admission patients using optimal subset matching with a propensity score. Standardized mean differences for all covariates were <0.1 . In the matched cohort, hospital characteristics and costs of the index hospitalization were compared using McNemar's test and the Wilcoxon signed-rank test. Temporal trends were evaluated using the Cochran-Armitage test of trend.

Results: Among 42,912 patients who received total thyroidectomy, 8,655 (20.2%) surgeries were same-day, 29,050 (67.7%) were overnight, and 5,207 (12.1%) were inpatient. Mean age was 52.3 years (SD 15.0). The proportion of patients who underwent same-day surgery increased from 14.4% to 21.4% over the study period ($p < 0.01$), while inpatient admissions decreased from 16% to 9% ($p < 0.01$). Overnight admissions fluctuated from 69.7% (2013) to 65.9% (2016) to 69.6% (2018) ($p = 0.01$).

In total, 7,492 same-day patients were matched to 7,492 overnight patients. Same-day patients had higher odds of treatment at a certified cancer center (OR 1.85; 95% CI 1.69–2.00), ACGME-accredited teaching hospital (OR 1.52; 95% CI 1.39–1.64), and highest volume quartile hospital (OR 1.23; 95% CI 1.13–1.33).

Same-day patients had lower median costs than matched overnight patients (\$7,334 (IQR 5,906–9,504) vs. \$8,307 (IQR 6,783–10,389)). Pairwise cost differences showed median savings of \$880 (IQR -1,512–3,285) for same-day relative to overnight admission ($p < 0.01$).

Conclusions: Although over two-thirds of patients are admitted overnight, same-day total thyroidectomy is increasingly performed. Same-day surgery may be a lower-cost option for selected patients, particularly in specialty centers with experience in thyroidectomy.

◆08. Early Observations with an ERAS Pathway for Thyroid and Parathyroid Surgery: Moving the Goalposts Forward

Nikita Machado¹, Courtney Gibson², Jaime Hyman³, Jennifer Ogilvie²

¹Yale New Haven Hospital, ²Endocrine Surgery, Yale New Haven Hospital, ³Anesthesia, Yale New Haven Hospital

Background: Enhanced Recovery After Surgery (ERAS) pathways improve perioperative outcomes including pain control, postoperative nausea and vomiting (PONV), surgical recovery, and resource utilization in the hospital setting for a variety of procedures. Our institution previously evaluated the incidence of PONV, PACU length of stay and opioid requirement in our thyroidectomy and parathyroidectomy patients, finding significant areas for intervention. With this follow up study, we evaluated our initial experience with an institutional ERAS protocol in our thyroidectomy and parathyroidectomy patients.

Methods: Data was extracted from all thyroidectomies and parathyroidectomies performed by endocrine surgeons between August 2020 - July 2021 (control group) and August 2021 - October 2022 (performance group) at our institution. The cutoff point between groups corresponded to the initiation of an ERAS protocol that was rolled out in stages as stakeholder buy-in was attained: 1. risk-based multi-modal PONV prevention and preoperative acetaminophen administration, 2: the addition of preoperative celecoxib, and 3: the addition of superficial cervical plexus blocks.

Results: There were a total of 240 parathyroidectomies and 310 thyroidectomies performed at our institution during this time period. Out of these, 56 parathyroidectomies and 63 thyroidectomies were booked as ERAS cases (119 cases) and received one or more of the above interventions. Comparison between the groups showed decreased average PACU length of stay (185.5-->156.8 mins for parathyroidectomies, 204.1-->171.1 mins for thyroidectomies), decreased incidence of PONV (15.7 --> 14.3% for parathyroidectomies, 26.9 -->4.8% for thyroidectomies), and decreased post-op MME (morphine milligram equivalent) use (29.1-->21.6 for parathyroidectomies, 30.7-->22.9 for thyroidectomies).

Conclusions: ERAS pathways are an important multidisciplinary adjunct that can have a significant impact on recovery after endocrine surgery procedures. Even with our limited initial data, we have seen an improvement in PACU length of stay as well as a decreased incidence of PONV and opioid use. We have since developed a comprehensive perioperative ERAS pathway with stakeholder buy-in and are planning to incorporate a survey on postoperative days 0 and 1, to better evaluate patient satisfaction with the addition of these protocols.

◆09. Diagnostic Performance of Current Molecular Tests in Indeterminate Thyroid Nodules with Hurthle Cell Cytology

Rajam S. Raghunathan¹, Xochitl R. Longstaff², Elena G. Hughes¹, Shanpeng J. Li³, Vivek R. Sant¹, Chi-Hong Tseng⁴, Jianyu Rao⁵, James X. Wu¹, Michael W. Yeh¹, Masha J. Livhits¹

¹Department of Surgery, University of California, Los Angeles, ²David Geffen School of Medicine, University of California, Los Angeles, ³Department of Biostatistics, University of California, Los Angeles, ⁴Division of General Internal Medicine and Health Services Research, University of California, Los Angeles, ⁵Department of Anatomic Pathology, University of California, Los Angeles

Background: Indeterminate thyroid nodules with Hurthle cell cytology remain a diagnostic challenge. First-generation molecular tests showed benign call rates as low as 30% and positive predictive values as low as 14%. We examined the diagnostic performance of current molecular tests in Hurthle cell nodules.

Methods: This subset analysis of our prospective randomized trial compared the performance of Afirma GSC and Thyroseq v3 in Bethesda III and IV nodules with Hurthle cell cytology. Molecular test samples were obtained at the time of initial FNA, and reflexively sent for processing when Bethesda III or IV cytology was found. Insufficient results were excluded.

Results: Molecular testing was performed on 149 Hurthle cell nodules. Of the 86 nodules tested with Afirma GSC, the benign call rate was 85% (66/78). Nine of 66 nodules with benign Afirma GSC results were resected, with no malignancies found. Twelve of 13 nodules with suspicious Afirma GSC results were resected, revealing three malignancies: two classical papillary thyroid carcinomas (PTCs) and one Hurthle cell carcinoma (positive predictive value [PPV] 25%). Fifty-two nodules (60%) with benign Afirma GSC results had ultrasound surveillance at 1 year, 96% of which were stable. Thyroseq v3 had a benign call rate of 64% (34/53). Positive mutations identified were isolated RAS (5), RAS + TERT (1), isolated TERT (1), TERT + EIF1AX (2), tp53 + EIF1AX (1), MET (1), TTF1 (1), and genetic alterations, abnormal gene expression and chromosomal copy number alterations (7). Five of 34 nodules with negative Thyroseq v3 results were resected, with no malignancies found. Nineteen of 24 nodules with positive results were resected, with four malignancies: three PTCs and one Hurthle cell carcinoma (PPV 21%). Twenty-eight nodules (44%) with negative Thyroseq v3 results had ultrasound surveillance at one year, 96% of which were stable.

Conclusions: The benign call rate of current molecular tests in Hurthle cell nodules is high. The absence of false negatives in our cohort strengthens the value of these tests in ruling out malignancy. Because the PPV of both molecular tests remains low, opportunities exist for clinical and sonographic characteristics to improve decision making in Hurthle cell nodules with suspicious molecular test results.

◆10. Clinical Utility of a microRNA Classifier in Cytologically Indeterminate Thyroid Nodules with RAS Mutations: A Multi-Institutional Study

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Background: Molecular testing (MT) has been used to guide clinical management and reduce unnecessary surgery for indeterminate (Bethesda III or IV) thyroid nodules identified on fine needle aspiration. Here, we clarify the clinical benefit derived from a commercially available microRNA classifier, with attention to nodules harboring *RAS* mutations.

Methods: A multiplatform test using DNA and RNA extracted from either direct smears or a separate RNA preservative solution combines panel-based DNA and RNA sequencing (ThyGenX®, v2 ThyGeNEXT®) with a microRNA expression risk classifier test (ThyraMIRv1®) to estimate risk of malignancy (ROM). Bethesda III and IV nodules that underwent multiplatform MT between 2017-2021 were compiled from three tertiary care academic centers. MT results were considered “positive” if the reported ROM was $\geq 10\%$. Additionally, we assessed ThyraMIR’s clinical utility in *RAS*-mutated indeterminate nodules. Comparison was performed using Fisher’s exact test with *p* values < 0.05 considered to be statistically significant.

Results: 397 nodules from 377 patients (70.8% women) of median age 59.1 years (range 17.4-91.7) underwent MT. Positive MT, detected in 126 (32.5%) nodules, was associated with a larger median nodule size (2.4 vs 2.2 cm, $p < 0.0001$), rate of surgery (74.6% vs 16.0%, $p < 0.0001$), and pathological diagnosis of carcinoma or NIFTP on resection (62.4% vs 23.8%, $p < 0.0001$) compared to negative MT. *RAS* mutations were the most common mutations identified (71/381; 18.6%) while *BRAF* mutations were identified in 8/381 (2.1%) nodules. *RAS* mutated nodules were classified as ThyraMIR+ (28/71; 39.4%) or ThyraMIR- (43/71; 60.6%). Between the ThyraMIR +/- groups, among *RAS*-mutated nodules, there was no significant difference in rate of surgery (83.7% vs 75%, $p = 0.3797$) or diagnosis of carcinoma or NIFTP on resection (58.3% vs 60%, $p > 0.999$). In this subgroup analysis, ThyraMIR’s sensitivity, specificity, NPV, and PPV are 63.6%, 34.8%, 40%, and 58.3%, respectively.

Conclusions: Positive MT is associated with an increased ROM confirmed on surgical pathology. However, the ThyraMIR® classifier failed to differentiate between pathologically benign and malignant *RAS*-mutated, indeterminate nodules. Diagnostic lobectomy should be considered for *RAS*-mutated nodules, regardless of microRNA expression status.

◆11. Primary Hyperparathyroidism in Patients with Multiple Endocrine Neoplasia Type 1: Impact of Genotype and Surgical Approach on Long-term Postoperative Outcomes

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Background: Previous studies have demonstrated that protein-truncating germline pathogenic variants in the N- or C-terminal exons (2, 9, or 10) of the *MEN1* gene may be associated with aggressive pancreatic neuroendocrine tumors. However, the impact of these variants on parathyroid disease is poorly understood. We sought to investigate the effects of genotype and surgical approach on clinical phenotype and postoperative outcomes in patients with MEN1-related primary hyperparathyroidism (PHPT).

Methods: A retrospective analysis was performed of patients with genetically confirmed MEN1 who were evaluated at our institution from 1985-2020. Patients were stratified by genotype (truncating variants in exons 2/9/10 vs. other variants) and index surgical approach (less-than-subtotal resection [<3 -glands; $<$ SPTX], subtotal resection [3 - 3.5 glands; SPTX], or total parathyroidectomy [4 -glands; TPTX]). Clinical data, age-related penetrance, and postoperative disease-free survival (DFS) were analyzed.

Results: We identified 209 patients (56% female) from 125 MEN1 kindreds (median age 51 years, IQR 37-62 years). Truncating *MEN1* variants in exons 2/9/10 occurred in 129/209 (62%) patients. PHPT was diagnosed in 194/209 (93%) patients, and at a younger median age in those with truncating exon 2/9/10 variants vs. other variants (27 years vs 31 years; $P=.006$). No significant differences in preoperative biochemical variables and end-organ manifestations were observed between groups. Follow-up data ≥ 6 months (median 182 months, IQR 100-313 months) were available for 167/181 (92%) patients after parathyroidectomy. In the overall cohort, median DFS was significantly worse in patients who underwent $<$ SPTX vs. SPTX/TPTX (60 months vs. 163 months; $P<.0001$). In the subgroup that underwent $<$ SPTX ($n=65$), patients with truncating exon 2/9/10 variants had significantly shorter DFS (33 vs. 84 months; $P=.01$), while DFS did not differ by genotype following SPTX ($n=96$) or TPTX ($n=6$). Permanent hypoparathyroidism rates (≥ 12 months after final surgery) were highest after index TPTX (40%), followed by $<$ SPTX (10%), and SPTX (6%).

Conclusions: MEN1 genotype may affect the age of onset of PHPT and time to recurrence after surgery. At index operation, $<$ SPTX should be performed with caution, especially in patients with truncating *MEN1* variants in exons 2/9/10, as the higher risk of recurrence is not offset by a decreased incidence of permanent hypoparathyroidism compared to upfront SPTX.

◆12. Is There a Role for Liquid Biopsy in the Surveillance of Parathyroid Carcinoma?

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Background: Parathyroid carcinoma (PC) is a rare malignancy with a poor prognosis and high rates of local and distant disease progression. There has been little progress made regarding treating or preventing progression. Liquid biopsy (LBx) may be an important tool in stratifying the risk of disease recurrence or progression and may guide surveillance and systemic treatments.

Methods: A prospectively maintained database of adult patients being treated for PC at a tertiary care center was utilized. Patients treated by the multidisciplinary endocrine oncology team were included. Demographics, clinical characteristics, laboratory and radiologic variables were collected to evaluate disease progression between 2017 and 2022. Circulating cell-free DNA (cfDNA) enrichment and circulating tumor cell (CTC) enumeration were obtained from serial blood samples.

Results: A total of 25 patients were identified: 64% male and median age was 56 years (IQR 42-63). Fifty blood samples were collected; median number of blood sampling per patient was 2 (1-3). At first CTC enumeration, 56% (14/25) of patients had no evidence of disease and 36% (8/25) had distant metastasis (DM). Median follow-up was 9 months (0-16) from first CTC collection. At last follow-up, 40% (10/25) of patients were found to have DM and 52% of patients had serial CTC enumeration; median highest CTC was 2 (range 0-22). cfDNA was assessed in 64% (16/25); median cfDNA level was 6.59 ng/mL (range 1.85-18.34). There was no difference in CTC or cfDNA between those with DM and those without DM. The most common mutation identified was TP53, present in 30% of cfDNA samples with a mutation. 60% of patients with TP53 mutation had DM vs 14% of patient without DM, $p=0.02$. cfDNA and PTH level were not found to have a relationship, ($r=-0.27$, $p=0.39$), but PTH and CTC had a linear relationship ($r=0.76$, $p<0.001$).

Conclusions: More than 50% of patients with PC develop metastatic disease. LBx appears to be a feasible tool in PC surveillance. While the relationship between cfDNA and PTH level remains unclear, the correlation between CTC enumeration and PTH level may be impactful. The finding that TP53 mutation is more prevalent in patients with distant metastasis may impact further management.

◆13. A Comparison of Incidental Parathyroid Rates Associated with Total Thyroidectomy Performed with or Without Near-Infrared Autofluorescence Imaging

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Background: Near-infra red autofluorescence (NIRAF) imaging is an adjunct to parathyroid identification. As it does not show perfusion, it is important to study its impact on thyroidectomy by measuring quantifiable data on parathyroid detection, rather than on function. The rate of incidental parathyroidectomy detected on thyroidectomy specimens is such an objective parameter that could be measured. The aim of this study was to compare incidental parathyroidectomy rates in patients undergoing total thyroidectomy with or without NIRAF.

Methods: With IRB approval, patients who underwent total thyroidectomy with or without NIRAF by multiple surgeons between 2014 and 2018 at a single center were identified retrospectively from a departmental database. Clinical and operative parameters, as well as rates of incidental parathyroidectomy detected on final pathology specimens for the NIRAF vs conventional surgery groups were compared using Mann Whitney U and Chi square tests. A sample size calculation using a type I error of 0.05, type II error of 0.2 and a 50% decrease from a baseline incidental parathyroidectomy rate of 30% yielded 114 patients in each group.

Results: There were a total of 300 patients in the NIRAF and 750 patients in the conventional group. The two groups were similar regarding age, gender, body mass index, diagnosis and thyroid weight. The mean number of parathyroid glands identified intraoperatively was the same for each group, with 3 glands. The rate of incidental parathyroidectomy detected on thyroidectomy specimens was 13.3% (n=40) in the NIRAF group and 29% (n=218) in the conventional surgery group (< 0.001). The impact of NIRAF in decreasing incidental parathyroidectomy rate was more profound for junior (from 36% to 17%) versus senior surgeons (from 20% to 13%). For the NIRAF vs conventional surgery groups, temporary (3.3% vs 4.5%, respectively, p=0.38) and permanent hypocalcemia (1% vs 1.5%, respectively, p=0.55) rates were similar.

Conclusions: Our results suggest that the use of NIRAF may help decrease the rate of incidental parathyroidectomy detected on pathology specimens, but missed intraoperatively during total thyroidectomy. The highest utility in this regard seems to be present for junior surgeons.

◆14. Efficacy and Safety of Near Infrared Fluorescence Identification of the Thoracic Duct During Left Lateral Neck Dissection

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Background: Thoracic Duct (TD) leaks occurs in up to 4.5% of left lateral neck dissections and can result in significant morbidity. Currently, no imaging modality is routinely used to identify the TD intraoperatively. Previously, we have shown the thoracic duct can be imaged with a near-infrared fluorescence (NIRF) camera after indocyanine green (ICG) injection. Herein, we report the results of our clinical trial of ICG lymphangiography during left lateral neck dissection for metastatic disease.

Methods: From 2018-2022, patients undergoing left lateral neck dissection for malignancy were enrolled in our clinical trial. ICG (5mg) was injected into the subcutaneous tissue on the dorsum of the left foot. Intraoperative imaging was performed with a hand-held NIR camera. Data was reported using descriptive statistics.

Results: 47 patients with thyroid, tongue, skin, or laryngeal cancer were enrolled with 7 excluded. Thirteen patients had prior neck surgery, and 3 had prior external beam radiation. The TD was visualized with ambient light in 52% (21 patients) of cases and with NIRF visualization in 64% (26 patients). In 15% of cases (6 patients), TD identification only occurred using NIRF. For those patients who received ICG post-dissection, two had TD visualization within 3 minutes after injection, but in four patients, visualization took at least 10 to 17 minutes. Five patients required ICG redosing (5mg) for initial visualization. The duration of TD NIR fluorescence was variable but generally several hours. In one case, NIRF visualization was seen 12 hours 20 minutes after injection (take-back for bleeding). All TDs in patients with prior neck radiation, and in 77% of patients with prior neck surgery were visualized with NIRF. Adverse reactions due to ICG occurred in one patient (hypotension managed with fluids and medication). Five intraoperative TD injuries occurred and were ligated intraoperatively, several aided by NIRF imaging. There with no chylous fistulas post-operatively.

Conclusions: This clinical trial demonstrates NIR identification of the TD is feasible with ICG lymphangiography even in patients with prior neck surgery or radiation. Furthermore, this technique is safe and simple to perform.

15. Incidental 68Ga-DOTATATE Uptake in Thyroid Nodules: Is Guideline-Directed Management Still Appropriate?

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Background: FDG uptake on PET imaging has been shown to be an independent risk factor for malignancy in thyroid nodules. More recently, a new PET radiotracer – 68Ga- DOTATATE – has gained popularity as a sensitive method to detect neuroendocrine tumors (NETs). With greater availability of this imaging, incidental 68Ga-DOTATATE uptake in the thyroid gland has increased. It is unclear whether current guideline-directed management of thyroid nodules remains appropriate in those that are 68Ga-DOTATATE avid.

Methods: We retrospectively reviewed 68Ga-DOTATATE PET scans performed at our institution from 2012-2022. Patients with incidental focal 68Ga-DOTATATE uptake in the thyroid gland were included. Fine needle aspiration (FNA) biopsies were characterized via the Bethesda System for Reporting Thyroid Cytopathology. Bethesda III/IV nodules underwent molecular testing (ThyroSeq v3) and malignancy risk $\geq 50\%$ was considered positive.

Results: In total, 1176 68Ga-DOTATATE PET scans were reviewed across 837 unique patients. Fifty-three patients (6.3%) demonstrated focal 68Ga-DOTATATE thyroid uptake. Nine patients were imaged for known medullary thyroid cancer (MTC). Forty-four patients had incidental radiotracer uptake in the thyroid and were included in our study. Included patients were predominantly female (75%) with an average age of 62.9 ± 13.9 years and standardized uptake value (SUVmax) in the thyroid of 7.3 ± 5.3 . Frequent indications for imaging included NET of the small bowel (n=17), lung (n=8), and pancreas (n=7). Thirty-three patients underwent subsequent thyroid ultrasound. Sonographic findings warranted biopsy in 24 patients, of which 3 were lost to follow-up. Cytopathology and molecular testing results are as follows: 12 Bethesda II (57.1%), 6 Bethesda III/ThyroSeq-negative (28.6%), 1 Bethesda III/ThyroSeq-positive (4.8%), 2 Bethesda V/VI (9.5%). Three nodules were resected, revealing two papillary thyroid cancers and one NIFTP. There was no difference in SUVmax between benign and malignant nodules (7.0 ± 4.6 versus 13.1 ± 5.7 , $p=0.106$). Overall, the malignancy rate among patients with sonography and appropriate follow-up was 6.7% (2/30). Among patients with cyto- or histopathology, the malignancy rate was 9.5% (2/21). There were no incidental cases of MTC.

Conclusions: The malignancy rate among thyroid nodules with incidental 68Ga-DOTATATE uptake is comparable to rates reported among thyroid nodules in the general population. Guideline-directed management of thyroid nodules remains appropriate in those with incidental 68Ga-DOTATATE uptake.

◆ 16. Thyroid Stimulating Hormone (TSH) Receptor as a Target for Imaging of Thyroid Cancer

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Background: Thyroid cancer is diagnosed in over half a million people each year. Clinical guidelines suggest patients receive surgical intervention, followed by pharmacological thyroid stimulating hormone (TSH) suppression and radioactive iodine (RAI) ablation of residual tissue. Unfortunately, up to 20% of thyroid cancers may become radioactive iodine refractory (RAI-R) through gradual loss of sodium-iodide symporter (NIS) expression. There is therefore need for alternative diagnostic and therapeutic approaches to RAI-R thyroid cancers. In this study, we propose targeting the TSH receptor (TSHR) as a non-invasive biomarker for positron emission tomography (PET) imaging of thyroid cancer.

Methods: Tissue microarrays (TMAs) containing 52 Hurthle cell thyroid carcinomas were immunostained to determine TSHR expression. For preliminary studies, the recombinant human TSH (rhTSH) analogue superagonist TR1402 was radiolabeled with ⁸⁹Zr (t_{1/2} = 78.4 h, β⁺=22.7%) to produce radiopharmaceutical [⁸⁹Zr]TR1402. A cell uptake assay was performed to compare the uptake of [⁸⁹Zr]TR1402 in wild type THJ529 thyroid cancer cells, with low TSHR expression, to a THJ529 cell line stably transfected with the human TSHR gene. In addition, preliminary imaging studies were carried out in male athymic nude mice bearing TSHR-expressing xenografts.

Results: In our preliminary experiments, thyroid cancer TMAs revealed that among 52 HCC patients 62% (27 primary and 5 recurrent) were TSHR membranous immunostain positive. When incubated with 1 nM [⁸⁹Zr]TR1402, the TSHR-expressing THJ529 cell line had 46.97 ± 11.92% bound/mg compared to 6.02 ± 0.98 in the wildtype cell line (p<0.001). Binding in the TSHR-expressing cells was shown to be receptor specific by blocking uptake with 230 nM TR1402, which reduced binding to 7.56 ± 1.86% bound/mg (p<0.001). Preliminary *in vivo* imaging data showed noticeable uptake of [⁸⁹Zr]TR1402 in the tumor region compared to other tissues, with standardized uptake values (SUVs) peaking at 1.25 on Day 1.

Conclusions: Based on preliminary studies, TSHR is a promising target for RAI-R thyroid cancer imaging with [⁸⁹Zr]TR1402. Given these results, there is potential to develop TR1402 for new therapeutic approaches, including Hurthle Cell Carcinoma which has limited therapeutic options.

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◆17. Primary Hyperparathyroidism Causes Objectively Measurable Cognitive Dysfunction Which is Improved by Parathyroidectomy

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Background: A known relationship between primary hyperparathyroidism (PHPT) and decreased quality of life has been shown using patient-reported outcome measures including Pasieka's Parathyroid Assessment of Symptoms, SF-36, and PROMIS. These tools provide value in measuring subjective quality of life, but there remains a paucity of information on objectively measured cognitive dysfunction in PHPT patients. We assessed whether PHPT and its associated curative surgery affected objectively quantifiable cognitive function, using BrainCheck®, a clinically validated, FDA approved instrument that allows rapid, objective evaluation of memory, attention, and executive function.

Methods: This was a single-institution study of 59 consecutive patients with PHPT, who underwent parathyroidectomy (2019-2021). BrainCheck®, an automated computerized cognitive assessment tool, was used. Evaluation was performed two weeks before and two weeks after surgery. The BrainCheck® Standard Battery assesses vulnerable areas of neurocognition including attention, executive function, and memory and allows comparison to population level controls. The association between BrainCheck® scores and parathyroidectomy were evaluated using a Wilcoxon Signed-Ranks Test.

Results: A total of 59 PHPT patients underwent the rapid cognitive assessment with BrainCheck® following parathyroidectomy. The majority were female (72.9%), white (49.2%) or African American (30.5%). A total of 44.1% of patients showed dysfunction relative to the general population preoperatively compared to 22% postoperatively. Of the 44.1% of patients that had dysfunction, 53.8% of them improved after parathyroidectomy. Postoperative scores were statistically significantly higher than preoperative scores ($Z=2.85$, $p=0.004$). This association remained statistically significant when the cohort was stratified by gender. Males had a statistically significant increase in scores ($Z=2.02$, $p=0.044$) as well as females ($Z=2.09$, $p=0.037$). Domain sub-analysis demonstrated a statistically significant association with improved executive function ($p<0.01$).

Conclusions: Our data indicate that there are objectively measured cognitive changes caused by PHPT, which can be reversed by parathyroidectomy as early as 2 weeks after surgery. Further studies are needed to determine if Braincheck® would be helpful as a routine clinical tool to identify "asymptomatic" patients who may have significant cognitive dysfunction which will benefit from parathyroidectomy, and to assess the pre and postoperative cognitive status of PHPT patients and predict time to recovery.

◆ 18. Do Men Improve Their Bone Mineral Density One Year After Parathyroidectomy for Primary Hyperparathyroidism? Results of a Prospective Study.

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Background: Osteoporosis is a criterion for surgery in patients with primary hyperparathyroidism (PHPT). This indication is based on results observed in women but is applied without gender differentiation. However, only a few small retrospective studies (including <25 patients) specifically assessed this outcome in men. The aim of this study was to evaluate the bone mineral density (BMD) and bone remodeling marker changes in a large series of men one year after parathyroidectomy for PHPT.

Methods: Patients who underwent parathyroidectomy for PHPT between 2016 and 2022 (n=351) were enrolled in a monocentric prospective cohort. Only men were included in the present study. Patients without one-year follow-up or with missing data (serum calcium and PTH levels, biocollection, and/or BMD measurement at lumbar spine and femoral neck) were excluded. BMD was measured by dual X-ray absorptiometry, a 1-year clinically significant change being defined by an increase ≥ 0.03 g/cm². Measured bone remodeling markers were CTX, P1NP and bone-specific alkaline phosphatases. Parameters were measured before and 12 months after parathyroidectomy.

Results: Forty-five men were included (mean age 58.8 ± 13.1 years). Before surgery, 22/45 patients (49%) had osteopenia and 5/45 (11%) had osteoporosis. Mean serum calcium and median serum PTH levels decreased significantly after surgery (2.48 ± 0.17 versus 2.82 ± 0.27 mmol/L pre-operatively, $p < 0.05$, and 48 [25th-75th percentile, 36.3-67.4] versus 118.7 [87.7-161.4] pg/mL pre-operatively, $p < 0.05$, respectively). One year after parathyroidectomy, the mean BMD increased significantly at the lumbar spine ($+0.06$ g/cm², 95%CI [0.01;0.11]), femoral neck ($+0.04$ g/cm² 95%CI [0.03;0.05]) and total hip ($+0.02$ g/cm² 95%CI [0.01;0.03]). A clinically significant BMD gain was observed for 21/45 patients (47%) at the lumbar spine, 23/45 (51%) at the femoral neck, 21/45 (47%) at the total hip and 6/24 (25%) at the forearm. Overall, 34/45 (76%) had a clinically significant BMD gain on at least one site. The mean serum concentration of CTX and P1NP significantly decreased one year after surgery, suggesting a decreased bone turnover.

Conclusions: These results validate osteoporosis as a surgical indication in men. They also suggest that men could take benefit from surgery in terms of BMD even though without osteoporosis.

◆19. Prevalence and Risk Factors for Dysphagia in Older Adults Following Thyroid and Parathyroid Surgery

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Background: Up to 50% of young patients report dysphagia after uncomplicated thyroid and parathyroid surgery. We hypothesize that older adults are at higher risk due to atrophy of laryngeal cartilaginous and muscular support that occurs with aging. Therefore, the purpose of this study was to determine the prevalence of swallowing dysfunction in older adults following thyroidectomy or parathyroidectomy and identify risk factors for its development.

Methods: We performed an IRB-approved, longitudinal prospective cohort study of older adults (age≥65) undergoing initial thyroid or parathyroid surgery. Patients with pre-existing vocal cord dysfunction or intraoperative loss of nerve signal were excluded. A Fried frailty index was measured for each patient at the time of enrollment. The validated Dysphagia Handicap Index (DHI) questionnaire was administered preoperatively and again at 1, 3, and 6 months postoperatively. Paired t-tests were used to compare mean differences in DHI scores before and after surgery. Logistic regression was performed to determine risk factors for worsened DHI scores.

Results: Of 175 older adults included in the study, 73.7% were female, 81.1% were white race, 50.9% underwent thyroidectomy, and 57.1% underwent bilateral procedures. Mean age was 71.1 years (range 65-94). Pre-operatively, 85% of pre-frail/frail patients reported swallowing impairment compared to 70% of non-frail patients (p=0.013). At 6-months postoperatively, 49% of the entire cohort reported worse swallowing than pre-operatively. Specifically, at 6 months following surgery, 26.6% of patients reported coughing when eating solid foods compared to 23.4% preoperatively (p<0.001), and 19.4% reported choking when taking medication compared to 13.1% preoperatively (p<0.001). Those with preoperative swallowing dysfunction had 3.36-fold greater odds of developing worsening dysphagia at 3-months following surgery (OR=3.36, 95%CI: 1.23-9.18). While frailty was associated with dysphagia at presentation, there was no association between worsened DHI score and age, sex, race, frailty phenotype, BMI, smoking status, presence of reflux, or extent of surgery.

Conclusions: Older adults commonly report swallowing impairment pre-operatively, which may impact activities of daily living up to 6-months following thyroid and parathyroid surgery. These findings should be discussed during preoperative counseling for older adults.

◆20. The Impact of Hormonal Secretion on Survival in Adrenocortical Carcinoma

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Background: Current evidence suggests that cortisol secreting adrenocortical carcinoma (ACC) has worse prognosis compared to non-secreting ACC. However, the impact of other secretory subtypes of ACC are poorly described.

Methods: This retrospective multicenter study within the American-Australian-Asian Adrenal Alliance (A5) included adults with ACC (1997-2020), utilizing TNM 8th. We compared overall survival (OS) and disease-free survival (DFS) among cortisol secreting, mixed cortisol/androgen secreting, androgen secreting, and non-secreting ACC while excluding mineralocorticoid secreting due to limited numbers.

Results: Of the 807 patients (mean age 50±15, 63% women), 6.6% were stage I, 28.7% stage II, 29.4% stage III, and 30.7% stage IV, while 4.6% were unknown stage. Of the total, 176 (25%) were cortisol secreting (24% mild and 76% overt), 96 (13.5%) were androgen secreting, 202 (28.5%) were mixed cortisol/androgen secreting, and 234 (33%) were non-secreting. Secreting ACC presented at later stage compared to non-secreting ACC (38% vs 19% for stage IV, p<0.01). Median follow-up was 25 (IQR 11, 60) months Median OS and DFS for the entire cohort were 60 and 9 months, respectively. Median OS was 36 months for cortisol secreting, 30 months for mixed, 60 months for androgen secreting, and 115 for non-secreting ACC, p<0.01. Median OS was shorter for those with overt vs mild hypercortisolism: 32 vs 37 months, p<0.01. Median DFS was 7 months for cortisol secreting, 8 months for mixed, 10 months for androgen, and 12 months for non-secreting ACC, p=0.06.

On multivariable analysis of age, sex, Ki67%, secretory type, stage, resection status, and adjuvant therapy, independent predictors of worse OS were older age, higher Ki67%, stage IV (vs I/II), mixed secreting (vs non-secreting), and incomplete resection, p<0.05. On subgroup analysis of patients with R0 resection, predictors of worse OS included older age, higher Ki67% and stage III (vs I/II). Higher Ki67% was the only predictor of worse DFS following R0 resection.

Conclusions: For all patients with ACC, mixed cortisol/androgen secretion was associated with worse survival, while cortisol or androgen secreting alone were not. Notably, among patients with R0 resection, secretory subtype did not impact survival. However, higher Ki67% remained a predictor of worse survival independent of resection status.

●HE 01. Association of Patient and Provider Sex Concordance with Specialist Referral in Primary Hyperparathyroidism

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Background: Surgical management of primary hyperparathyroidism (PHPT) reduces the incidence of nephrolithiasis, fractures, and cardiovascular complications. However, barriers to workup and management of PHPT exist. Recent data have suggested that patient and provider sex concordance is associated with better rapport, increased cancer screening, and fewer surgical complications. We sought to evaluate the impact of patient and provider sex concordance on referral for PHPT.

Methods: We queried an institutional database for patients with first incident hypercalcemia and subsequent biochemical diagnosis of PHPT. Retrospective chart review was performed to identify PCP sex, endocrinologist sex, and surgeon evaluation for PHPT. Demographic and clinical covariates were collected, including baseline PTH and calcium lab values and complications of PHPT. Sex concordance (male patient and male provider or female patient and female provider) was evaluated as a binary predictor of endocrinologist and surgeon evaluation using multivariable logistic regression and Cox proportional hazards modeling.

Results: Among 1,100 patients with PHPT, mean age was 62.5 (SD 13.6) and 74% were female. PCP sex was 52% female and 63% of patients had sex concordance with their PCP. Endocrinologist sex was 59% female, and 45% of patients had sex concordance with their endocrinologist. Female patients were less likely to have a sex-concordant PCP (60% vs. 71%, $p=.001$) or endocrinologist (41% vs. 58%, $p<0.001$) compared to male patients. After adjusting for age, race, insurance status, Elixhauser comorbidities, baseline calcium and PTH lab values, and PHPT complications, those patients with PCP sex concordance had an estimated 32% higher odds of endocrinologist evaluation (OR 1.32 (CI 1.03-1.73, $p=0.047$) compared to those with sex discordance. Similarly, those patients with endocrinologist sex concordance had an estimated 48% higher rate of surgeon evaluation (HR 1.48, CI 1.1-2.0, $p=0.009$). Stratified analysis revealed that sex discordance reduced the estimated rate of surgeon referral for female patients (HR 0.63, CI 0.44-0.89, $p=0.008$) but not male patients (HR 1.06, CI 0.58-1.93, $p=0.861$).

Conclusions: Sex discordance between patients and their healthcare professionals may be a barrier to referral in primary hyperparathyroidism and may disproportionately affect female patients. Further evaluation of the impact of patient and provider identities on communication and decision making are needed to ensure equity in access to surgical care.

●HE 02. Social Vulnerability and Time to Surgeon Evaluation for Primary Hyperparathyroidism

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Background: Identifying patients at risk for undertreatment of primary hyperparathyroidism (PHPT) is essential to minimizing long-term sequelae including osteoporosis, nephrolithiasis, and cardiovascular disease. The Centers for Disease Control and Prevention (CDC) social vulnerability index (SVI) assigns a score to a geographic area based on several social determinants of health (SDOH). We assessed the impact of social vulnerability on time to surgeon evaluation among patients with PHPT.

Methods: We performed a retrospective review of patients from our institutional database with first incident hypercalcemia between 2010 and 2018 and subsequent biochemical diagnosis of PHPT. The SVI was merged with the institutional data via patient zip code at the time of first incident hypercalcemia. Patients were stratified into SVI quartiles where quartile 1 (Q1) represented the lowest vulnerability and Q4 represented the highest vulnerability. Baseline sociodemographics and clinical characteristics were compared and Cox-regression was used to assess the association between SVI and time to surgeon evaluation.

Results: A total of 1,082 patients were included. There was no difference in age, sex, calcium, or PTH by SVI quartile. Patients with a higher SVI were more likely to be Black or African American (Q1 SVI: 5% vs. Q2 SVI: 5% vs. Q3 SVI: 12% vs. Q4 SVI: 42%, $p < 0.001$) and to have more comorbidities (>7 Elixhauser comorbidities; Q1 SVI: 23% vs. Q2 SVI: 26% vs. Q3 SVI: 28% vs. Q4 SVI: 38%, $p < 0.001$). Comparatively, patients with a lower SVI were more likely to have private insurance (Q1 SVI: 56% vs. Q2 SVI: 53% vs. Q3 SVI: 38% vs. Q4 SVI: 36%, $p < 0.001$). Patients with a higher SVI were also less likely to be evaluated by a surgeon (Q1 SVI: 31.1% vs. Q2 SVI: 31.41% vs. Q3 SVI: 25.93% vs. Q4 SVI: 21.92%, $p = 0.03$). On adjusted analysis, patients with the highest vulnerability (Q4) had a 33% lower estimated rate of surgeon evaluation and were seen an estimated 67 days later compared to patients with the lowest vulnerability (Q1) (HR: 0.67, CI 0.47-0.97, $p = 0.032$).

Conclusions: Highly vulnerable populations with PHPT are at greater risk for under-evaluation by a surgeon which increases probability of developing long term-sequelae of their disease. This emphasizes the importance of SDOH in the management of PHPT.

●HE 03. Widening Regional Inequalities among Decreasing Utilization of Parathyroidectomy in US Dialysis Patients

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Background: It has been suggested that parathyroidectomy (PTX) has become a less attractive therapy for dialysis-dependent patients with secondary hyperparathyroidism despite unambiguous evidence of improved long-term survival, and morbidity -bone mineral and cardiovascular health- and quality of life. The purpose of our study was to ascertain whether underutilization of PTX in ESRD patients is a regional or national trend and characterize the regional differences in clinical practice over time.

Methods: The United States Renal Data System was used to identify 2,406,911 patients on dialysis from 1990-2015. Of which, 35,609 patients underwent PTX. Patients were subdivided into US Census regions and End Stage Renal Disease (ESRD) subregional networks. Variation in PTX rates were compared to their respective dialysis population over a 25-year period and subset analysis performed from 2010-2015. Analysis of patient demographic, socioeconomic, and ESRD characteristics, was performed by regional network. Geographical-adjusted odds ratios of parathyroidectomy were calculated using multivariate regression.

Results: PTX rates decreased from 262.5 per 100,000 per year to 55.7 nationally from 1990-2015. PTX rates varied from 8.54 to 24.71 per 1000 patients (2.89 fold) and accounted for 1.28-3.08% of the ESRD population depending on the region. The highest PTX rates were performed in the South (18.82), followed by the Midwest (13.35), with the lowest rates in the West (12.1) and Northeast (12.372). Geographical location was found to be independently associated with PTX in multivariate regression after controlling for differences in underlying demographic, socioeconomic, and ESRD characteristics. Comorbidities and duration on dialysis increased in patients undergoing PTX over the study period. Racial disparities widened over time with Blacks and Hispanics increasingly more likely to have PTX, 50.7% and 9.2% 1990-2015 versus 54.3% and 11.4% 2010-2015, respectively. The widening disparity was most pronounced in the Northeast for Blacks and in the West for Hispanics with an increase of 6.2% Blacks versus 4.5% Hispanics respectively.

Conclusions: PTX rates of have decreased over time with disparate access regionally. Possible factors include adoptions in advances of medical management, differences in disease severity, guideline ambiguity about indication, extent, and goals of surgery, and experienced surgeon availability. Possible factors influencing inequities in PTX access should be further investigated for geographic-specific variation.

●HE 04. Who Serves Where: A Geospatial Analysis of Access to Endocrine Surgeons in the United States and Puerto Rico

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Background: The association between surgical volume and patient outcome in thyroidectomy is well established, with higher specific case volume of the surgeon leading to lower risk of complications. We hypothesized that the geographic distribution of endocrine surgeons may limit access to high-volume thyroid surgeons in the U. S. - particularly in rural areas.

Methods: We used web-based directories from the American Association of Endocrine Surgeons (AAES), American Head & Neck Society (AHNS), and the American Academy of Otolaryngology-Head and Neck Surgery (AAO-HNS) to identify addresses of endocrine surgery specialists in the U.S. and Puerto Rico (PR). These addresses were geocoded using Geocodio to translate them into spatial coordinates. Using these coordinates and the OpenStreetMap roads network, we used Valhalla's Isochrone application programming interface (API) to calculate the areas within 60- and 90-minutes' driving distance from the offices. We then used 2020 U.S. census data to calculate the census tract population inside or outside the accessible areas.

Results: As of April 2022, AAES had 437 listed providers with addresses in 40 states, the District of Columbia (D.C.), and PR. AHNS had 102 providers in 28 states, D.C., and PR. AAO-HNS had 94 providers in 31 states; there were no providers in D.C. or PR. Excluding duplicate providers across organizations, 606 addresses were geocoded. New York (n=70) and California (n=59) had the highest number of providers, while Alaska, Kansas, Montana, Nevada, and Wyoming had no providers. 31.25% (78.4 million) of Americans do not have access to an endocrine surgeon within a 60-minute drive. 16.8% (47.3 million) of Americans do not have access within a 90-minute drive. Areas of coverage from the middle of the country westward are primarily focused around major metropolitan cities.

Conclusions: Nearly one-third of Americans, predominately in rural areas in mid-western and western states, do not have access to an endocrine surgeon within an hour's drive, highlighting a concerning geographic barrier to care and potentially leading to increased risk of complications and costs to the healthcare system. Further work is needed to identify strategic placement of high-volume endocrine surgeons to accommodate patient access and mitigate disparities to quality care.

●HE 05. Disparities in Emergency Department Utilization Following Outpatient Thyroidectomy Across Three States

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Background: Outpatient thyroidectomy has become more common. Only single institution studies exist regarding post-thyroidectomy emergency department (ED) utilization and readmission, and there are few studies examining encounters not resulting in readmission (“treat-and-release”). Our objectives were to evaluate post-outpatient thyroidectomy ED utilization and readmission across three states, characterize associated factors, and identify disparities in utilization.

Methods: The Healthcare Cost and Utilization Project (HCUP) State Ambulatory Surgery, Emergency Department, and Inpatient Databases were utilized to identify adult outpatient (same-day or <24-hour discharge) thyroidectomies in Florida, Maryland, and New York from 2016-2017. Procedures were linked with ED encounters and inpatient admissions within 30 days following surgery. Hierarchical multivariable logistic regression was used to identify factors associated with post-thyroidectomy treat-and-release ED encounters and readmission.

Results: A total of 14,035 patients at 358 facilities underwent outpatient thyroidectomy. The median age was 53 years (IQR: 42-64), and 11,221 (80%) were women. Treat-and-release ED encounters occurred for 1,457 (10.4%) patients, while readmission occurred for 438 (3.1%). The most common presenting diagnoses during treat-and-release encounters were paresthesia (5.4%), cervicalgia (4.7%), and dyspnea (4.7%). The most common readmission diagnoses were hypocalcemia (19.4%), complications of malignant neoplasm (9.2%), and surgical site infection (4.6%). In adjusted analysis, greater odds of treat-and-release encounters were associated with non-Hispanic Black (vs. non-Hispanic white; adjusted odds ratio [aOR]: 1.6, 95% confidence interval [CI]: 1.3-1.9) and Hispanic race and ethnicity (aOR: 1.4, 95% CI: 1.2-1.7), Medicare (vs. private insurance; aOR: 2.0, 95% CI: 1.6-2.4) and Medicaid insurance (aOR: 3.2, 95% CI: 2.6-2.9), and individuals in rural areas (vs. urban; aOR: 1.7, 95% CI: 1.2-2.6). There were no significant associations of readmission with race and ethnicity, insurance, or geographic location.

Conclusions: ED utilization after outpatient thyroidectomy was common, and we identified racial, ethnic, socioeconomic, and geographic disparities with treat-and-release encounters. However, no disparities were observed among readmitted patients, suggesting that treat-and-release encounters are potentially preventable. Standardization of perioperative care pathways, with focus on identifying and addressing specific issues in vulnerable populations, may be an opportunity to improve care, reduce disparities, and improve patient experience by avoiding unnecessary ED visits after outpatient thyroidectomy.

◆21. Disparities in Access to High-Volume Parathyroid Surgeons in the United States – A Call to Action

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Background: Parathyroidectomy by a high-volume surgeon is associated with a reduced risk of perioperative complications as well as failure to cure primary and secondary hyperparathyroidism. There are limited data on disparities in access to high-volume parathyroid surgeons (HVPS) in the U.S.

Methods: We used publicly available 2019 Medicare Provider Utilization and Payment data to identify all surgeons who performed >10 parathyroidectomies for Medicare fee-for-service beneficiaries, anticipating that fee-for-service beneficiaries likely represent only a subset of their high-volume practices. HVPS characteristics and geographic distribution were evaluated. Inequality in the distribution of surgeons was measured by Gini coefficient. The association between neighborhood disadvantage, based on Area Deprivation Index, and proximity to a HVPS was evaluated using one-way ANOVA with Bonferroni-corrected pairwise comparisons. A sensitivity analysis was performed restricting to HVPS within each hospital referral region (HRR), evidence-based regional markets for tertiary medical care.

Results: We identified 445 HVPS who met inclusion criteria with >10 parathyroidectomies for Medicare fee-for-service beneficiaries. HVPS were 71% male and 59.8% general surgeons. HVPS were more likely to practice in a Metropolitan Statistical Area (MSA) with a population >1 million than in less populous metropolitan or rural areas. The number of HVPS per 100,000 fee-for-service Medicare beneficiaries in the 53 most populous MSAs ranged from 0 to 4.94, with the highest density identified in Salt Lake City, UT. In 2019, 50% of parathyroidectomies performed by HVPS were performed by 20% of surgeons in this group, suggesting unequal distribution of surgical care (Gini coefficient 0.41). Patients in disadvantaged neighborhoods were farther from a HVPS than those in advantaged neighborhoods (median distance: disadvantaged 27.8 miles, partially disadvantaged 20.7 miles, partially advantaged 12.1 miles, advantaged 8.4 miles; $p < .001$). This association was also shown in the analysis of distance to HVPS within HRR ($p < .001$).

Conclusions: Older adults living in disadvantaged neighborhoods have less access to HVPS, which may adversely affect treatment and outcomes for patients with primary and secondary hyperparathyroidism. This disparity highlights the need for actionable strategies to provide equitable access to care, including improved regionalization of HVPS services and easing travel-related burdens for underserved patients.

◆22. A Multi-Institutional Study from the US ROPE Consortium Examining Factors Associated with Endocrine Surgery Exposure for General Surgery Residents

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Background: Prior analyses of general surgery (GS) resident case logs demonstrate a decline in endocrine experience in recent decades. This study aims to identify individual and program-level factors that contribute to the endocrine operative experience of GS residents and decision to pursue an endocrine surgery fellowship.

Methods: Endocrine-specific case log data for all graduates from 18 ACGME-accredited GS residency programs in the US Resident Operative Experience (ROPE) Consortium over an 11-year period were analyzed. Both individual and program-level data were collected.

Results: 1,240 residents were included in this study (median age 33, 35.1% female). There were 17 (1.4%) graduates who matched into endocrine surgery while 1,223 (98.6%) pursued another fellowship or went directly into practice. Those who matched into endocrine surgery completed more total endocrine cases (81 vs 37, $p < 0.01$), including more thyroid (52 vs 21, $p < 0.01$), parathyroid (25 vs 11, $p < 0.01$) and adrenal cases (4 vs 2, $p < 0.01$). On multivariable linear regression, program factors positively associated with endocrine cases included being a high-volume per resident operative program (+5, 95% CI 3 to 6, $p < 0.01$), employing endocrine-trained surgeons (+8, 95% 7 to 10, $p < 0.01$), having a dedicated endocrine surgery rotation (+10, 95% CI, 8 to 12, $p < 0.01$), and residency co-located with an endocrine surgery fellowship (+4, 95% CI 2 to 6, $p < 0.01$). In

contrast, large-size residency programs (-9, 95% CI -12 to -7, $p < 0.01$), programs in the bottom 50 in NIH-funding (-10, 95% CI -12 to -8, $p < 0.01$) and programs employing otolaryngologists performing endocrine surgery (-3, 95% CI -4 to -1, $p < 0.01$) were negatively associated.

Conclusions: This study identified program-level characteristics associated with a more robust endocrine surgery experience. Modifiable program factors include optimizing the pipeline recruitment of dedicated endocrine surgeons and inclusion of endocrine surgery rotations in the GS residency curriculum. AAES-sponsored faculty mentorship or external rotations may also help recruit residents to the field. Implementing these program-level changes will help maintain and ultimately enhance a strong general surgery presence amongst endocrine surgeons long-term.

◆23. Malpractice Litigation Following Thyroid Surgery: What Factors Favor Surgeons?

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Background: The price of litigation can impact physicians financially, reputationally, and professionally. Although thyroid surgery is associated with favorable patient outcomes and relatively low complication rates, litigation following thyroid surgery continues to be prevalent. The purpose of this study is to characterize and describe malpractice claims against surgeons performing thyroid surgery and investigate what factors favor physicians in these proceedings.

Methods: The Westlaw legal database, which includes all publicly available state and federal cases in the United States, was queried using the terms “thyroid,” “surgery,” and “medical malpractice.” Cases were excluded if they did not involve thyroid-surgical intervention. From this search, data were compiled including causes cited for initiating litigation, case outcomes, year and state of the court’s decision, whether the state involved had tort reform provisions in place, and certain demographic details.

Results: The search yielded 139 cases between 1949 and 2022. Ninety-five cases remained following exclusion criteria. The most common cause of action was medical negligence, followed by failure to provide adequate informed consent. The most common inciting surgical event was recurrent laryngeal nerve injury, implicated in 45 of these cases (47%). Sixty-four cases culminated in final decisions, with surgeons prevailing in a majority of these (48 cases or 75%). Patients prevailed in only 16 cases (25%), with damage awards ranging between \$32,000 and \$3,751,863 (median \$673,135). Fourteen of these 16 cases (where patients won) were decided by jury (88%), whereas only 46% of cases won by surgeons went to jury verdict. Fifty-eight cases were sited in states with tort reform provisions in place—surgeons prevailed in 54% of those cases. However, in cases from states without tort reform, surgeons prevailed in only 46%. Gender discordance was noted between surgeons and patients; a large majority of surgeons were male, whereas a large majority of patients were female. However, there did not appear to be an association between gender and case disposition. Interestingly, of the 95 cases that met criteria, only one mentioned use of intraoperative recurrent laryngeal nerve monitoring.

Conclusions: Juries appear to favor patients, whereas surgeons prevail more frequently when decisions are based solely on legal interpretation. Furthermore, where tort reforms are in place, a higher percentage of surgeons prevail.

◆24. Lithium-Associated Primary Hyperparathyroidism: An Evaluation of Screening and Referral Patterns in a Southeastern Veteran Population

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Background: Long-term lithium therapy (Li-tx) has a well-established but under-recognized association with primary hyperparathyroidism (PHPT). We evaluated rates of hypercalcemia, screening for PHPT, and referral patterns for parathyroidectomy (PTX) among U.S. veterans on chronic Li-tx.

Methods: Patients undergoing Li-tx were identified from 2000-2022. Demographic characteristics, duration of Li-tx, and post-treatment calcium and parathyroid hormone (PTH) levels were abstracted. Baseline characteristics between patients on chronic Li-tx (duration > 12 months), with and without hypercalcemia (calcium \geq 10.2mg/dL), were compared using Chi-square or Fisher's exact test as appropriate. Rates of screening for hypercalcemia, PHPT (defined as PTH \geq 30pg/mL), referral for PTX, and surgical outcomes were evaluated. Cure was defined as normocalcemia 6 months postoperatively. Records of patients referred for PTX were independently reviewed by two investigators.

Results: 1356 patients underwent Li-tx during the study period, 514 of whom received chronic Li-tx. There was no difference in gender ($p=0.78$), race ($p=0.49$), or ethnicity ($p=0.14$) between those with and without post-treatment hypercalcemia. Of 150 patients on chronic Li-tx with post-treatment hypercalcemia, 112 (74.7%) underwent no further evaluation for PHPT, while 38 (25.3%) patients had a PTH level recorded. Although 34 (89.5%) patients screened positive for PHPT, only 5 (13%) were referred for PTX. One patient declined surgery. Of the four patients who underwent PTX, mean calcium was 11.2 mg/dL (range 11.1-11.4), and mean PTH was 272 pg/mL (range 108-622). Three patients localized on preoperative imaging, two of whom underwent unilateral exploration (UE) with cure, with one patient experiencing recurrence at 31 months; the remaining patient who localized preoperatively underwent bilateral exploration (BE) had resection of 2 ipsilateral glands and experienced persistence. The patient who did not localize preoperatively underwent BE with resection of 3 glands and preliminary evidence of cure, not yet reaching 6 months postoperatively.

Conclusions: Screening for PHPT and referral for surgical evaluation is underutilized in U.S. veterans undergoing chronic Li-tx. Although further investigation is needed to evaluate generalizability to the broader population, institutional protocols to standardize screening and referrals to endocrinology and/or endocrine surgery could benefit this population at increased risk for PHPT.

◆25. Gender Differences In Patients With Primary Hyperparathyroidism

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Background: Gender differences in presenting symptoms of pHPT patients and outcomes after parathyroidectomy (PTX) have previously been described, but whether the observed differences can be diminished by systematic use of an objective outcomes tool, such as the validated Pasioka Parathyroidectomy Assessment Score (PAS), is not known.

Methods: All pHPT patients were asked to complete symptom assessment during triage at the first pre-operative and subsequent post-operative (1-2 weeks and 6 month) visits. The assessment included query for 13 PAS parameters evaluated using a visual analog-scale as described by Pasioka (quantitative summative score 0-1300), and general quality of life (QOL) and wellness. For this study, an IRB-approved review was conducted of a prospectively maintained database of pHPT patients (1/2017-12/2019) and inclusion criteria included cure (6-month normocalcemia) after initial PTX and longitudinal completion of assessments for the 3 time-points.

Results: The study cohort was mostly women (78%, 175/225). Preoperatively and compared to women, men had a higher mean calcium (11.1 v. 10.8 mg/dL; $p=0.008$), lower likelihood of bone demineralization (34% v. 62%, $p<0.001$), but the same incidence of kidney stones (32% v. 26%, $p=0.37$). The median preoperative PAS was higher in women (160, 0-940) than in men (39, 0-710, $p<0.001$) although there were equivalent rates of asymptomatic pHPT (PAS=0, 14% v. 8%, $p=0.19$). After curative PTX, women reported a substantial reduction in symptomatology with PAS declining by 48% at initial postoperative visit (median, 160 v. 83, $p<0.001$) which remained stable at 6 months (83 v. 74, $p=0.54$). In contrast, PAS scores in men did not change at either the initial postoperative visit (38 v. 35; $p=0.08$) or at 6-months (38 v. 47.5; $p=0.52$). Further, when evaluating individual symptoms queried by the PAS, there was no change in any single parameter, QOL ($p=0.69$), or wellness ($p=0.07$).

Conclusions: When assessed with PAS, improvement in symptoms was clearly demonstrated for women with pHPT after curative PTX. Whether symptom improvement also occurs in men is less apparent but may be due to disparities in the development and validation of outcomes tools in general. Further studies are needed to define if quality of life metrics for pHPT would more accurately be gender-specific.

26. Impact of Parathyroidectomy On Insulin Resistance in Patients with Primary Hyperparathyroidism

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Background: Insulin resistance is significantly higher in primary hyperparathyroidism (PHPT) patients than in control subjects. This finding may explain the increased incidence of cardiovascular complications observed in patients with PHPT. However, the impact of parathyroidectomy on insulin resistance is poorly documented and controversial. The objective of this study was to evaluate the evolution of insulin resistance at 12 months after parathyroidectomy for PHPT according to the preoperative severity of glucose metabolism abnormalities.

Methods: An institutional database of PHPT patients who underwent parathyroidectomy between 2017 and 2021 was retrospectively reviewed (NCT04798092). Patients with history of diabetes, severe chronic kidney disease (GFR \leq 30 mL/min/1.73 m²), and with missing data without 1-year follow-up were excluded. Fasting glucose and insulin were evaluated before and after parathyroidectomy (at 3, 6, and 12 months). Prediabetes and insulin resistance were defined as fasting glucose \geq 1.00 g/L (American Diabetes Association-ADA) and HOMA-IR $>$ 2.5 (Homeostatic Model Assessment for Insulin Resistance), respectively.

Results: Two hundred and thirty one patients (181 females) were included. Preoperatively, mean fasting glucose was 0.98 ± 0.12 g/L and 75 patients (32%) had prediabetes (fasting glucose \geq 1.00 g/L). Mean HOMA-IR was 3.29 ± 2.79 mU/L and 108 patients (47%) had insulin resistance (HOMA-IR $>$ 2.5). At 12 months postoperative (n=231), 217 patients (94%) were normocalcemic. An improvement in insulin resistance (decrease of HOMA-IR values) was observed in 125 patients (54%) without difference between patients with versus without NIH criteria for parathyroidectomy (ns). HOMA-IR values significantly decreased after parathyroidectomy in patients with prediabetes (-2.02; p=0.04) and in patients with insulin resistance (-0.85; p<0.001). In patients with prediabetes, 48/75 (64%) improved their insulin resistance, including 19/48 (40%) with normalization of fasting glucose. In multivariate analysis, prediabetes (1.82, 1.03-3.21; p=0.037) or preoperative HOMA-IR $>$ 2.5 (3.90, 2.23-6.75; p<0.001) remained independent predictors for insulin resistance improvement observed between preoperative and 12 month postoperative.

Conclusions: Parathyroidectomy for primary hyperparathyroidism is more likely to improve insulin resistance in patients with prediabetes or in patients with higher preoperative HOMA-IR values (HOMA-IR $>$ 2.5). These data support the use of preoperative glucose abnormalities to better select patients for surgery.

27. A Prospective Comparison of Octreotide to Vasopressors as First Line Treatment of Intraoperative Carcinoid Crisis

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Background: Intraoperative carcinoid crisis typically manifests as sudden onset of profound hypotension during operations for neuroendocrine tumors. Historically, crisis was attributed to massive release of vasoactive hormones from tumors. Accordingly, many guidelines recommended perioperative octreotide, both as prophylaxis against and as first line treatment for crises that still occur. Multiple studies have since shown octreotide does not prevent crisis and guidelines have begun to stop recommending prophylactic octreotide. In contrast, anesthesiology and other guidelines continue recommending octreotide as first line treatment for crisis. However, the effectiveness of octreotide for treating crisis has not been separately analyzed in any large series. Based on recent research showing there is no release of hormones during crisis, we hypothesize octreotide is not an effective treatment for crisis.

Methods: A prospectively maintained carcinoid anesthesia database was analyzed for documented crises. Outcomes were compared between operations during a protocol when patients received a prophylactic octreotide infusion and first line treatment for crisis was bolus intravenous octreotide and during a subsequent protocol when vasopressors were first line treatment and no octreotide was administered. Statistical significance of differences in outcomes were determined using Student's t-test, Mann Whitney U-test, and Fisher's exact test.

Results: Among 150 consecutive operations when octreotide was first line therapy, crisis occurred during 45 (30%) and the median crisis duration was 6 minutes. The mean number of octreotide boluses administered was 2.1 and 43 patients (96%) required subsequent vasopressor administration to resolve crises. Twelve patients (27%) had crises lasting > 10 minutes. Among 195 consecutive operations when vasopressors were first line treatment and no octreotide was administered, crisis occurred during 49 (25%) (p=NS), the median crisis duration was 3 minutes (p<0.001), and no crises lasted > 10 minutes (p<0.0001).

Conclusions: Octreotide was ineffective as first line treatment of crisis with nearly all patients also requiring vasopressors to resolve crisis and many patients having crises lasting > 10 minutes. Vasopressors as first line treatment resulted in significantly shorter crises with no crises lasting > 10 minutes. Vasopressors, not octreotide, should be first line treatment for intraoperative carcinoid crisis and guidelines should be changed accordingly.

28. Radiofrequency Ablation of Thyroid Nodules; A Prospective Multi-Institutional North American Experience

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Background: Radiofrequency ablation (RFA) for benign thyroid nodules aims to achieve a volume reduction ratio (VRR) of $\geq 50\%$. However, the factors which predict treatment success have not been defined in a large-scale study.

Methods: RFA data from three American academic institutions were studied. Mann-Whitney U, Wilcoxon rank sum, and correlation coefficient tests were used to analyze the impact of predictor values on VRR at 6 and 12 months.

Results: A total of 407 nodules were analyzed to assess the impact of predictor variables on VRR. Median VRRs at 6 and 12 months were 66.90% (IQR 50.89-81.75) and 70.77% (IQR 53.47-82.06) respectively. By 6 months, 75.15% of nodules had achieved a VRR $\geq 50\%$, and 88.95% at 12 months. Factors that significantly impacted VRR were nodule vascularity, original volume, and energy delivered. Nodules achieving $\geq 50\%$ VRR at 6 months had significantly smaller median original volume (10.38 ml, IQR 4.1-24.4) compared to those that did not achieve $\geq 50\%$ VRR (16.42 ml, IQR 3.2-45.5, $p < 0.001$). Those achieving VRR $\geq 50\%$ at 12 months had increased median energy delivered (1917 J/ml [IQR 1255- 3054] vs 1191 J/ml [IQR 1054-2008], $p = 0.01$) and peripheral vascularity rather than internal vascularity ($p < 0.001$). Complications included temporary voice changes (1.72%), nodule rupture (0.74%), vasovagal response (0.74%), and a single case of hemorrhage into the nodule (0.25%).

Conclusions: This is the largest North American cohort of thyroid nodules that underwent radiofrequency ablation at three North American academic institutions. The factors of nodule vascularity, original volume and energy applied have significant impact on VRR.

29. Normocalcemic Hyperparathyroidism: Intervention to Differentiate Primary from Secondary Hyperparathyroidism

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Background: Primary hyperparathyroidism (PHP) is classically defined as hypercalcemia with inappropriately elevated parathyroid hormone (PTH) levels. Normocalcemic hyperparathyroidism can occur but should not be considered an indication for surgery until common etiologies for secondary hyperparathyroidism are comprehensively excluded. Calcium deficiency is an under-recognized cause of normocalcemic hyperparathyroidism, and we aim to determine if implementation of a preoperative calcium challenge can be used to reduce unnecessary parathyroidectomy.

Methods: Consecutive series of patients referred for parathyroidectomy were reviewed (1/21-6/22) and inclusion criteria were those with normocalcemia (serum calcium <10 mg/dL) and concurrently elevated PTH levels. Therapy with supplemental calcium and vitamin D3 was routinely recommended, and follow-up laboratory studies assessed.

Results: A total of 29/314 (9%) patients had normocalcemic hyperparathyroidism with mean calcium, PTH, and vitamin D 25OH of 9.5 ± 0.3 mg/dL, 109.9 ± 34.9 pg/mL, and 42.7 ± 23.8 ng/mL. Confounding factors included eGFR <60 in 2, loop diuretic use in 4, and 4 had prior gastric bypass or gastric sleeve surgery. Supplemental calcium with ongoing vitamin D3 was systematically recommended for all 29, and at least 1 follow-up biochemical evaluation was completed for 27 (92%) (mean time 8.0 mo, range 1.9-16.4). Results were unchanged in 9 patients (33%), normalization of PTH levels with persistently normal calcium levels in 13 (48%), and hypercalcemia with elevated PTH levels (classic PHP) in 5 (19%). Compared to classic PHP patients, those with normalized PTH and calcium had no differences in pre-intervention calcium ($p=0.11$), PTH ($p=0.9$), or vitamin D 25OH ($p=0.6$) levels. However, post-intervention, and compared to patients with normalized levels, those with classic PHP had higher mean levels of calcium (10.2 ± 0.3 vs. 9.6 ± 0.03 , $p=0.002$) and PTH (81.9 ± 20.5 vs. 56.8 ± 18.3 , $p=0.03$) with no difference in vitamin D 25OH (44 ± 7.8 vs 45 ± 13.9 , $p=0.88$). Parathyroid exploration has been completed for 1 of 5 classic PHP patients to date.

Conclusions: A preoperative calcium challenge was prospectively initiated in normocalcemic hyperparathyroidism patients with high compliance (92%). Short interval calcium supplementation uncovered ~50% who had resolved secondary hyperparathyroidism which avoided unnecessary surgery while classic PHP was unveiled in at least 20% allowing for prompt and correct surgical intervention.



POSTERS

◆ Denotes Resident/Fellow Competition Poster

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

◆01. Unmet Needs of Family Members and Patients with Adrenocortical Carcinoma

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Background: Quality of life is reduced in patients with adrenocortical cancer (ACC). No studies have examined unmet needs (UNs) in this cohort. We hypothesized patients and their family members/significant others have UNs in multiple domains, including issues unique to ACC.

Methods: Electronically distributed 60 question cross-sectional surveys of adult patients with ACC and their family members/significant others using the validated Cancer Survivor and separate Family Unmet Needs instruments assessed six domains. Eight ACC-specific questions were added. Data was reported using descriptive statistics, with comparisons made using Pearson Chi-square test and regression analysis (significance, $p \leq 0.05$).

Results: 68 patients and 48 family members responded. Mean time from diagnosis was 45 (± 4) months. 67% of patients underwent surgery. 23% of patients had active disease. 95% of all respondents reported at least one UN (76% information, 85% medical care/logistical, 90% emotional, 88% relationship, 72% financial, 85% treatment-related needs). 45% had UNs across all domains.

Patients

30% reported needing assistance with travel arrangements to a center with more experience (only 46% had financial means to travel). Current use of mitotane (34%) and shorter time since diagnosis were predictors of increased UNs ($p = 0.05$, $p=0.03$). 35% taking mitotane reported needing more information about mitotane and also had increased emotional and relationship needs ($p=0.05$, $p=0.05$). Shorter time since surgery or not having undergone surgery were associated with increased emotional needs ($p=0.03$, $p<0.01$). 80% noted positive aspects resulting from their journey with ACC. 50% requested assistance regarding spiritual beliefs. 45% reported wanting to seek additional support prompted by taking the survey.

Family members/significant others

Patients never needing to take mitotane (50%), longer time since diagnosis and shorter time since surgery were predictive of increased UNs ($p=0.02$, $p=0.01$ and $p<0.01$). 88% desired more information overall. When mitotane was prescribed, 82% reported the need for more information about mitotane. No mitotane use was associated with increased need for information versus mitotane use ($p=0.012$).

Conclusions: Those affected by ACC have unmet needs across multiple domains, most commonly treatment related information and emotional/relationship support. These results provide a framework for further investigation to ultimately provide better comprehensive care.

◆02. Genetic Testing Referral Rates for Pheochromocytoma and Paraganglioma in a Single Academic Center

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Background: Although guidelines recommend genetic testing for all patients with pheochromocytoma or paraganglioma, compliance is variable. Potential barriers to referral include cost, lack of physician awareness, and availability of genetic counseling. The purpose of our study was to determine clinical and patient factors that influence the referral rate for genetic testing.

Methods: Retrospective, single-institution study of patients who underwent resection of a pheochromocytoma or paraganglioma from September 2012 to September 2022. Primary outcome was referral rate for genetic testing. Patient demographics, tumor size and location were evaluated to identify predictors of genetic test positivity.

Results: Among 231 patients, 71% were referred for genetic testing and 62% completed testing. Compared to those age 50+, patients under age 50 were more likely to be referred for genetic testing (81% vs 65%, $p=0.01$). Compared to those with Medicare/Medicaid, patients with private insurance were more likely to be referred for testing (73% vs 42%, $p=0.01$). Patients with abdominal paragangliomas were more likely to be referred for genetic testing than those with cervical and thoracic paragangliomas (75% vs 47%, $p=0.01$), which may be related to differences in the primary team responsible for management. Of 64 patients with pheochromocytoma who underwent genetic testing, 14 (22%) had a positive result: RET 29%, VHL 21%, NF1 21%, SDHD 14%, and SDHB 7%. Patients younger than age 30 with pheochromocytoma were more likely to have positive genetic testing results than patients age 30+ (50% vs 17%, $p=0.02$). Of 38 patients with paraganglioma who underwent genetic testing, 17 (45%) had a positive result: SDHB 47%, SDHD 29%, SDHA 12%, MSH6 12%, and TMEM127 6%. Among patients who underwent a genetic test, those with a paraganglioma were more likely to have a positive genetic test compared to those with a pheochromocytoma (45% vs 22%, $p=0.02$).

Conclusions: Almost half of patients with paraganglioma and one-fourth of those with pheochromocytoma were found to have germline mutations, reinforcing the recommendation to consider universal genetic testing. Demographic, insurance, and anatomic factors influence the likelihood of referral for genetic testing and may present opportunities to increase equity in the management of these tumors.

◆03. A 1:1 Matched Comparison of Posterior Retroperitoneal Adrenalectomy with Lateral Transabdominal Adrenalectomy

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Background: Current guidelines recommend selecting either a posterior retroperitoneal (PRA) or a lateral transperitoneal (LTA) approach for adrenalectomy based on tumor size, patient anthropometric parameters and surgeon expertise. Prior studies suggested that PRA offers a shorter operation and a faster recovery. Nevertheless, these studies are limited by their sample size and unequal patient characteristics. The aim of this study was to compare the outcomes of robotic PRA and LTA using a 1:1 matched analysis.

Methods: With IRB-approval, patients who underwent robotic PRA were matched 1:1 to patients who underwent robotic LTA between 2008 and 2022 at a single center. Matching factors included diagnosis, tumor size, distance between skin and Gerota's fascia and perinephric fat thickness. Perioperative outcomes were compared between groups using Chi-square and Wilcoxon Rank Sum tests. Continuous data are presented as medians.

Results: Seventy-seven patients in each group were matched for diagnosis (adrenocortical adenoma (77.9%), pheochromocytoma (13%), malignancy (6.5%), and others (2.6%), $p=0.99$), tumor size (2.8 vs 2.9 cm, $p=0.89$), distance between skin and Gerota's fascia (4.8 vs 4.9 cm, $p=0.32$) and perirenal fat thickness (1.1 vs 1.0 cm, $p=0.73$). Gender, bilaterality and rate of previous ipsilateral abdominal quadrant surgery were similar between groups. Patients in PRA group were younger (53 vs 59 years, $p=0.03$). There was no difference between PRA and LTA groups, respectively, in terms of operative time (134 vs 128 min, $p=0.64$), conversion to open (0% vs 0%, $p=0.99$), morphine milligram equivalents (MME) used (18 vs 20 MME/day, $p=0.72$), pain level on post-operative day 1 (Visual Analog Scale 5 vs 6, $p=0.14$), length of stay (1 vs 1 day, $p=0.48$) and 90-day complications (2.6% vs 3.9%, $p=0.65$). Estimated blood loss for PRA was statistically lower (5 vs 10 mL, $p=0.001$) but not considered to be clinically significant.

Conclusions: Perioperative outcomes of LTA, including those related to recovery, were similar to those of PRA when matched for tumor and patient anthropometric parameters. Therefore, other factors, such as anticipated challenges in exposure and vascular proximity, along with tumor size, bilaterality and adhesions, need to be considered when selecting the best approach for adrenalectomy in a given patient.

◆04. Posterior Retroperitoneoscopic Adrenalectomy Does Not Lower Pain or Opioid Use Compared to Transabdominal Adrenalectomy

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Background: Both laparoscopic transabdominal adrenalectomy (LTA) and posterior retroperitoneoscopic adrenalectomy (PRA) have been proven to be safe and effective approaches. A reported advantage of PRA is less postoperative pain, however there has been limited research directly investigating this claim. Therefore, we sought to compare postoperative pain and opioid use in LTA versus PRA.

Methods: Perioperative (intraoperative and 48 hours postoperative) analgesic use and patient reported numeric pain rating scale (NRS) scores were evaluated for all laparoscopic adrenalectomies performed between 2015-2021 at a single academic, tertiary hospital. Operations requiring conversion to open were excluded. Opioid use was calculated as Morphine Milligram Equivalents (MME). For reference, 5mg of oxycodone is equivalent to 7.5MME. Multivariate linear regression was performed to evaluate associations with opioid use and patient demographics and comorbidities, past surgical history, tumor characteristics, and surgical approach.

Results: A total of 126 adrenalectomies were evaluated, of which 88 (70%) were LTA and 38 (30%) PRA. The population was 58% female with an average age of 54 (SD 13). Of the adrenal tumors resected, 75% were functional and the average tumor size was 3.4 cm (SD 2.4). Length of stay by approach was similar, with 78% of LTA discharged by postoperative day 1 compared to 87% of PRA ($p=0.48$); 95% of both groups were discharged by postoperative day 2.

There was no significant difference between surgical approach in average reported postoperative pain score, either at rest (4.3 LTA vs. 4.2 PRA, $p=0.67$) or with activity (4.8 LTA vs. 5.3 PRA, $p=0.19$). Controlling for other factors, patients undergoing LTA used 10.7 MME (95%CI -19.1-40.5) more opioid on average than PRA, although this was not statistically significant. The most significant factor associated with increased opioid use was large tumor size ($>4\text{cm}$ 48.1 MME more vs. $<1\text{cm}$ [(95%CI 4.0-92.2)]).

Conclusions: There is no significant difference in immediate postoperative pain experienced or opioid used between PRA and LTA. Our next step is to investigate opioid used outside of the hospital and long-term pain consequences, if any, to fully compare the two approaches.

◆05. Slipping Through the Cracks: Use of Natural Language Processing to Retrospectively Identify Adrenal Incidentalomas

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Background: Cross-sectional imaging frequently identifies concerns unrelated to the original indication. Adrenal gland “incidentalomas” (AGI) are present in approximately 5% of scans, with follow-up imaging and biochemical evaluation infrequently performed historically. This study utilized a natural language processing (NLP) algorithm to identify rates of follow-up imaging and biochemical evaluation for AGIs.

Methods: Radiology reports of patients undergoing axial imaging from July 2020-June 2021 were queried using NLP to identify AGIs. Patients' records were reviewed to determine date of first detection and whether follow-up imaging and biochemical evaluation (aldosterone, renin, cortisol, or catecholamine testing) were performed. Descriptive and comparative statistics subsequently summarized the data.

Results: AGIs were identified in 1,784 patients. Mean age was 64 years; 51% were female. While the majority (n=1,134, 64%) of patients underwent later cross-sectional imaging, only 11% received imaging specifically for adrenal follow-up and 13% underwent any biochemical evaluation. Younger age was associated with biochemical evaluation (61.4yrs vs 64.5yrs, p<0.001), but not follow-up imaging (64.3yrs vs 63.7yrs, p=0.45). Females had higher rates of imaging and biochemical follow-up (53.3% vs 46.7%, p=0.01; 16.3% vs 10.6%, p<0.001, respectively). Larger nodules (3-4cm) were more likely to have both follow-up imaging (71% vs 57% for 1-2 cm, p=0.01), and biochemical evaluation (30% vs 11% 1-2 cm, p<0.001). Patients whose AGI was first detected during the study period (n=925) were less likely to have follow-up imaging than previously detected nodules (41% vs 87%, p<0.001). Patients with previously detected nodules were more likely to receive biochemical evaluation (22% vs 6%, p<0.001) and had a mean 1.5 adrenal-specific follow-up scans. Patients with malignancy were more likely to have any follow-up imaging (32.9% vs 7.5%, p<0.001), while patients whose initial indication was for adrenal mass were most likely to have adrenal-specific imaging (46.5% vs 5.9%, p<0.001). Trauma patients had the lowest rates of any (2.38% vs 9.8%, p<0.001) and adrenal-specific follow-up imaging (0.5% vs 10.0%, p=0.001).

Conclusions: Gaps still exist regarding identification, natural history and comorbidities in patients with AGIs. With low rates of biochemical and subsequent imaging for adrenal nodules, further efforts should ensure that patients with adrenal nodules receive appropriate care.

◆06. Cost Benefit Analysis of Outpatient Adrenalectomy: A Propensity Matched Cohort Study Utilizing NSQIP

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Background: Outpatient minimally invasive (MIS) adrenalectomy has previously been shown to be safe to perform without increased risks of complication. However, the rate of outpatient MIS adrenalectomy remains low in the United States. Our aim was to investigate the cost-benefit of increasing the rate of outpatient adrenalectomy (OA) at the national level.

Methods: The National Surgical Quality Improvement Program database (2014-2018) and an institutional database (2012-2022) were used to identify patients undergoing MIS adrenalectomy. A quasi-experimental study was conducted performing propensity score matching on gender, age class, race, BMI class, ASA class, and surgical indication using ICD9/10 diagnosis codes resulting in matched cohorts of OA and inpatient adrenalectomy (IA). Using the matched patients, hospitalization and 30-day outcome rates were estimated, and costs were determined using institutional data. A decision model was constructed to evaluate the cost-benefit of increasing the rate of OA in the United States. Sensitivity analysis was performed to examine the uncertainty of cost, probability, and utility estimates in the model.

Results: Of 4,140 patients undergoing MIS adrenalectomy in the study period, 224 (5.4%) underwent OA. Of the OA patients, 77.6% were for functional lesions with the most common indication being for aldosteronoma (23.9%), followed by Cushing's (15.9%) and pheochromocytoma (15.9%). There were no statistically significant differences between the two groups in 30-day outcomes. The dominant strategy was OA with the cost per OA of \$11,587-\$14,587 compared to \$15,847-\$18,847 for the median length of stay of 2 days for an IA. Microsimulation modeling over 5,000 patients with double and triple rates of OA demonstrated a range of cost savings of \$1,201,222-\$3,540,665. Sensitivity analysis demonstrated that OA was the preferred strategy in 100% of scenarios.

Conclusions: Using data-driven theoretical modeling, OA was determined to show considerable cost benefit while maintaining safety when compared to IA.

◆07. Access to Subspecialist Endocrine Care – Should I Call the Surgeon or the Endocrinologist First?

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Background: COVID-19 exacerbated chronic issues surrounding access to care, and access to endocrine care is no exception. However, unlike many subspecialties, patients can access endocrine care through a medical or surgical subspecialist. Our goal was to evaluate current regional access to care for surgical endocrine disease.

Methods: An internet search was used to identify all fellowship-trained medical and surgical endocrine providers in Colorado and Wyoming. An IRB approved telephone survey was used to gather data on first available appointments for thyroid cancer, hyperthyroidism, hyperparathyroidism, and thyroid fine needle aspiration, as well as availability of language interpretation services and acceptance Medicare/Medicaid. Practice demographics were obtained from their websites. All individual provider and practice data was de-identified for analyses. Differences in practice demographics and access to care between endocrine surgeons and endocrinologists were evaluated using standard statistical methods.

Results: Seven endocrine surgeons and 74 medical endocrinologists were identified. Endocrine surgeons were more likely to be associated with academic or urban multidisciplinary community centers. Seven surgeons (85.7%) and 58 endocrinologists (78.3%) were accepting new patients and successfully surveyed ($\chi^2=0.545$, $p=0.46$). The mean times to first available appointments between surgeons and endocrinologists were much shorter for all conditions surveyed: thyroid cancer (9.67 vs 117 days, $p<0.001$); hyperthyroidism (10.5 vs 124 days, $p<0.001$); hyperparathyroidism (10.5 vs 124 days, $p<0.001$). Endocrinologists were more likely to perform in-office thyroid FNA, but not significantly so (33% of surgeons vs 79% of endocrinologists, $\chi^2=0.013$, $p=0.09$).

Conclusions: Despite having relatively few fellowship-trained endocrine surgeons, patients in Colorado and Wyoming can access subspecialty endocrine care significantly faster through a surgical referral. These data support primary care providers referring directly to an endocrine surgeon rather than to an endocrinologist for work up and definitive care of conditions for which a surgical intervention may be indicated. Additional research is needed to identify the factors behind the disparity in wait times between surgical and medical endocrine providers.

◆08. Mapping Thyroid and Parathyroid Surgery for Medicare/Medicaid Beneficiaries and the Elderly: Analyzing Workforce and Population Changes From the Past Decade.

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Background: Medicare/Medicaid beneficiaries (MCB) and the elderly are implicated to be at higher risk for worse outcomes following thyroid and parathyroid surgery and to undergo operations by lower-volume surgeons. Over the past decade, there has been an influx of endocrine-focused surgeons entering the workforce but scant data reflecting their impact on underserved populations. We examined the distribution of these surgeons over time with respect to population changes, including implications for MCB and the elderly.

Methods: Comprehensive Center for Medicare and Medicaid datasets from 2012 to 2020 were utilized to identify the number of thyroidectomies and parathyroidectomies performed for MCB. High-volume surgeons were characterized by specialty, year entering practice, practice type, and geography. United States Census data were used to plot state-level population changes during the study period.

Results: From 2012-2020 the number of HVS expanded from 851 to 970 (14%). By 2020, HVS were practicing in 48 states and HVS per 1 million population increased significantly overall ($p < 0.05$). However, twelve states experienced a decline in HVS per 1 million population and three states remaining stable, including: six states that rank in the top twenty for elderly populations, five for Medicare, four for Medicaid, and five states that experienced population growth $>400,000$. Over nine years, 238,813 thyroidectomies and 174,040 parathyroidectomies were performed for MCB; HVS performed 11% and 45%, respectively. From 2013 to 2019, thyroidectomies by HVS decreased from 14% to 11% and representation of HVS declined from 6% to 4% (both $p < 0.05$). By contrast, parathyroidectomies by HVS increased from 42% to 49% and representation of HVS grew from 7% to 9% (both $p < 0.05$). In 2013, 86% of thyroidectomies and 58% of parathyroidectomies were performed by surgeons who performed ≤ 10 /year compared to 89% and 51% in 2019, respectively (both $p < 0.05$).

Conclusions: Despite notable expansion of the HVS workforce over the previous decade, most thyroidectomies for MCB and the elderly are performed by surgeons who performed ≤ 10 /year; whereas, a greater proportion of parathyroidectomies are shifting towards HVS. Expansion of the HVS workforce does not match population demands, specifically for MCB and the elderly, and strategic opportunities to improve access for underserved populations persist.

◆09. Somatostatin Receptor 2(SSTR2) Targeted and Drug Combination Delivery for Neuroendocrine Cancer Therapy

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Background: Neuroendocrine tumors (NETs) frequently metastasize to the liver, and more than 50% of patients have metastatic disease at diagnosis. Chemotherapy, radioembolization and cryoablation show limited efficacy, thus other forms of therapy are warranted. Somatostatin receptor 2 (SSRT2) is expressed in about 70% NETs and is an ideal target to treat primary and metastatic NETs. To specifically target and treat SSTR2 positive NETs we developed a new monoclonal antibody (mAb) that selectively binds to SSTR2, established mAb tagged exosomes (mAb-Exo) as a drug delivery vehicle, identified a natural compound originating from marine sponges (VC-A) capable of inhibiting NE cancer cell proliferation, and combined this novel compound with conventional anti-NE cancer drug (VP-16).

Methods: NET cell lines (BON and H727) and non-cancerous cells: pulmonary fibroblasts (WI-38) and normal thyroid cells (Nthyori) were treated with VC-A or VP-16 for 72 hours and an MTT assay was used to determine IC50 values. Western blot and Annexin V binding were used to assess anticancer effects of VC-A on NET markers and cell viability respectively. Flow cytometry was used to determine cell cycle effects, and Western blot was utilized to analyze treated cell lysates. Anti-SSTR2 mAb-Exo were generated in HEK293 cells and purified. Cancer specific targeting of SSTR2-mAb-Exo was determined in a NET xenograft mouse model by IVIS imaging 24 hrs post-injection.

Results: VC-A demonstrated a low nanomolar IC50 against BON and H727. Over 10-fold higher dose was required to induce cytotoxicity in WI-38 and Nthyori. VC-A decreased NE cancer markers, reduced anti-apoptotic, cell cycle and active p-AKT proteins in BON cells. Additionally, VC-A treatment decreased BON cells viability by inducing cell cycle arrest at S-phase, triggering apoptotic events. Western blot showed a decrease in AKT/mTOR phosphorylation. Combination VC-A and VP-16 potentiated cell cycle arrest in G1 phase and apoptosis. IVIS imaging of tumor and important organs showed that mAb-Exo specifically targeted NETs. The BON tumor growth was significantly attenuated in the mAb-Exo-VC-A/VP-16 group compared to mAb-Exo-VP-16 and mAb-Exo groups.

Conclusions: VC-A showed promise as a potential new therapeutic compound increasing the efficacy of a currently approved treatment, VP-16, through toxicity potentiation. The SSTR2 mAb-Exo system delivered potent drugs directly to NET and reduced xenograft growth and systemic toxicity.

◆10. Understanding Transcriptional Regulation of Notch3 Signaling in Pancreatic Neuroendocrine Tumor Cells

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Background: Pancreatic neuroendocrine tumors (pNETs) arise from the endocrine cells in the pancreas. The 5-year overall survival for patients with advanced disease remains less than 30%, warranting detailed investigations into new treatment strategies. The Notch pathway is a cell-cell communication pathway with four isoforms. Notch signaling is dysregulated in pNETs and may serve as a therapeutic target. The Notch3 receptor regulates the Notch1 receptor, leading to changes in cancer cell behavior. In this study, we aimed to uncover transcription factors critical for Notch3 expression in pNETs.

Methods: To determine critical promotor regions required for Notch3 expression, we performed a deletion mapping analysis. Luciferase reporter constructs harboring various deletion fragments of the Notch3 promoter were transfected into pNET cells. A bioinformatic analysis was done to predict transcription factors able to bind different regions of interest. Transcription factor candidates were confirmed by an electrophoresis mobility shift assay (EMSA), mass spectrometry, and siRNA knockdown.

Results: Luciferase activity was lost in pNET cells containing Notch3 promoter constructs less than 182bp from the transcription start site, indicating a segment between -157bp and -114bp contains the active transcription factor binding site. An EMSA assay using a biotinylated oligonucleotide probe against the Notch3 promoter region of interest mixed with pNET nuclear extract showed a shifted band, suggesting the presence of a critical transcription factor. To delineate transcription factor candidates, bioinformatic analyses returned 30 unique TFs, including CTCF and BORIS, that could bind the DNA sequence of interest. Mass spectrometry on the shifted EMSA band confirmed the presence of CTCF and BORIS. Knockdown of BORIS by siRNA reduced Notch3 gene expression in pNET cells, showing that BORIS promotes Notch3 expression. Overall, we have found that Notch3 gene transcription is regulated via the transcription factors CTCF and BORIS that bind a specific region from 114 to 157 base pairs upstream of the Notch3 transcription start site.

Conclusions: This study provides mechanistic evidence regarding the regulation of the Notch3 gene in pNETs. Notch signaling is disrupted in neuroendocrine cancers and modulation of the pathway may yield therapeutic benefit.

◆11. The Role of Demographic and Clinical Factors in Germline Mutation Testing for Patients with Primary Hyperparathyroidism

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Background: Genetic counseling is recommended in primary hyperparathyroidism (pHPT) based on age, multi-gland disease (MGD), and personal or family history (FHx), although current guidelines and clinical practices vary. The aim of this study was to examine genetic counseling referral patterns and rates of germline mutations in patients operated on for pHPT.

Methods: A single institution review was performed of adult patients who underwent parathyroidectomy for pHPT between 1/16-9/22. Genetic testing referral criteria included age (hypercalcemia onset \leq 40 years), MGD, FHx of pHPT, or personal history suspicious for a pHPT-related endocrinopathy. Patients with known germline mutations were excluded. Genetic counseling and testing rates were examined by indication and demographics, including the Area Deprivation Index (ADI) using neighborhood income, education, employment, and housing quality socioeconomic data.

Results: Of 1210 patients with presumed sporadic pHPT, 560 (46.3%) met study criteria. Median age was 63.0 (IQR 51.3,69.8) years. Genetic counseling was discussed with in 329 (58.8%); 218 (38.9%) underwent counseling and 207 (37.0%) had testing.

There were no differences in sex, race/ethnicity or ADI scores among patients who received counseling (n=218), had counseling discussed but not performed (n=111), or did not have discussion of counseling (n=231). Patients who had no discussion were older (median age 67.0 (IQR 60.4,72.2)) and most frequently had MGD as the sole indication (n=210; 90.9%) compared to counseling discussed/not performed (62.1 (IQR 50.1,71.3); n=55, 49.5%) and counseling only groups (54.4 (IQR 43.0,66.3); n=49; 22.5%) [all p<0.001].

Germline mutations were identified in 7 (3.4%) of 207 patients tested (1.3% (7/560) of the cohort). Identified mutations were: MEN1 (2; 28.6%), CDC-73 (4; 57.1%), and CASR (1; 14.3%). Mutations were most common in patients with FHx (4/82; 4.9%), followed by age (4/127; 3.1%) and personal history (2/68; 2.9%). Of those tested for age alone, 2 patients were <30 years. No mutations were identified in 40 patients tested postoperatively solely because of MGD.

Conclusions: In this study of surgical patients with pHPT, 3% had germline mutations, all with either a suggestive personal/FHx or age <40. No germline mutations were identified in patients with only MGD; further investigation of MGD as the sole indication for genetic counseling is needed.

◆12. Should the Extent of Parathyroidectomy Depend on Age?

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Background: It is traditionally taught that the prevalence of multiglandular parathyroid disease (MGD) increases with age. Studies have reported a general association between the two variables, but none have thoroughly examined how MGD prevalence changes across decades of life. The lack of a national comprehensive database on parathyroid disease makes evaluation of MGD difficult, as many studies are limited by small sample sizes. In this study, we compare the prevalence of multiglandular parathyroid disease across age decades, with the goal of better describing the relationship between MGD and age.

Methods: An institutional database of patients who underwent surgery for primary hyperparathyroidism (PHPT) from 2000 to 2021 was reviewed. Patients with multiple endocrine neoplasia syndrome were excluded. Patients were separated into age groups based on their decade of life. Disease etiology was compared across age groups using logistic regression with adjustment for preoperative creatinine level.

Results: We identified 2340 PHPT patients with etiologies for their hyperparathyroidism listed. Of these, 1577 (67.4%) had single adenomas, 274 (11.7%) had double adenomas, and 489 (20.9%) had hyperplasia. Single gland disease (SGD) prevalence remained $\geq 60\%$ throughout each decade of life, and steadily increased from the 6th (65%) to 10th (100%) age decade ($p=0.002$). Parathyroid hyperplasia prevalence was highest (40%) for patients in the first decade of life, and generally decreased with age until the 5th decade of life (19%). Logistic regression revealed the odds of hyperplasia decreased by 7% with every 10-year increase in age (OR 0.93 [0.868, 0.998]), although this was not statistically significant after adjusting for preoperative creatinine level ($p=0.066$). The rate of unilateral exploration increased from the 3rd (36%) to 10th (75%) decade while the recurrence rate decreased from the 4th (8%) to 10th (0%) age decade.

Conclusions: Given the lack of a national comprehensive database on parathyroid disease, to our knowledge this study utilized one of the largest cohorts of surgical patients with primary hyperparathyroidism in the United States. We found that the prevalence of single adenomas increased with age and was 100% for patients in their tenth decade of life. Given that recurrence is less of a concern with advancing age, minimally invasive parathyroidectomy should be the operation of choice in elderly patients.

◆13. Heterogeneity of Patients With Primary Hyperparathyroidism: Implications for Interpretation of Intraoperative PTH

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Background: Assessing intraoperative cure of primary hyperparathyroidism based on predefined rules (such as 50% drop in PTH or 50% drop + normalization) assumes that intraoperative PTH dynamics are uniform for all patients. We used a novel finite mixture model to determine whether patient characteristics could cause heterogeneity in the relationship between changes in intraoperative PTH and long-term outcomes of parathyroidectomy, making it difficult to apply universal criteria to define intraoperative cure.

Methods: We analyzed 2,526 patients aged 18+ years who underwent parathyroidectomy for hypercalcemic primary hyperparathyroidism at our institution from 2001-2022. We used finite mixture models with up to four latent classes to identify unique subgroups of patients and to analyze the relationship between intraoperative PTH dynamics and normalization of postoperative calcium.

Results: The mean patient age was 62±13 years, 76% were women, mean preoperative calcium was 11±0.7 mg/dl, and mean PTH was 124±85 mg/dl. Intraoperative PTH levels were measured at baseline and 5, 10 and 15 minutes post-resection.

We identified four subgroups of patients with unique intraoperative PTH dynamics. Each of these groups was associated with unique demographic characteristics, pre-operative biochemical profiles, and cure rates ($p < 0.03$): (1) Early responders had the largest drop in PTH at 5 minutes, were most likely to attain a 50% drop in PTH (88%), but surprisingly had the lowest cure rate (91%, $p = 0.017$). (2) Intermediate responders had the largest drop in PTH between 5-10 minutes, were most likely to have hyperplasia (25%, $p < 0.001$), and had the highest cure rate (96%, $p = 0.017$). (3) Steady responders had similar changes in PTH at each PTH assessment and had baseline Ca/PTH levels between those of Early and Intermediate responders. (4) Late responders had the largest drop in PTH at 15 minutes, were more often men (43%, $p < 0.001$), and had the highest preoperative calcium.

Conclusions: We found considerable heterogeneity in how intraoperative PTH changes during parathyroidectomy. We also found that patterns of patient heterogeneity affect long-term outcomes of parathyroidectomy. The complexity and heterogeneity of patients with hyperparathyroidism suggests that the judgement of expert surgeons should not be replaced by any universal criteria to define intraoperative cure.

◆15. A Thorough Evaluation for Primary Hyperparathyroidism: More Than a Stone's Throw Away

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Background: Primary hyperparathyroidism (PHPT) is a treatable cause of nephrolithiasis. However, PHPT is not consistently evaluated in nephrolithiasis patients. Signs and symptoms of parathyroid disease were explored in relation to evaluation of PHPT in nephrolithiasis patients.

Methods: This retrospective review evaluated patients with nephrolithiasis on imaging at a single tertiary care center between 2017-2021. Charts were reviewed for measurement of serum calcium levels after nephrolithiasis was diagnosed. Patients with hypercalcemia (≥ 10.2 mg/dL) were identified, and patient characteristics associated with further evaluation with serum parathyroid hormone (PTH) levels and specialist referral were assessed.

Results: Of 808 patients studied, most (767, 94.9%) had calcium levels measured. Of 201 (26.3%) hypercalcemic patients, 56 (27.9%, $p < 0.001$) had PTH levels drawn. PTH was more often assessed in patients with higher median calcium levels (10.7 IQR[10.3-11.2] vs. 10.4 IQR[10.3-10.6], $p < 0.001$), symptomatic nephrolithiasis (58.9% vs. 42.8%, $p = 0.04$), and recurrent nephrolithiasis (44.4% vs. 17.0%, $p < 0.001$). Depression (42.9% vs. 26.9%, $p = 0.03$) and osteopenia/osteoporosis (25.0% vs. 7.6% $p < 0.001$) were associated with PTH assessment, whereas bone fractures, fatigue, and polyuria/polydipsia were not. PTH was most likely assessed in patients with stones, depression, and osteopenia/osteoporosis (OR 15.5, 95% CI 3.2-73.5) vs. stones and osteopenia/osteoporosis (OR 4.1, 95% CI 1.7-9.6) or depression (OR 2.0, 95% CI 1.1-3.9) alone. PTH levels were elevated (> 64 pg/mL) or non-suppressed (40-64 pg/mL) in the majority (32, 57.1%) of patients with levels assessed. Of these, 13 (32.1%) were referred to endocrinology. Referred patients had higher median PTH (79.5 IQR [30-128] vs. 42.5 IQR[25-65], $p = 0.01$) and calcium levels (10.9 IQR[10.7-11.6] vs. 10.5 IQR[10.3-11.1], $p = 0.02$) than those without referral. Nine (28.1%) hypercalcemic patients with elevated/non-suppressed PTH were referred for parathyroidectomy. The type or degree of symptoms were not associated with endocrinology or surgeon referral; however, few patients were referred overall.

Conclusions: PTH evaluation in hypercalcemic nephrolithiasis patients was low. The majority of these patients who were evaluated had elevated or non-suppressed PTH levels, but only a fraction were referred to endocrinology or surgery. Awareness of PHPT diagnosis and symptoms may improve workup, referral, and treatment of PHPT patients with nephrolithiasis and hypercalcemia.

◆16. Opportunistic Screening in Primary Hyperparathyroidism: Using 4-D CT to Estimate Bone Mineral Density

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Background: Primary Hyperparathyroidism (PHPT) affects bone metabolism increasing the risk of osteoporosis and fractures. Patients with PHPT commonly undergo four- dimensional computed tomography (4D-CT) for preoperative localization, granting the opportunity to evaluate bone morphology. We hypothesized that surgeons could use 4D-CT as an opportunistic screening tool for assessment of bone mineral density (BMD) to select patients requiring further evaluation.

Methods: We retrospectively identified patients with PHPT who underwent 4D-CT and dual-energy X-ray absorptiometry (DXA) scans at a single institution between 2014-2020. Hounsfield units (HU) of cervical and thoracic vertebrae were measured in 4D-CT by two independent observers. Interrater reliability was assessed, and correlation patterns between HU and DXA values were analyzed. Diagnostic accuracy of HU to predict bone mineral disease was assessed through receiver operating characteristic (ROC) curves.

Results: Of 253 screened patients, 53 had both 4D-CT and a DXA with scans no more than 1 year apart. 43 (81%) were female, with a mean age of 62.3 +/-7.6 years. By DXA, 10 patients (18.9%) had normal BMD, 23 (45.3%) had osteopenia, and 19 (35.8%) had osteoporosis. Interrater reliability was highest for thoracic vertebrae (0.91-0.98). HU were varied when comparing cervical vertebrae c3-c7 ($p < 0.001$) but were consistent when comparing across thoracic vertebrae T1-T4 ($p = 0.186$). HU for thoracic vertebrae were significantly different between patients with normal BMD, osteopenia, and osteoporosis by DXA ($p = 0.003$). Correlation coefficients between HU, BMD and t-score calculated from the hip ranged from 0.33-0.55 and were highest among thoracic vertebrae. AUCs varied from 0.71-0.87 and were highest in thoracic vertebrae. HU identified patients with bone mineral disease with optimal cut-off values of 254.1 HU [AUC=0.79 (95% CI: 0.64-0.94)] at T1, 231 HU [AUC=0.86 (95% CI: 0.73-0.98)] at T2, 230 HU [AUC=0.87 (95% CI: 0.76-0.98)] at T3, and 231.6 HU [AUC=0.86 (95% CI: 0.76-0.97)] at T4.

Conclusions: This is the first study to demonstrate that 4D-CT may be useful in evaluating BMD, with consistent measures and similar HU cutoff values found across T1-T4 for bone mineral disease identification, indicating that 4D-CT may aid surgeons in optimizing the use of localization studies in PHPT.

◆18. Development of a Machine Learning Model for the Diagnosis of Atypical Primary Hyperparathyroidism

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Background: Atypical primary hyperparathyroidism (PHPT), including normocalcemic and normohormonal variants, can be a diagnostic challenge. Clinically, factors in addition to calcium and parathyroid hormone (PTH) may aid in the diagnosis. We sought to create a machine learning model to predict the percent chance of a patient having PHPT for both classic and atypical forms.

Methods: The model was constructed from 672 patients with surgically proven PHPT (70% classic, 30% atypical) from a single institution and were compared to 3,393 controls from the National Health and Nutrition Examination Survey. Initial variables in the model were calcium and PTH, and then were supplemented with phosphorus, 25-OH vitamin D, gender and body mass index (BMI). The atypical subset was defined as calcium <10.3 mg/dL and/or PTH <65 pg/dL. A binary-outcome PHPT prediction model was generated using main-effects-only logistic regression. A random split (80/20 training/validation) was used to train and validate the model. The area under the receiver operating characteristic (AUC), sensitivity, specificity, positive (PPV) and negative predictive values (NPV) were calculated. The logworth score reflects the relative contribution of each parameter to the model.

Results: In classic PHPT, calcium and PTH alone predicted PHPT with almost 100% accuracy. In atypical PHPT, the training set achieved an AUC of 0.997 with calcium (logworth 62.5, $p < 0.001$), PTH (logworth 28.5, $p < 0.001$) and phosphorus (logworth 18.8, $p < 0.001$) contributing the most to the model. There was minimal impact of vitamin D (logworth 6.4, $p < 0.001$), gender (logworth 5.5, $p < 0.001$) and BMI (logworth 1.3, $p < 0.05$). In the validation set, the sensitivity, specificity, PPV and NPV were 86.8%, 99.8%, 97.05% and 99.4%, respectively.

Conclusions: This machine learning model reliably diagnoses PHPT in patients with atypical variants and is enhanced by using variables in addition to calcium and PTH. Incorporating this diagnostic tool into the electronic medical record could alert clinicians to the percent chance that a patient has PHPT for both classic and the more challenging atypical forms.

◆19. Treatment of Hypercalcemic Hyperparathyroidism After Kidney Transplantation Is Associated with Improved Allograft Survival

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Background: Persistent tertiary hyperparathyroidism (tHPT) after kidney transplantation (KT) is associated with allograft failure. Previous studies on managing tHPT were subjected to survivor treatment selection bias. The treatment of tHPT with regard to allograft function remains unclear. Therefore, we assessed whether treatment for hypercalcemic tHPT is associated with allograft survival.

Methods: Of 1264 transplant recipients (2015-2019), we analyzed 280 patients with elevated adjusted serum calcium and parathyroid hormone (PTH) after KT. Patients were characterized by treatment: cinacalcet, parathyroidectomy, or no treatment. Time-varying Cox regression with delayed entry at the time of first elevated calcium after KT was conducted to compare death-censored and all-cause allograft failure by treatment groups.

Results: Of the 280 recipients with tHPT, 49 (17.5%) underwent PTx, and 112 (40.0%) received Cinacalcet. The median (IQR) time from KT to first elevated calcium was 1 (0-4) months. The median (IQR) time from first elevated calcium to receiving cinacalcet and parathyroidectomy were 0 (0-3) and 13 (8-23) months, respectively. Fifteen patients failed cinacalcet management and subsequently underwent parathyroidectomy. There were no differences in patient demographic characteristics and donor kidney quality between groups. Patients who received no treatment had shorter dialysis vintage ($p=0.0017$) and lower PTH at KT ($p=0.002$), later onset of hypercalcemia after KT ($p<0.001$), PTH ($p=0.012$) and calcium levels at most recent follow-ups were significantly lower ($p<0.001$) in the PTx group. Treatment with PTx (adjusted hazard ratio (aHR)=0.18, 95%CI 0.04-0.76, $p=0.02$) or cinacalcet (aHR=0.14, 95%CI 0.004-0.47, $p=0.002$) was associated with lower risk of death-censored allograft failure. Age at transplant (aHR=1.02, 95%CI 1.003-1.05, $p=0.02$) and Medicare as primary insurance (aHR=2.95, 95%CI 1.14-5.89, $p=0.002$) were associated with increased risk of all-cause allograft failure, while receipt of PTx (aHR=0.28, 95%CI 0.12-0.66, $p<0.001$) or cinacalcet (aHR=0.38, 95%CI 0.22-0.66, $p<0.001$) was associated with lower risk (Figure 1) of all-cause allograft failure.

Conclusions: This study overcomes survivor treatment selection bias and demonstrates that treatment of hypercalcemic tHPT after KT is associated with improved allograft survival. Parathyroidectomy was more effective than cinacalcet in controlling hyperparathyroidism after kidney transplantation. Hypercalcemic hyperparathyroidism should be screened and treated following kidney transplantation to achieve this survival benefit.

◆20. Parathyroid Cryopreservation and Autotransplantation: Should We Abandon It?

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Background: Cryopreserved heterotopic parathyroid autotransplantation (CHPA) to treat surgically-induced hypoparathyroidism after total or subtotal parathyroidectomy, while conceptually appealing, is seldom performed. Given the complexity and reported high costs of hypoparathyroidism management, we evaluated the utilization and financial costs of CHPA over a 17-year period.

Methods: An IRB-approved, retrospective review of records was performed at our high-volume center to identify patients who underwent CHPA. Patient, operative, laboratory, and medication data, along with operating room and hospital cost information, were assessed.

Results: From August 2005 to September 2022, 591 patients underwent parathyroid harvest, yielding 604 samples that were cryopreserved for a mean of 31 months (range 1 – 183 months). Among 591 cryopreservation patients, only 10 (1.69%) underwent CHPA with 11 reimplantation procedures (one patient received CHPA twice). Mean age at time of CHPA was 44.1 years and 60% were male. Patients who underwent CHPA had primary and secondary hyperparathyroidism (50% each, respectively) as underlying diagnoses. One patient had multiple endocrine neoplasia type 1 (MEN1). The mean time from parathyroid cryopreservation to autotransplantation was 26.3 months (range 2.5 – 150.7 months). The site of heterotopic autotransplantation included the upper extremity (45.5%), abdominal wall (36.4%), and chest wall (18.2%). After CHPA, a rise in PTH and decrease in calcium supplementation requirement was noted in 44.4% and 60% of patients, respectively. Two (20%) patients had complete resolution of calcium supplementation requirements. For all 591 patients, the cost of initial freezing and cryopreserved storage was \$295,191 (mean \$499/patient) and \$284,591 (mean \$482/patient), respectively. Thawing 11 parathyroid samples cost \$7,090. Hospital and operating room costs were available for 7 of the 11 CHPA procedures and totaled \$30,707 (mean \$4,387, range \$2,094 - \$12,475). Cumulative cost of cryopreservation for 591 patients and autotransplantation for 10 patients was estimated at \$635,127.

Conclusions: To our knowledge, we report the largest single-institution parathyroid cryopreservation case series to date. Utilization of CHPA after cryopreservation was low, with mixed efficacy, and at substantial total cost. While select patients derive benefit from cryopreservation and CHPA, these data bring into question their population-level value. Thus, endocrine surgery centers should carefully consider the advantages and disadvantages of parathyroid cryopreservation.

◆21. The Use of Artificial Intelligence to Detect Parathyroid Tissue on Ex-Vivo Specimens

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Background: Recently, it has been suggested that near infrared autofluorescence (NIRAF) imaging could be used to decrease the number of frozen sections obtained to confirm parathyroid tissue during thyroidectomy and parathyroidectomy procedures. The aim of this study is to assess the ability of an artificial intelligence (AI) model to differentiate parathyroid tissue on surgical specimens.

Methods: With IRB approval, an image library of ex vivo specimens obtained in thyroidectomy and parathyroidectomy procedures was created between November 2019 and December 2021 at a single academic center. Ex-vivo AF images of surgically removed PGs, thyroid glands, lymph nodes and fibroadipose tissue were uploaded into an AI platform. Two different models were trained, with first model using AF images from all specimens, including thyroid and second model excluding thyroid to prevent specimen size influence on results. Deep learning models were trained to detect AF signals specific to PGs. Randomly chosen 80% of data was used training, 10% for validation and 10% for testing. Recall, precision and area under curve (AUC) of models were calculated. As a comparison to AI models, a logistic regression analysis was done to identify a cut-off based on the intensity of AF signals.

Results: First model, used 694 images from 405 patients (419 PGs and 275 non-parathyroid tissue). Recall, precision and AUC of model to differentiate parathyroid tissue from other specimens were 87%, 87% and 0.96, respectively. Positive predictive value was 94.6% for detecting PG and 78.1% for non-parathyroid tissue. Second model used 509 images (419 PGs and 90 non-parathyroid tissue). Recall, precision and AUC of this model were 92%, 92% and 0.97, respectively. Positive predictive value for detecting PG was 93.1% and non-parathyroid tissue 85.7%. Logistic regression analysis of manually calculated AF intensity, without AI, reported a sensitivity, specificity and AUC of 75%, 59% and 0.68, respectively, for detecting parathyroid tissue.

Conclusions: The visual deep learning model developed to identify parathyroid tissue in ex vivo specimens demonstrated a high sensitivity and positive predictive value. This has a potential to decrease the number of frozen sections obtained during thyroidectomy and parathyroidectomy procedures to confirm parathyroid tissue.

◆22. A Prospective Assessment of Near-Infrared Parathyroid Autofluorescence (NIRAF) in Total Thyroidectomy for a High-Volume Clinical Setting

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Background: Near-infrared autofluorescence (NIRAF) can improve parathyroid gland (PG) preservation in total thyroidectomy but the added benefit on its routine use (over standard care) among experienced endocrine surgeons remains unclear. The present study assessed the added benefit of NIRAF by comparing the number of in-situ PGs identified, PGs inadvertently removed and rate of hypoparathyroidism after total thyroidectomy between those with and without NIRAF by high-volume surgeons.

Methods: Over an 18-month period, consecutive patients undergoing elective total thyroidectomy with or without concomitant central neck dissection by two high-volume (>200 thyroid / parathyroid procedures per year) surgeons were assigned to either surgery with NIRAF (group I) or without NIRAF (group II), based on the availability of the NIRAF device (Karl Storz OPAL-1, Germany). Number of PGs identified, auto-transplanted and/or inadvertently-removed as well as postoperative calcium and PTH levels were compared. Transient hypoparathyroidism was defined as in-hospital serum adjusted calcium <8.0mg/dL. Permanent hypoparathyroidism was defined as the requirement of calcium and calcitriol supplement for >6 months to maintain serum adjusted calcium ≥ 8.0 mg/dL.

Results: Both group I (n=73, 53.3%) and II (n=63, 46.7%) had comparable baseline demographics and biochemistry. The PTH levels immediately, 4-hours and 1-day after operation, and Day-1 serum calcium were comparable ($p>0.05$). No significant difference in the rate of post-operative transient or permanent hypoparathyroidism were found between group I and II (6.8% vs 9.4%, $p=0.617$ and 0% vs 3.13%, $p=0.220$). Rate of inadvertent parathyroidectomy (5.48% vs 5.08%, $p=0.834$) and auto-transplantation (1.37% vs 3.12%, $p=0.161$) were also similar. Total number of in-situ PGs identified with NIRAF versus visual inspection was not different (117 vs. 117, $p=0.323$). Among the 19 PGs inadvertently-removed, NIRAF identified 3 additional PGs (1.2%) not seen by visual inspection. NIRAF tended to have a higher number of PG identified on the excised specimen (2.7% vs. 3.9%, $p=0.083$).

Conclusions: NIRAF was able to identify more inadvertently-removed PGs on the excised thyroid specimen than visual inspection alone. However, the added benefit of NIRAF over visual inspection alone in a high-volume clinical setting appeared to be limited. NIRAF did not appear to significantly lower hypoparathyroidism rate in total thyroidectomy.

◆23. Sentinel Lymph Node Detection in Thyroid Carcinoma Using 68Ga-tilmanocept PET/CT

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Background: Sentinel lymph node (SLN) biopsy (SLNB) is a diagnostic staging procedure not currently used in thyroid carcinoma. SLN imaging of the neck is challenging due to the shine through effect; the peritumorally injected radiotracer produces a large hotspot on conventional imaging, potentially hiding SLNs located close to the primary tumor. 68Ga-tilmanocept, a new tracer for SLN imaging using PET/CT, limits this effect. SLNB could select thyroid carcinoma patients for less or more extensive treatment depending on their nodal status. In differentiated thyroid carcinoma (DTC), there is a trend to use less postoperative radioactive iodine. SLNB could select patients who are not eligible for this deescalation of treatment. Standard treatment of medullary thyroid carcinoma (MTC) consists of total thyroidectomy with central neck dissection. A positive SLN in the lateral compartment would indicate an additional lateral neck dissection, possibly leading to cure. The aim of this study was to prove the concept of SLNB using 68Ga-tilmanocept PET/CT in thyroid carcinoma.

Methods: Ten thyroid carcinoma patients underwent preoperative 68Ga-tilmanocept PET/CT, 15 and 60 minutes after injection. The next day, SLNB was performed using ICG-99mTc-nanocolloid for intraoperative identification. The corresponding lymph node levels were resected for reference.

Results: Seven DTC and 3 MTC patients were included, of whom 4 had preoperatively proven metastases. On average, 2.7 (range 1-5) SLNs were detected on PET/CT and resected. Eleven SLNs were depicted in the central and 16 in the lateral neck compartment. The second PET/CT did not detect additional SLNs. SLNB detected (micro)metastases in all but one patient. Eighteen of 27 pathologically assessed SLNs were positive, 7 negative, and 2 did not contain lymph node tissue. Fourteen of 20 corresponding levels contained metastases, of which 2 corresponded to a negative SLN. Five out of 6 cN0 patients were upstaged due to the SLNB procedure. Additional resection due to the SLNB led to cure in one MTC patient.

Conclusions: 68Ga-tilmanocept PET/CT was able to depict SLNs in all patients. Using ICG-99mTc-nanocolloid the SLN were successfully detected intraoperatively and removed. SLNs were mostly located in the lateral neck. Although most patients had no preoperatively proven metastases, only one patient showed no (micro)metastases.

◆24. Intraoperative Pathologic Evaluation to Determine Extent of Surgery in clinically N0 Unilateral Papillary Thyroid Carcinoma

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Background: Although papillary thyroid carcinoma (PTC) has an indolent prognosis, central lymph node metastasis (CLNM) often occurs, which is associated with increased risk of local recurrence. Intraoperative pathologic evaluation (IOPE) can provide information regarding CLNM and help surgeons to determine the appropriate surgical extent. We detailed description of numbers and sizes of IOPE to evaluate the efficacy of IOPE and to determine risk factors associated with CLNM in clinically N0 unilateral PTC.

Methods: From May 2021 and July 2022, we retrospectively reviewed the medical charts of patients performed with prospective IOPE who were scheduled for lobectomy in Seoul National University Hospital. Depending on the number and size of CLNM on IOPE, total thyroidectomy was performed.

Results: Of the 351 patients, 104 (29.6%) and 137 (39.0%) were identified with CLNM on IOPE and in the final pathological result, respectively. The sensitivity and specificity of IOPE were 71.0% and 97.2%. Among 104 IOPE positive cases, 41 (39.0%) patients proceeded on to total thyroidectomy and 63 (61.0%) patients were performed with lobectomy due to the small number and size of CLNM in IOPE. Although there were 39 (39/247, 15.8%) false negative patients of IOPE, all of them except 2 cases showed low-risk PTC (<2 mm, ≤5 LN) according to American Thyroid Association 2015 guideline. Univariate analysis showed that male, younger age (<55 years), echogenic foci on preoperative ultrasonography, and size 1.0 were significantly associated with an increased risk of CLNM ($p=0.001$, $p=0.023$, $p=0.001$ and $p=0.004$, respectively). In multivariate analysis, male (HR: 1.907, $p=0.013$), size ≥ 1.0 (HR: 1.688, $p=0.037$) and echogenic foci (HR: 1.706, $p=0.022$) were significantly associated with increased the risk of CLNM.

Conclusions: The number and size of IOPE can provide more reliable information for surgeons to determine the surgical extent in unilateral PTC and avoid aggressive treatment. Moreover, male and echogenic foci on preoperative ultrasonography can be considered as predictive factors for CLNM.

◆25. Propensity Match Analysis of Lobectomy Versus Total Thyroidectomy in N1b Papillary Thyroid Carcinoma at a US Tertiary Cancer Center

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Background: Lateral cervical lymph node metastases from papillary thyroid carcinoma (PTC) are typically treated with total thyroidectomy (TT) + lateral neck dissection (LND) +/- central neck dissection (CND) in Western countries to enable radioactive iodine (RAI) ablation and serum thyroglobulin surveillance. However, thyroid lobectomy (TL) with isthmectomy + LND +/- CND is common in Japan due to a lack of RAI access, potential reduction in complication rates and understanding that most PTC cases are low-risk (1). The objectives of this study were to compare recurrence and survival outcomes in propensity matched TL and TT patients who presented with N1b PTC at a tertiary cancer center in the United States.

Methods: After IRB approval, patients with N1b PTC treated at a US tertiary cancer center between 1986 and 2015 were identified from a prospectively maintained thyroid cancer database. 706 patients who underwent TT + LND +/- central neck dissection (CND) and 35 patients who underwent TL + LND +/- CND were identified. Propensity score (PS) matching was undertaken to match patients on age, gender, PTC subtype, TNM stage, neck dissection and ATA risk. Kaplan-Meier and logrank test were used to compare outcomes.

Results: 35 eligible TL patients were identified and propensity matched to 35 TT patients. There was no significant difference between TL and TT in overall survival (10-year: 97.1% vs 95.0%, $p=0.21$), disease specific survival (10-year: 96.8% vs 100%, $p=0.31$) or recurrence free survival (10-year: 88.9% vs 89.7%, $p=0.93$). There was no significant difference in local, regional and distant recurrence between the matched cohorts ($p > 0.05$).

Conclusions: Survival and recurrence outcomes are equivalent when comparing TT and TL in patients with N1b PTC in our study. This supports the experience of centers in Japan and suggests TL + ND might be a safe and effective alternative to TT + ND in select patients with low-risk PTC. Studies with greater patient numbers are required to explore this finding further.

1) Ito Y, Miyauchi A. Prognostic factors and therapeutic strategies for differentiated carcinomas of the thyroid. *Endocr J.* 2009;56(2):177-92

◆26. Preoperative Evaluation Uncommonly Identifies Poorly Differentiated Thyroid Cancer

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Background: The recent increased utilization of thyroid ablative techniques has highlighted the importance of preoperative identification of high-risk subtypes of thyroid cancer. Poorly differentiated thyroid cancer (PDTC) is a rare but aggressive subtype of thyroid cancer that can be difficult to identify due to its heterogeneous presentation. The aim of this study is to understand whether current molecular testing and routine preoperative evaluation can identify high-risk subtypes like PDTC.

Methods: We retrospectively analyzed institutional data to identify patients with PDTC who had undergone molecular testing from 2010-2022. From 2010-2014 only BRAF testing was performed. From 2015-2022 it has been our institutions routine practice to obtain molecular testing on FNA specimens with indeterminate cytology and next-generation sequencing (NGS) on surgical pathology.

Results: 46 cases of PDTC were identified and 29 (63%) underwent molecular testing and were included in this study. 62% were female, and the mean age was 57.9 years. Preoperatively, 7% of patients had ultrasound findings of local invasion and 17% had confirmed locoregional or distant disease – in total only 6 patients (21%) had signs of aggressive disease pre-operatively. Cytopathology results included 7% Bethesda II, 14% Bethesda III, 41% Bethesda IV, 14% Bethesda V, and 14% Bethesda VI. All 7 patients with FNA specimens sent for molecular testing were classified as suspicious for malignancy. At the time of surgery, 14% had gross extra-thyroidal extension. 52% of patients underwent a total thyroidectomy. 48% underwent initial hemithyroidectomy, with 85% returning for completion thyroidectomy. The mean tumor size was 4.2cm, with 58% of tumors being <4cm. BRAF testing was performed on all 29 PDTC, of which 2 (7%) had mutations. Post-operatively NGS was performed on 20 tumors, with 60% having a RAS mutation (NRAS 30%, KRAS 15%, HRAS 15%). Additional mutations identified were PIK3CA 10%, PTEN 5%, TSC2 5%, and JAK3 5%. 30% had no mutations identified. There were no molecular markers that reliably identified patients with PDTC.

Conclusions: Nearly 80% of patients ultimately found to have PDTC had no signs of aggressive disease identified prior to surgery. Preoperative imaging, FNA, and current molecular testing is insufficient to rule out high risk thyroid cancer.

◆27. mRNA Expression Profiling Identifies MACIS-Derived Differentially Expressed Gene Signatures in Aggressive Stage T1 Papillary Thyroid Cancer

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Background: The optimal management of stage T1 papillary thyroid carcinoma (PTC) remains controversial. To identify surgical candidates, this study aims to identify molecular characteristics of T1 PTC associated with aggressive clinical features and outcomes.

Methods: We analyzed RNA-sequencing data from The Cancer Genome Atlas (TCGA) to identify differentially expressed (DE) genes by MACIS score in T1 PTC compared to those of T2-T4 PTC. Pathway analysis was performed using the Kyoto Encyclopedia of Genes and Genomes (KEGG) and modeled with R, clusterProfiler. The intersected genes associated with adverse clinical features were selected and modeled using eXtreme Gradient Boosting (XGBoost) to predict outcomes.

Results: Of 409 DE genes from 445 primary PTC samples by MACIS score, we identified 144 and 280 DE genes in *RAF*-like PTC (n=315) and *RAS*-like PTC (n=124), respectively. Only three DE genes (CIDEA, SST, and HP) by MACIS score overlapped between *RAF*-like and *RAS*-like PTC, suggesting distinct molecular characteristics between the two groups. To highlight the DE genes associated with more advanced T stage, we selected 14 and 23 overlapped DE genes by MACIS between T1 and T2-T4 in *RAF*-like and *RAS*-like PTC, respectively. The predictive model for lymph node metastasis and recurrence using the intersected DE genes between T1 and T2-T4 by MACIS score yielded an area under the ROC curve of 0.74 and 0.66, respectively. The enriched pathways in *RAF*-like PTC included multiple ATP-dependent sodium/potassium, and chloride transporters and pathways related to cardiomyocyte contraction (calcium voltage channel, actin, and myosin). The enriched pathways in *RAS*-like PTC included steroid hormone biosynthesis, ATP-dependent transporters of calcium, sodium/potassium, water channel protein, and nitric oxide synthase.

Conclusions: Our analyses identified two sets of DE genes associated with MACIS score by *RAF-RAS* subtypes in T1 PTC that overlapped with those of T2-T4 PTC. The gene pathways associated with each subtype were previously described in other organ systems, but our analysis associates them with PTC. The predictive model of the intersected DE genes between stages performed fairly well in predicting lymph node metastasis. Our data can be useful in creating an adjunct molecular testing to identify patients with high-risk T1 PTC.

◆28. Molecular Characteristics of Isthmus Papillary Thyroid Cancers: Supporting Evidence for Aggressive Clinical Behavior

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Background: Previous studies demonstrate that thyroid nodules arising from the isthmus are more likely to be malignant than lobar nodules. Furthermore, isthmus papillary thyroid cancers (PTCs) have been reported to be more clinically aggressive with increased rates of lymph node metastases, multifocality, and local invasion. The cause of these differences remains poorly understood, and surgical treatment of isthmus cancers remains controversial. We hypothesize that isthmus cancers may have a more aggressive molecular profile, contributing to this difference in clinical presentation.

Methods: The Cancer Genome Atlas (TCGA) database was queried via the Xena platform (<https://xenabrowser.net>, University of California, Santa Cruz) to analyze the molecular profile of isthmus PTCs compared to lobar and multifocal PTCs. Tall cell PTCs were excluded from analysis due to their known more aggressive behavior. Clinical, gene mutation, and gene expression data were analyzed. The BRAFV600E-RAS (BRS, 71-gene signature) and the extracellular signal-related kinase scores (ERK, 52-gene signature) were assessed. Both gene signatures are closely associated with mitogen-activated protein kinase function (MAPK), which is the predominant driver of thyroid tumorigenesis. The thyroid differentiation score (TDS, 16-gene signature), which summarizes the expression levels of thyroid metabolism and function genes, was also analyzed.

Results: We analyzed the molecular characteristics of 453 PTCs, which included 21 isthmus PTCs. There were no significant differences between isthmus and non-isthmus PTC demographic and clinical variables, including gender, age, stage, grade, ATARisk and MACIS score. There were also no significant differences in the frequency of RAS family, fusion driver, TERT, and tumor suppressor gene mutations. There was a trend of increase BRAF mutations ($p=0.10$). A more aggressive gene expression molecular profile was observed in isthmus PTCs compared to PTCs in other thyroid sites with a significant differences in the BRAFV600E-RAS (-0.27 vs -0.63 , $p=0.05$), ERK (5.26 vs 18.7 , $p<0.05$), and TDS scores (0.03 vs -0.58 , $p<0.05$).

Conclusions: These results provide a possible genetic explanation for the more aggressive behavior reported in isthmus PTCs. In conjunction with previous clinical reports, these data suggest that surgeons should use caution when considering limited surgical resection such as isthmusectomy for papillary thyroid cancers arising from the isthmus.

◆29. Validated Predictive Model for Treatment and Prognosis of Follicular Thyroid Carcinoma

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Background: Our group has developed and validated a calculator for determining overall survival (OS) and individualizing treatment in papillary thyroid cancer (PTC). Our current aim is to develop a similar prognostic calculator for follicular thyroid cancer (FTC) and Hurthle cell cancer (HCTC) based upon clinical, pathological, and treatment variables using the National Cancer Data Base (NCDB).

Methods: Patients with FTC and HCTC surgically treated from 2004-2020 were selected from the NCDB. Multivariate analysis was performed for age, gender, race, Charlson Comorbidity Index (CCI), histology, tumor size, extra-thyroidal extension (ETE), surgical margins, nodal status, type of surgery, and use of radioactive iodine (RAI). Exclusion criteria included metastatic disease and incomplete data. Patients were randomly allocated into either a training (80%) or validation set (20%). Cox regression prediction models and bootstrap coefficients were used to generate a mathematical model to predict 5 and 10-year OS. Area under the curve (AUC) was used to assess the model's overall performance. OS was compared in training and validation sets.

Results: 26,290 patients were included for analysis. Multivariable analysis of all the above variables were found to be significant ($p < 0.01$) and were used to construct a mathematical model. Predicted and observed OS from the Cox regression were determined for training and validation models. The AUC for the 5 and 10-year OS were 0.79 and 0.81 for the training set and 0.78 and 0.79 for the validation set.

Examples: A 55-year-old female with T3aN0 minimally invasive FTC has a 10-year OS of 94.1% with thyroid lobectomy, 94.5% with total thyroidectomy (TT), and 95.5% with TT and RAI. Upstaging this patient to T3bN1 and ETE and more aggressive histology gives a 10-year OS with TT 71.8% versus 77.2% with TT and RAI. For a 65-year-old male with T3bN1 HCTC with ETE and a TT has his 10-Year OS increased from 40.0% to 48.8% with RAI.

Conclusions: This validated model predicts 5 and 10-Year OS for FTC and HCTC using clinical, pathologic, and treatment variables and promotes individualized therapy for these less-common tumor types.

◆30. Prevalence of Occult Contralateral Foci in Patients with Medullary Thyroid Cancer

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Background: Though standard treatment for patients with medullary thyroid cancer (MTC) consists of total thyroidectomy with neck dissection, the rationale for bilateral surgery in patients with unilateral ultrasound findings remains unclear. This study investigated the presence of occult contralateral disease in patients with MTC to understand its true prevalence and better advise the recommendation for total thyroidectomy.

Methods: In this retrospective, multi-center cohort study, we examined patients with MTC who underwent thyroidectomy from 1998-2022. The primary endpoint was the prevalence of sonographically occult foci of MTC in the contralateral lobe among patients with sporadic MTC.

Results: The cohort comprised 155 patients with a mean age at diagnosis of 52.7 years, 59% of whom were female. In this cohort, 97 patients underwent genetic testing, and of those, 27% carried germline RET mutations. Initial surgical management consisted of total thyroidectomy (n=139, 90%), lobectomy followed by completion thyroidectomy (n=7, 5%), or lobectomy alone (n=9, 6%). Neck dissections were performed as part of initial therapy in 56% of patients. Pathologic evidence of MTC in the contralateral lobe was noted in 41 patients (26%), 10 of whom had occult contralateral disease. Among these 10 patients, 4 had germline RET mutations, 1 had a family history of MTC without germline RET mutation, 4 were negative for germline RET mutations, and 1 had unknown status. In MTC patients with germline RET mutation (n=26), 22 (85%) had contralateral foci and 4 (15%) had occult contralateral disease. Among patients with sporadic MTC (n=71), 12 (17%) had contralateral foci of MTC and 5 (7%) had occult contralateral disease. Among patients who underwent lobectomy alone with postoperative calcitonin levels, 2/6 (33.3%) had undetectable calcitonin levels (<2.0 pg/mL) at a median follow-up of 9.6 months.

Conclusions: Contralateral foci of MTC were found in 26% of patients. In patients with sporadic disease, the rate of occult contralateral foci of MTC was 7%. A staged approach involving initial thyroid lobectomy could be considered in patients with sporadic MTC and no contralateral ultrasound findings, with no further surgery if the calcitonin level becomes undetectable.

◆31. Cancer-Related Fear and Worry in Patients with Low-Risk Thyroid Cancer: A Longitudinal Study

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Background: Patients' emotions are known to influence the decision between lobectomy or total thyroidectomy (TT) for low-risk papillary thyroid cancer (PTC) treatment. This study investigated the experience of patients with low-risk PTC with respect to thyroid cancer-related fear and worry.

Methods: Adults with biopsy-proven low-risk PTC (cT1-2N0M0) or $\geq 70\%$ risk of PTC on molecular testing were identified by their surgeon for this prospective, multi-institutional (n=15) study from November 2019-June 2021. Participants completed two validated scales of cancer-related fear and worry at the time of their treatment decision and again 9 months later. The scales were developed for breast cancer and adapted to thyroid cancer. Patients choosing lobectomy were compared to those choosing TT (with or without prophylactic central neck dissection; TT \pm CND) using independent samples t-tests. Changes in preoperative and postoperative scores were evaluated using paired t-tests.

Results: Of 177 eligible patients, 125 completed the initial survey (70.6% response); of those, 114 completed the 9-month follow-up (92% retention). Overall, 83.3% were female and 82.5% were white; 45 participants chose lobectomy (36.0%) and 77 chose TT \pm CND (61.6%). At the time of the treatment decision, there were no differences between patients choosing TT \pm CND and those who selected lobectomy in thyroid cancer-related fear or worry (fear score 26.1 \pm 6.5 vs 25.1 \pm 6.4, on a scale of 8-40, p=0.42; worry score 8.4 \pm 2.5 vs 7.9 \pm 2.4, on a scale of 3-13, p=0.34). At follow-up, there were still no differences in fear or worry scores between the two groups, respectively (fear 23.0 \pm 7.2 vs 23.3 \pm 7.8, p=0.85; worry 6.5 \pm 1.7 vs 6.2 \pm 1.2, p=0.43). Across all participants, thyroid cancer-related fear and worry decreased after surgery (fear 25.8 \pm 6.4 to 23.1 \pm 7.4; worry 8.2 \pm 2.4 to 6.4 \pm 1.5, each p<0.001).

Conclusions: Patients with low-risk PTC report similarly high levels of thyroid cancer-related fear and worry at the time of their treatment decision and 9 months later regardless of the extent of surgery. These levels decrease slightly over time, suggesting that surgical treatment of low-risk PTC with either lobectomy or TT may provide an emotional benefit to patients. However, patients may need additional support to reduce their fear and worry before and after treatment.

◆32. Evolving Incidence Trends of Papillary Thyroid Carcinoma Diagnosis Across Race and Socioeconomic Status: A Joinpoint Regression Analysis

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Background: Disparities in papillary thyroid carcinoma (PTC) diagnosis are known to exist by patient demographics and socioeconomic status (SES), but recent incidence trends are unknown.

Methods: Using data from the Surveillance, Epidemiology, and End Results (SEER) registries (2009-2018), joinpoint regression analyses were performed to characterize incidence and annual percentage change (APC) by census-tract level socioeconomic status (SES) quintiles (Groups 1-5, with 1 being lowest SES) with further stratification by reported race. Incidence is provided as cases per 100,000 persons with 95% confidence intervals in parentheses.

Results: The incidence of PTC increased with increasing SES [Group 1: 5.7 (5.5-5.8), Group 2: 6.9 (6.7-7.0), Group 3: 7.6 (7.5-7.7), Group 4: 8.3 (8.2-8.5), Group 5: 9.3 (9.2-9.5)]. Over the 10-year period, incidence rates grew fastest in lower SES groups [Group 1: APC 2.7% (2.1%-3.3%), Group 2: 2.4% (1.1%-3.8%), Group 3: 1.6% (0.4%-2.9%) all $p < 0.05$] while stabilizing in those of higher SES [Group 4: 1.0% (-0.2%-2.2%), Group 5: 0% (-0.7%-0.7%)]. Lower SES quintiles also saw increases in the rate of T1 diagnosis: between 2010 and 2018, T1 incidence rose from 6.8-7.7 in Group 1, 8.9-9.3 in Group 2, and 9.6-11.0 in Group 3.

When analyzing by race, White, Asian, and Hispanic patients had increasing incidence by SES. Black patients had similar incidence rates across SES quintiles [Group 1: 3.2 (3.0-3.4), Group 2: 3.6 (3.4-3.9), Group 3: 4.0 (3.7-4.3), Group 4: 3.8 (3.5-4.1), Group 5: 4.2 (3.8-4.7)]. APC in White patients was stable over time in the highest SES quintile [APC=-0.2% (-0.8%-0.4%)] but rose steadily in all other quintiles (APC 1.5%-1.9%, all $p < 0.05$). Similarly, there was increasing incidence in Hispanic patients with lower SES over time [Group 1: APC=4.2% (3.4%-5.1%), Group 2: 2.6% (1.0%-4.3%), Group 3: 3.0% (1.2%-4.8%)]. APC in Black and Asian patients, however, did not correlate with SES.

Conclusions: From 2009 to 2018, the incidence of PTC increased in lower SES groups while stabilizing in higher SES groups. These trends are seen in White and Hispanic patients, and were concurrent with an increase in the diagnosis of T1 disease. This may represent decreasing disparities in the diagnosis of PTC by SES over the past 10 years, while racial barriers persist.

◆33. Disparities in Sex, Race, and Ethnicity in Patients Eligible for Adjuvant Treatment in Anaplastic Thyroid Cancer

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Background: Anaplastic thyroid cancer (ATC) is an aggressive disease with poor prognosis. For those who undergo upfront surgery, NCCN and ATA guidelines recommend chemotherapy and radiation as adjuvant treatments. We sought to identify patients at risk of receiving less-than-adequate adjuvant treatment, and to identify independent predictors of survival.

Methods: Adult patients who underwent upfront surgery for ATC from 2010–2017 were identified from the National Cancer Database. Patient demographics, clinicopathologic characteristics, treatments, and outcomes were compared between those who received adequate adjuvant treatment (AAT), defined as both postoperative chemotherapy and radiation, versus inadequate treatment. Multivariate logistic regression models were used to identify predictors of receiving AAT. Cox regression was used to identify independent factors associated with overall survival (OS).

Results: 675 patients diagnosed with ATC underwent upfront surgery from 2010 to 2017. 281 patients received inadequate treatment (127 received no adjuvant treatment, 57 received only radiation, and 97 received only chemotherapy), while 394 patients received AAT. Multivariate logistic regression identified the following patient factors associated with receipt of inadequate treatment: age (OR 0.94, CI 0.92-0.96, $p < 0.001$), female sex (OR 0.60, CI 0.41-0.89, $p = 0.011$), non-white race (OR 0.44, CI 0.25-0.80, $p = 0.007$), Hispanic ethnicity (OR 0.33, CI 0.14-0.75, $p = 0.009$), stage 4C disease (OR 0.55, CI 0.37-0.82, $p = 0.004$), and a Charlson-Deyo comorbidity (CDCC) score greater than 0 (OR 0.55, CI 0.36- 0.85, $p = 0.008$). Patient education, income, insurance status, location, and facility type were not significant predictors. The 5-year OS was significantly worse in those who did not receive AAT (21.6% vs. 12.7%, $p < 0.001$). Significant factors associated with OS on multivariate Cox regression included age (HR 1.02, CI 1.003-1.029, $p = 0.014$), CDCC score greater than 0 (HR 1.31, CI 1.04-1.66, $p = 0.023$), stage 4C disease (HR 2.32, CI 1.86-2.88, $p < 0.001$), and receipt of AAT (HR 0.63, CI 0.51-0.78, $p < 0.001$).

Conclusions: Receipt of AAT was the only independent factor associated with decreased mortality in ATC. However, female patients, older patients, and those who identify as non- white or Hispanic are less likely to receive this care. Further research is needed to identify the reasons for this disparity in care.

◆34. The Impact of the Affordable Care Act on Thyroid Surgery in the Ambulatory Setting: A Difference-in-Differences Analysis

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Background: The Affordable Care Act, enacted in 2010, expanded access to surgery in states that implemented Medicaid expansion in 2014. Concurrently, thyroid surgery increasingly shifted from the inpatient to ambulatory setting as outpatient surgery was accepted as a safe, lower-cost option. Using a difference-in-differences framework, we sought to examine the effect of Medicaid expansion on the use of ambulatory settings for thyroid resection.

Methods: We identified patients who underwent thyroid resection using the Healthcare Cost and Utilization Project's State Inpatient Databases and State Ambulatory Surgery and Services Databases. Surgical care was compared between Medicaid expansion states (IA, KY, MD, NJ, NV, VT) and non-expansion states (WI, NE, NC, FL). The pre-expansion period (PRE) was 2012-2013 and the post-expansion period (POST) was 2016-2018, allowing for a washout during implementation. The primary outcome was surgical setting (ambulatory versus inpatient). An adjusted difference-in-differences analysis evaluated the association between Medicaid expansion and ambulatory setting utilization. Stratified analyses were performed by race and income quartile.

Results: Of 100,379 patients, 37,504 (37%) were treated in expansion states and 62,875 (63%) in non-expansion states. Medicaid expansion was associated with increased use of Medicaid insurance for thyroidectomy in expansion (PRE: 7.6%; POST: 14.9%) compared to non-expansion (PRE: 7.8%; POST: 7.4%; $p < 0.001$) states. Medicaid expansion was associated with an unadjusted 7.5% increase in ambulatory thyroid surgery in expansion (PRE: 72.6%; POST: 92.4%) compared to non-expansion (PRE: 77.1%; POST: 89.4%; $p < 0.001$) states. With adjustment for potential confounders, patients had two-fold higher odds of ambulatory surgery in the expansion states relative to non-expansion states following Medicaid expansion (OR 2.02, 95% CI 1.87-2.18; $p < 0.01$). This finding was consistent for Black (OR 2.15, 95% CI 1.78-2.61; $p < 0.001$) and White (OR 1.98; 95% CI 1.79- 2.18; $p < 0.001$) patients and for those with household incomes in the highest (OR 1.56, 95% CI 1.32-1.83; $p < 0.001$) and lowest (OR 2.95, 95% CI 2.47-3.51; $p < 0.001$) quartiles.

Conclusions: Medicaid expansion was associated with increased use of ambulatory thyroid resection. The increased uptake of ambulatory thyroidectomy in expansion states may reflect accommodations made for increased demand in healthcare following Medicaid expansion.

◆35. Association of Medicaid Expansion with Access to Thyroidectomy for Benign Disease at High Volume Centers

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Background: Medicaid expansion (ME) of the ACA aimed to improve access to healthcare for vulnerable populations. While ME was associated with increased access to high volume centers for operations for thyroid cancer, it is unknown whether ME improved access for patients with benign thyroid conditions. The aim of this study is to evaluate the association of ME with thyroidectomy at high volume centers for benign disease.

Methods: The Vizient Clinical Data Base® was queried for patients undergoing thyroidectomy for benign disease from 2010-2019. ME status as of January 1, 2014 was analyzed. Hospitals were stratified by operative volume quartiles [Hospitals (Median Cases/Hospital) Q1: 12 (1765), Q2: 17 (1215), Q3: 29 (685), Q4: 306 (215)]. Odds of operation by insurance status at high volume centers before and after ME were calculated. Difference in difference analysis (DD) was performed to determine change in payer distribution by hospital quartile after ME.

Results: There were 82,602 patients at 364 hospitals who underwent thyroidectomy for benign disease. Patients were predominantly female (81.5%) and white (65.0%). Over the entire study period, Medicaid patients had increased odds of thyroidectomy at lower quartile hospitals (Q1: ref, Q2: 1.61, Q3 2.46, Q4: 1.94, $p<0.001$) while private patients had decreased odds of thyroidectomy at lower quartile hospitals (Q1: ref, Q2: 0.87, Q3 0.57, Q4: 0.57, $p<0.001$). Odds of thyroidectomy at low-volume centers were higher for Medicaid patients in non-expansion (NE) states after ME versus expansion (E) states (Q1: ref, Q2: NE 1.56 vs E 1.15, Q3: NE 3.18 vs E 1.82, Q4: NE 1.47 vs E 1.61, $p<0.001$). DD revealed ME was associated with an increased percentage of Medicaid patients in all quartiles, but this effect was largest at lower volume hospitals (Q3: +6.84%, $p<0.001$, Q4: +6.23%, $p<0.001$) compared to high volume centers (Q1: +3.78%, $p<0.001$, Q2: +3.73%, $p=0.002$).

Conclusions: Medicaid expansion was associated with increased access to high volume centers for operations for benign thyroid disease. Despite this, patients with Medicaid remain most likely to have care at low volume centers. Disparities still exist between privately insured patients and Medicaid patients seeking surgical care for benign thyroid disease.

◆36. Single-session Radiofrequency Ablation (RFA) For the Treatment of Persistent/Relapsed Graves' Disease - A Pilot Study

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Background: Graves' disease (GD) is the most common cause of hyperthyroidism and antithyroid drug (ATD) is generally the preferred upfront treatment. However, with over half of patients suffer from persistent / relapsed disease when ATD is discontinued, prolonged ATD maintenance is the only option when other definitive treatments like surgery or radioiodine therapy are not considered. Given that ablating thyroid tissue with heat can cause irreversible parenchyma necrosis and lessen its underlying function, our study hypothesized ablating most of the thyroid parenchyma bilaterally with radiofrequency ablation (RFA) may lower thyroid function and induce disease remission.

Methods: Eligible patients with persistent / relapsed GD underwent one-session of ultrasound-guided RFA to both thyroid lobes under intravenous sedation. The aim of each procedure was to ablate as much of the visible parenchyma as possible with the RFA probe. Those with a large thyroid lobe (>20mL) or who were pregnant or planning for pregnancy, and deemed unfit medically were excluded. Thyroid function tests were monitored 6-8 weekly afterwards. The primary outcome was the 12-month disease remission (defined as a state of biochemical euthyroidism or hypothyroidism without ATD maintenance). Secondary outcomes were complication rates.

Results: Of the 68 patients with persistent/relapsed GD, 15 (22.1%) patients underwent the procedure. At 12-month, 11 (73.3%) patients were in remission. Of these 11 patients, 8 remained in biochemically euthyroidism while 3 suffered from biochemical hypothyroidism afterwards. Among the 4 patients found not to be in remission, 3 patients had a biochemical relapse within 6 months (at 4 weeks, 5 months and 5.5 months). One patient had a relapse at 8 months. In the 4 patients not in remission, 3 patients were able to maintain biochemically euthyroidism at a reduced daily ATD dose (when compared to baseline dose). The percentage of dose reduction ranged between 50 – 83.3%. No patients suffered from vocal cord palsy, skin burn, hematoma formation, thyroid storm or worsening of Graves' ophthalmopathy afterwards.

Conclusions: In well-selected patients, single-session radiofrequency ablation of the thyroid gland may be a potential treatment for patients with persistent / relapsed GD who do not wish to undergo either surgery or RAI or continue ATD. In our experience, it is a safe and well-tolerated ambulatory procedure.

◆37. Ethanol Ablation is a Successful Primary Treatment Modality for Lateral Neck Metastases in Papillary Thyroid Carcinoma

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Background: Percutaneous ethanol ablation (PEA) has emerged as a treatment for recurrent papillary thyroid carcinoma (PTC) in the lateral neck (LN) following compartment oriented therapeutic lymphadenectomy. However, the safety and utility of PEA as a primary treatment modality for LN metastases remains undefined. We aimed to investigate long- term outcomes of PEA of LN disease both with and without prior lymphadenectomy.

Methods: We conducted a retrospective study of patients with LN PTC treated with PEA from 2013 to 2018. Patient characteristics, disease volume, morbidity, and recurrence (development of new/worsening lymphadenopathy within PEA-treated LN compartment) were assessed.

Results: We identified 117 patients who underwent PEA for PTC LN metastases; 67 (57%) had a prior LN dissection (LND). Median follow-up after PEA was 5.5 years (IQR= [3.1,7.5]) and median time from thyroidectomy to PEA was 4.9 years (IQR=[1.7,8.8]). On average, 1.4 LN nodes (range: 1-6 nodes) were treated within compartments II (9%), III (27%), IV (52%), V (5%) or multiple compartments (7%). Three patients (3%) developed transient nerve-related complications after PEA. Forty (34%) developed recurrence, prompting additional PEA in 25 (62.5%), LND in 9 (22.5%), and PEA plus LND in 6 (15%). Twenty-nine (25%) developed lateral neck disease in another compartment. No difference in recurrence was seen in patients who did or did not undergo pre-PEA LND (p=1.0). Of the 50 who underwent PEA without prior LND, 33 (66%) did not recur, 4 (8%) required LND, 12 (24%) underwent repeat PEA, and 1 (2%) required LND and repeat PEA. Of patients who underwent PEA without prior LND, treating more nodes and having a lower BMI were independently associated with an increased risk of recurrence, while age, pre-PEA thyroglobulin, and pre-PEA average nodal volume were not associated with recurrence. Of all patients who underwent LND after PEA (including patients undergoing repeat LND), dissection was “difficult” in 8 (53%) and 4 (27%) developed complications (transient nerve dysfunction=3, lymphatic leak=1).

Conclusions: PEA is a safe primary treatment modality for LN metastases of PTC in selected patients but is associated with high recurrence rates. Most recurrences can be treated with repeat PEA, avoiding LND in 90% of patients.

◆38. A National Study of Postoperative Thyroid Hormone Supplementation Rates After Thyroid Lobectomy

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Background: The reported rates of thyroid hormone supplementation after lobectomy are primarily derived from single-institution studies evaluating benign disease. The American Thyroid Association (ATA) updated guidelines in 2015 to allow lobectomy for small, low-risk, well-differentiated thyroid cancer. The objective of this study is 1) to evaluate the proportion of thyroid lobectomy before and after the guideline change and 2) to determine the need for postoperative thyroid hormone supplementation for benign and malignant nodules in a national patient cohort.

Methods: The IBM MarketScan Database (2008-2020) was used to identify adult (\geq age 18) patients who underwent thyroid resection for benign or malignant nodules. Multivariable logistic regression models compared the proportion of patients who underwent lobectomy vs. total thyroidectomy before and after the ATA guidelines change (2008-2015 vs. 2016-2020). For patients who underwent thyroid lobectomy, multivariable logistic regression models were used to assess the association between indication for surgery (benign vs. malignant) and need for postoperative thyroid hormone supplementation.

Results: Of the 81,926 patients identified, 33,756 (41.2%) underwent thyroid lobectomy for benign (N = 27,452, 81.3%) or malignant (N = 6304, 18.7%) indications, 45,104 (55.1%) underwent total thyroidectomy for benign (N = 25,510, 56.6%) or malignant (N = 19,594, 43.4%) indications, and 3,066 (3.7%) underwent lobectomy followed by completion thyroidectomy for benign (N = 510, 16.6%) or malignant (N = 2,556, 83.4%) indications. Compared to the 2008-2015 period, the proportion of patients undergoing lobectomy for malignancy was higher in the 2016-2020 period (34.3% vs. 30.3%, $p < 0.001$), with a concomitant decrease in completion thyroidectomy performed (25.6% vs. 29.8%, $p < 0.001$). Patients who underwent lobectomy for malignancy were significantly more likely to require hormone supplementation (59.3% vs. 39.4% [$p < 0.001$], aOR 2.34 [95% CI 2.20-2.48]) and less likely to wean off supplementation in the 18 months following surgery (13.3% vs. 17.9% [$p < 0.001$], aOR 0.73 [95% CI 0.65-0.82]) compared to those with benign disease.

Conclusions: The proportion of patients undergoing lobectomy compared to total thyroidectomy increased significantly following the 2015 ATA guideline change, without a concomitant increase in completion thyroidectomy. Further, lobectomy for malignancy was associated with significantly higher odds of requiring thyroid hormone supplementation.

◆39. The Complication Profile of Pediatric Thyroid Surgery at a Tertiary Cancer Center

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Background: Current guidelines recommend total thyroidectomy (TT) in the majority of pediatric patients with well-differentiated thyroid cancer. However, there has been a move towards de-escalating surgery due to excellent disease specific survival and the morbidity of post-operative complications. Prior systematic reviews have found permanent post-operative hypocalcemia after TT occurs in approximately 10% of pediatric patients and the risk is significantly higher in malignant disease (Kao et al 2021). Vocal cord paralysis occurs in 1.7% of pediatric thyroidectomies for benign or malignant disease nationally (Hanba et al 2017). However, there is a scarcity of data from centers with a solely malignant practice.

Methods: An IRB-approved retrospective chart review was conducted at a tertiary cancer center for pediatric patients (≤ 21 years-of-age) with well-differentiated thyroid cancer who had surgery between 1986-2021. Clinicopathological characteristics and complications were evaluated. Both univariate and multivariate analyses were carried out to identify factors associated with permanent hypocalcemia (>12 -month duration).

Results: A total of 309 pediatric patients with well-differentiated thyroid carcinoma were identified, with a median follow-up of 61 months and median age of 18.6 years. 67% underwent TT and 33% underwent partial thyroidectomy. Gross extrathyroidal extension was identified in 14%. 40% (123/309) had N0 disease, 28% (85/309) N1a and 33% (101/309) N1b. No patients developed a neck hematoma and 2 patients (0.6%) had post-operative wound infection. Only 5 patients (1.6%) had temporary unilateral vocal cord palsy that returned to full function and 2 patients (0.6%) had permanent post-operative vocal cord palsy due to recurrent laryngeal nerve (RLN) invasion by tumor. Permanent post-operative hypocalcemia occurred in 5.2% (16/309). Central neck dissection (OR 3.66; $p=0.028$), T4 (OR 6; $p=0.008$) and N1b disease (OR 5.39; $p=0.011$) were identified as risk factors for permanent hypocalcemia after univariate analysis and N1b disease (OR 3.62; $p=0.017$) was an independent risk factor after multivariate analysis. Younger age was not associated with greater risk of permanent hypocalcemia (OR 0.94; $p=0.411$).

Conclusions: Pediatric thyroid surgery at a tertiary cancer center results in low complication rates, despite 60% of patients having nodal metastases. Vocal cord paralysis is avoidable unless disease is found to be invading the RLN intraoperatively. Advanced N-stage is an independent risk factor for permanent hypocalcemia.

◆40. How Can We Objectively Evaluate the Effectiveness of Protocol-Driven Calcium and Calcitriol Supplementation After Thyroidectomy?

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Background: Determining the effects of calcium and calcitriol supplementation after thyroidectomy is difficult because observational studies are biased by unmeasured confounding variables that differ between patients who are treated versus those who are untreated. A regression discontinuity design, a relatively new and novel analytic technique, can address this problem by balancing measured and unmeasured confounding to generate an unbiased estimate of how treatments affect outcomes. The purpose of this study was to evaluate the effects of calcium supplementation following thyroidectomy, using a regression discontinuity design.

Methods: Our institution follows a protocol after total or completion thyroidectomy: patients with postoperative PTH between 10-20pg/ml receive calcium carbonate, while those with PTH <10 pg/ml receive calcium and calcitriol. We used a regression discontinuity design to determine protocol effects on (1) transient hypocalcemia, (2) 2-week postoperative calcium, and (3) readmission or emergency room visits for 2,294 consecutive patients who underwent total or completion thyroidectomy from 2010-2022.

Results: The mean age for the cohort was 50 ± 15 years and 78% were women. Fifty-seven percent of operations were for benign disease, including 2,054 total thyroidectomies and 240 completion lobectomies.

For patients with postoperative PTH < 10, supplementation with calcium and calcitriol did not eliminate symptomatic hypocalcemia (p<0.001), but did lead to normalization of calcium at two weeks after surgery and effectively prevented emergency room visits or readmissions.

For patients with postoperative PTH <20 but >10, calcium supplementation was associated with improved rates of symptomatic hypocalcemia and reduced risk of emergency room visits or readmissions. Calcium supplementation was also associated with normalization of two-week postoperative calcium: 9.24 mg/dl for untreated versus 9.07 mg/dl for patients treated with calcium (p for difference NS).

Conclusions: Selective supplementation with calcium and/or calcitriol after thyroidectomy is associated with improved postoperative outcomes, even after accounting for both known and unknown differences in confounding variables. Unlike standard techniques for measuring treatment effects using observational data, our novel use of a regression discontinuity design allowed for an unbiased estimate of how our protocol improves patient outcomes after thyroidectomy.

41. Social Exposome and the Tip of Iceberg in diagnosing Thyroid Cancer in Disproportionately Affected Communities: A US population-based Multi-Ethnic Study

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Background: Social exposome is the cumulative integration of environmental exposures and socioeconomic status in relation to cancer-related health outcomes. Currently, there is no framework to account for the comprehensive exposomics signature that may predict outcomes related to thyroid cancer. This study aimed to identify geospatial exposome interactions to assess various social and environmental exposures related to outcomes in patients with thyroid cancer.

Methods: Population-based data from the Surveillance, Epidemiology, and End Results (SEER) registries were analyzed to assess the contemporary burden of thyroid cancer by age, gender, race/ethnicity, and pathological status. Social and environmental risk factors were evaluated across the country in correlation with thyroid cancer rates. Multivariate linear regression and decision tree models were generated to identify independent prognostic factors.

Results: The age-adjusted incidence rate of thyroid cancer was 15.5 per 100,000 for all ages combined and was higher in younger adults (27.3/100,000), females (22.8/100,000), and whites (16.9/100,000) ($p < 0.05$ for all). Higher rates of thyroid cancer were among groups living in metropolitan counties compared to non-metropolitan areas ($p < 0.001$). Individuals with higher income levels showed a 10.9% increase rate than those below \$35,000 annual income. Interestingly, American Indian/Alaska Natives had a lower incidence rate (9.6/100,000) but presented with a more advanced stage at diagnosis (30.6%, $p < 0.05$). Black individuals showed the least incidence rate (9.4/100,00); however, they had the worst 5-year survival (88.2%, $p < 0.05$). In further assessing socioeconomic markers, the average annual count of thyroid cancer cases across counties was directly correlated with crowding (more than one household per room) ($r = 0.37$, $p = 0.007$), non-English language ($r = 0.67$, $p < 0.001$), and poor education (less than grade 9) ($r = 0.65$, $p < 0.001$). Smoking cessation ($r = -0.32$, $p = 0.001$), fruit consumptions ($r = -0.36$, $p = 0.005$), and residential UV exposure ($r = -0.3$, $p = 0.027$) were associated with lower thyroid cancer rates.

Conclusions: Demographically, incidence rates increased in higher-income patients due to early screening. However, the risk of developing the advanced disease was higher with exposure to environmental risk factors and in underserved populations, suggesting higher unreported rates or lower quality healthcare services that eventually affected the overall survival of these patients. Thyroid cancer may be linked to an individual's "social-exposome", and early screening in these susceptible communities could provide the framework to implement sustainable preventive cancer control programs.

42. Black and Publicly Insured Patients Experience Significant Delays in the Workup of Thyroid Nodules

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Background: Equal access to timely care is essential to improving health disparities. We sought to evaluate where delays in the workup of thyroid nodules exist and if specific sociodemographic groups experience delays in care.

Methods: A retrospective review of all neck ultrasounds (US) between 2017-2019 at a single tertiary care center was performed. Patients with a prior neck US or whose US did not evaluate the thyroid were excluded. Date the US was referred and performed, reason for referral (incidental from other imaging, symptomatic/clinical exam, or high-risk screening), and date FNA was performed, if indicated, were abstracted.

Demographic factors analyzed included patient age, gender, race/ethnicity, Charlson comorbidity index (CCI), insurance coverage, and rural/urban status (based on zip codes). Multivariate linear and logistic regressions were utilized to evaluate demographic factors associated with timely care.

Results: A total of 3,459 US were reviewed, of which 1,565 met inclusion criteria. The sample was 76.7% female, 85.6% white, and 92.8% lived in an urban area; 64.9% were covered by private insurance. The average age was 50.9 years (SD 17.7).

Median time from referral to US was 7 days (IQR 3-22); 69.5% of US were ordered for symptoms/clinical exam workup and 20.3% for follow-up of incidental findings. Linear regression demonstrated a longer time to US for patients with incidentally found nodules (35.7 days longer vs. symptomatic workup [95%CI 27.9-43.4]) and multiple comorbidities (27.9 days longer vs. CCI 0 [95%CI 17.6-38.3]). There was no significant difference in time to US by patient race/ethnicity.

FNA was recommended in 377 patients, with 314 obtaining one. Medicaid patients were less likely to obtain a recommended FNA (OR 0.2 [95%CI 0.1-0.7]) compared to privately insured patients. Median time from US to FNA was 14 days (IQR 10-20). Black (23.1 days longer vs. white [95%CI 13.3-32.8]) and Medicaid (7.7 days longer vs. private insurance [95%CI 2.6-12.7]) patients had significantly longer periods between US and FNA.

Conclusions: Black patients and patients on Medicaid experience significant delays in the workup of their suspicious thyroid nodules. Access to timely FNA in particular should be an area of focus to help improve health equity in endocrine surgery.

43. Tumor Volume-Doubling Rate in Papillary Thyroid Microcarcinomas Under Active Surveillance is Negatively Associated with Patient Age

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Background: Older patient age is an adverse prognostic factor in clinical papillary thyroid carcinoma. Conversely, in papillary thyroid microcarcinoma (PTMC) on active surveillance (AS), we found that younger age was associated with disease progression. In our previous report, progression was analyzed as a categorical data: presence of an increase in tumor diameter ≥ 3 mm or not. Increases < 3 mm and decreases in tumor size were neglected. To better elucidate the tumor volume dynamics, we performed a quantitative analysis using Tumor Volume-Doubling Rate (TV-DR).

Methods: From 2005 to 2019, 2896 patients diagnosed with low-risk PTMC at Kuma Hospital opted AS. Excluding those associated with Graves' disease or those who took LT4 at or before the diagnosis, 2175 patients who had 4 or more ultrasound examinations were enrolled. Two hundred twenty-four patients started LT4 administration during AS, and 121 patients had 4 or more ultrasound examinations prior to initiating LT4. In these patients only the periods before LT4 were included for the present analysis. We divided the current 2072 patients into three subsets based on age at diagnosis: young (< 40 years), middle-aged (40-59 years), and old patients (≥ 60 years). The TV-DR was calculated using the ultrasound tumor size and date of examination for each patient.

Results: Duration of AS (mean \pm SD, year) in the young, middle-aged, and old groups were 6.18 ± 3.18 , 6.24 ± 3.29 , and 5.99 ± 3.10 , respectively. The proportion of patients with TV-DR ≥ 0.5 /year were 5.5%, 2.5%, and 1.7%, respectively ($p < 0.01$) and TV-DR < 0.5 /year and ≥ 0.1 /year were 26.9%, 18.3%, and 14.7%, respectively ($p < 0.01$), showing tumors with moderate growth and slow growth decreased over age. The proportions of patients with TV-DR < 0 /year were 43.4%, 56.0%, and 60.6%, respectively ($p < 0.01$), showing increase in shrinking tumors over age.

Conclusions: Quantitative analysis using TV-DR elucidated tumor volume dynamics in PTMCs during AS and TV-DR was strongly and negatively associated patient age. The present quantitative study also revealed increase in shrinking tumors over age.

44. Predicting Molecular Test Result and Surgical Pathology in Indeterminate Thyroid Nodules with Completely Automated Machine Learning on Ultrasound Features

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Background: Annually in the US, 100,000 thyroid nodules return cytologically indeterminate on fine-needle-aspiration (FNA) and represent a source of potentially unnecessary surgery. Molecular testing helps with risk-stratification but remains costly and has poor positive predictive value (PPV). Previous machine learning (ML) efforts on ultrasound features have required intensive manual segmentation, the selection of nodule boundaries against surrounding tissues. We have developed an automated segmentation ML algorithm to obviate this need. We hypothesize that ML can improve the clinical workflow in two ways: reducing the number of molecular tests by automatically classifying malignancy from imaging and clinical variables, and improving the accuracy of molecular testing by combining it with imaging features.

Methods: A retrospective single-institution dataset was compiled of 139 patients with indeterminate thyroid nodule cytology from 2016-2022, who all underwent molecular testing (Afirma or ThyroSeq) and subsequent surgical resection. A 67/33% split was utilized for training/validation sets and synthetic oversampling was utilized to account for class imbalance in molecular results. A multi-scale convolutional neural network (CNN) architecture was previously trained and validated to automatically segment thyroid nodules from ultrasound images. ML classifiers were trained to predict the outcome of molecular testing from imaging and then combining imaging with molecular testing to predict surgical pathology.

Results: A random forest classifier using ultrasound and clinical features to predict molecular result had a 17% benign call rate (BCR) and achieved 90% sensitivity, 57% specificity, 92% PPV, 50% negative predictive value (NPV), and area under the curve (AUC) 0.72. Molecular testing alone to predict surgical pathology had 94% sensitivity, 19% specificity, 44% PPV and 83% NPV, with AUC 0.56. A gradient-boosted tree classifier combining ultrasound features with molecular testing to predict surgical pathology had a 22% BCR and improved performance to 94% sensitivity, 33% specificity, 49% PPV, 90% NPV, and AUC 0.70.

Conclusions: ML can segment and classify thyroid nodules in a completely automated fashion and predict a suspicious molecular test result with significant success, potentially avoiding costly molecular testing in a subset of patients. Our classifier enables modest improvement over molecular test alone in specificity, with slight improvements in PPV and NPV, while maintaining similar sensitivity, allowing patients who need molecular testing to achieve improved diagnosis.

45. Targeting Autophagy in the Thyroid Cancer Microenvironment

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Background: The tumor microenvironment (TME) is a complex ecosystem whereby cancer cells reside and interact with a diverse surrounding stroma. Autophagy helps shape the TME by activating various signaling pathways that facilitate crosstalk between tumor cells and the local microenvironment. We sought to characterize the role of autophagy in the TME of thyroid cancer.

Methods: Validated papillary (BCPAP) and anaplastic (8505c) human thyroid cancer cell lines were co-cultured with fibroblasts, the major component of the stroma, to mimic the TME. Markers of epithelial-mesenchymal transition (EMT), apoptosis, and fibroblast activation were assessed by Western blot. Scratch migration, Matrigel invasion, and chemokine assays were utilized to characterize tumor cell and fibroblast behavior. Low dose Lys05 (10uM) was utilized for autophagy inhibition.

Results: Fibroblasts co-cultured with BCPAP or 8505c cells acquire an activated, cancer associated fibroblast (CAF), phenotype. Fibroblasts co-cultured with BCPAP tumor cells upregulate expression of markers of EMT, vimentin and N-cadherin. These effects are reversed with autophagy inhibition via Lys05. In BCPAP or 8505c tumor cells, fibroblast co-culture unexpectedly results in autophagy independent downregulation of EMT and upregulation of apoptosis. Culture media from co-cultured BCPAP/fibroblast cells significantly potentiates tumor cell migration (2.7x, $p < 0.0002$) and invasion (3.4x, $p < 0.0001$) as compared to culture media from BCPAP cells alone. Analysis of BCPAP/fibroblast co-culture media identified upregulation of three chemokines: CXCL10, CXCL16, and SDF-1, all of which are known to regulate immune cell recruitment, as well as tumor cell migration and invasion. Concomitant autophagy inhibition of co-cultured BCPAP/fibroblast cells with Lys05 attenuates expression of these chemokines ($p < 0.05$).

Conclusions: Autophagy shapes the TME of thyroid cancer via upregulation of EMT mediators, potentiating tumor cell migration and invasion, and enhancing chemokine secretion within the stroma. Notably, co-cultured tumor cells exhibit downregulation of EMT mediators and upregulation of apoptosis in what appears to be an autophagy independent manner. These observations highlight the contradictory role of autophagy as a double-edged sword in cancer biology. Clarifying the mechanisms driving these differential responses to therapy will aid in the development of rationale therapeutics targeting autophagy within the thyroid cancer TME.

46. Thresholds for Surgical Referral in Primary Hyperparathyroidism: A Discrete Choice Experiment

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Background: Primary hyperparathyroidism (PHPT) is surgically cured with low complication rates in the hands of experienced endocrine surgeons, yet patient referral for surgery is highly dependent on referring provider. We performed a discrete choice experiment (DCE) to characterize factors leading to referral for surgical evaluation for PHPT.

Methods: An online DCE was conducted among practicing physicians in the fields of endocrinology, primary care (medical providers), endocrine surgery, and otolaryngology (surgical providers). Anonymous responses were solicited from 6 geographic regions representing academic and community-affiliated practices. Respondents were presented 10 patient scenarios with primary hyperparathyroidism and asked which they would refer to surgery versus medical management (imaging, calcimimetic, or surveillance) given different clinical and biochemical patient factors: age >50 or <50 years, normocalcemic versus classic PHPT, osteoporosis versus none, and/or cardiac comorbidities. Choices were analyzed using mixed logistic regression with random respondent intercept.

Results: Ninety-eight individuals opened the survey; 65 completed it (66.3%). Respondents were 51% female, 60% practicing >10 years, and 85% in academic settings. A majority were endocrinologists (60%), then endocrine surgeons (35%), and 57% had ≥10% of their practice focusing on parathyroid disease. Respondents referred to surgery more often if patients presented with classic disease (72% versus 37%), age <50 (70% vs 39%), no comorbidities (59% vs 48%), and osteoporosis (64% versus 51%) (all p<0.01). In multivariable logistic regression, predictors of choosing surgical referral were: surgical provider (OR: 41.49, [CI: 9.95-172.92]), patient age <50 years (16.61, [8.57-32.18]), classic primary hyperparathyroidism (13.07, [6.98-24.46]), osteoporosis (3.54, [1.88-6.65]), and lacking comorbidities (2.45, [1.43-4.21]) (p-value <0.001 for all). Practice duration, setting, and physician gender were not significant predictors of surgical referral (p>0.05). Among medical providers, age showed the largest impact on the probability of referring for surgery (age > 50: 10% vs age <50: 65%, p <0.05). Surgical providers were more likely to refer to surgery regardless of patient factors (p<0.001).

Conclusions: Overall, respondents were reluctant to refer patients with primary hyperparathyroidism to surgery if they were >50 years old, had comorbidities, or mild disease, despite previously published data on surgical benefit and safety. Further research and outreach are needed for provider education to increase access to surgery.

47. Association of Pre- and Post-Renal Transplantation Parathyroid Hormone and Calcium Levels with the Graft Outcome

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Background: Persistent hyperparathyroidism after renal transplantation (RT) is associated with increased graft loss and mortality. Medical treatment is the first-line therapy for persistent hyperparathyroidism, with surgery reserved for refractory cases. However, a clear parathyroid hormone (PTH) target range has not been established to determine which patients will benefit from surgery. This study sought to examine the effect of PTH and other clinical factors on primary graft failure (PGF) and determine a target PTH range for post-RT patients.

Methods: A retrospective study was performed including all adult patients who underwent RT between 2010 and 2021 at a single institution with no history of parathyroidectomy. Patients who were younger than 18 years or missing PTH values were excluded. Patient demographics, graft characteristics, pre- and post-RT lab values, and graft outcomes were recorded and analyzed.

Results: A total of 228 patients who underwent RT without history of parathyroidectomy were included. Of these patients, 17 developed PGF, while 211 had continued graft function. Compared to patients in the non-PGF (NPGF) group, patients in the PGF group had significantly higher pre-RT PTH levels (935.00 ± 298.17 vs. 477.70 ± 33.90 , P -value=0.002) as well as significantly higher PTH levels at 1-2 years post-RT (573.41 ± 133.77 vs. 166.27 ± 10.52 , P -value <0.001). The PGF group also had higher post-RT alkaline phosphatase, phosphorus, and creatinine levels than the NPGF group, but neither pre- nor post-RT calcium levels were significantly different between the two groups. Multivariate logistic regression analyses revealed that post-RT, but not pre-RT, PTH level was an independent predictor of PGF. When post-RT PTH levels were divided into quartiles, only the 4th quartile (PTH >222 pg/dL) was found to be significantly associated with PGF. Interestingly, there was no difference in the post-RT calcium levels between the patients with post-RT PTH >222 pg/dL and those with lower PTH values.

Conclusions: Persistent hyperparathyroidism at 1-2 years after renal transplantation, regardless of calcium levels, was shown to be associated with worsened graft outcomes. Our study showed that elevated PTH range (above 222 pg/dL based on our analysis) is significantly associated with PGF and warrants more aggressive treatment, including surgical intervention when necessary, regardless of calcium levels.

48. Quality of Life and Social Determinants of Health: A Longitudinal Study of a Diverse Cohort of Endocrine Surgery Patients

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Background: Racial minorities may have disproportionately worse outcomes after endocrine surgery, but have been underrepresented in quality of life (QOL) studies. Although social determinants of health (SDH) may disproportionately impact racial minorities, who are more likely to have negative SDH and live in disadvantaged areas, the impact of SDH on QOL for all is understudied. The objective of this study was to examine how SDH affected longitudinal QOL in a racially diverse endocrine surgery patient population.

Methods: Adult patients undergoing thyroid, parathyroid and adrenal surgery between 6/2020-2/2021 from a single endocrine surgery division were recruited. Participants completed preoperative and postoperative surveys (2 weeks, 3 months, 6 months). Individual-level SDH was assessed [e.g. affordability of necessities, activities of daily living (ADLs)]. Environmental-level SDH was assessed with the Social Vulnerability Index, measuring census tract-level social vulnerability. QOL was assessed at all times with the Patient- Reported Outcomes Measurement Information System-29 survey, which assessed QOL in different domains. Mixed effects multivariable regression models were performed to study longitudinal trends in QOL adjusting for surgery, time, and patient characteristics.

Results: Cohort (n=222) characteristics: average age 53.3 years; 79% female; 9.1% Hispanic; 57.7% White, 30.9% Black, 10.5% Other (multi-race, Asian, Native Hawaiian, Pacific Islander, American Indian). Compared to preoperative results: postoperative parathyroid patients were better able to participate in social roles and had less fatigue; postoperative thyroid and parathyroid patients had less pain interference, anxiety, and sleep disturbance, sustained postoperatively (p<0.05). Individual-level SDH predicted QOL: difficulty paying for basic necessities or needing help with ADLs were associated with worse QOL in multiple domains (e.g. fatigue: 7.64, 95% CI 3.7, 11.6; physical function -4.95, 95% CI -7.2, -2.7, respectively; p<0.05); being employed and the presence of material and social capital predicted better QOL in certain domains (e.g. depression: -4.3, 95% CI -7.32, -1.32, p<0.05). Sex, race, ethnicity, cancer status, or environmental SDH did not affect QOL (p>0.05).

Conclusions: With the equitable added experience of racial minorities, this longitudinal study showed QOL postoperative improvements in endocrine surgery patients. Individual-level SDH, particularly related to socioeconomic resources, predicted QOL independent of race. Effective interventions aimed to improve QOL may need to focus on these.

49. Improving Therapeutic Targeting of Somatostatin Receptor Type 2 in a Pancreatic Neuroendocrine Xenograft Model

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Background: Somatostatin surface receptors (SSTRs) are a unique feature of Pancreatic Neuroendocrine Tumors (PNETs) that can be targeted with Peptide Receptor Radionucleotide Therapy (PRRT), resulting in a survival benefit in well-differentiated PNETs. Poorly differentiated/high-grade PNETs lose the ability to express SSTR type 2 and thus become ineligible for SSTR2-targeted therapies. As epigenetic mechanisms play a crucial role in regulating gene expression, we explored the possible role of drug-induced modifications of SSTR2 surface expression to improve therapeutic response to SSTR2-targeted therapy in a SSTR2-deficient PNET model.

Methods: PNET cell lines BON1 and QGP1 were treated with HDAC inhibitor Entinostat (Syndax Pharmaceuticals, Inc.). The QGP1 xenograft mouse model harboring low basal SSTR2 expression, was used to analyze the therapeutic efficacy of combined sequential HDAC inhibitor and 177Lu-DOTATATE therapy. SSTR2 expression was evaluated by FACS. 177Lu-DOTATATE (2MBq/mouse) was injected by tail vein and after 24h, the activity of 177Lu-DOTATATE was measured in tumors and other organs.

Results: A significant increase in SSTR2 surface expression was found in BON1 and QGP1 cells at 500nM after 72h of Entinostat treatment (500nM is the median C_{max} in patients and the 72h exposure mimics the AUC in patients after 1 dose of entinostat 5mg). A significant surface increase of SSTR2 was seen in QGP1 tumors with Entinostat at 6mg/kg (p<0.0169) and 12mg/kg (p<0.0354) after 5 days of treatment. This translates into a significant increase of 177Lu-DOTATATE uptake in Entinostat-treated mice with 12mg/kg for 5 days (p<0.0004). Notably, after an initial decrease in body weight the mice maintained their weight until the end of study. Entinostat treatment followed by 177Lu-DOTATATE demonstrated limited toxicity as evidenced by minimal uptake of 177Lu-DOTATATE in all major organs.

Conclusions: Our findings indicate that the HDAC inhibitor Entinostat increases the surface expression of SSTR2 *in vitro* and *in vivo* PNET model. This model can be leveraged to improve targeting of SSTR2-deficient tumors with 177Lu-DOTATATE therapy, and potentially allow for more effective targeted therapy in patients with receptor-negative metastatic PNETs.

50. Multi-genomic Analysis of the Metabolome Identifies the Amino Acid Transporter SLC7A11/xCT as a Novel Biomarker Correlating with Poor Survival in Adrenocortical Carcinoma

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Background: Adrenocortical carcinoma (ACC) still carries a poor prognosis for most patients since advanced stage is common at diagnosis. Despite metabolic genes being involved in tumor initiation and progression, multi-genomic analysis of the metabolome in ACC patients has not been reported. Therefore, we hypothesized that metabolic signatures correlated with survival outcomes can identify novel prognostic and diagnostic biomarkers in adrenocortical carcinoma.

Methods: The GEO2R program NCBI Gene Expression Omnibus identified the expression of metabolic enzymes in ACC and normal adrenal data sets. Metabolic genes and transporters were identified from MSigDB. Kaplan-Meier curves for dysregulated enzymes were identified in UALCAN. STRING network was used to identify the pathways. GEPIA identified correlation between the differentially expressed genes. miRNA network for the metabolic regulator was identified using miRnet.

Results: Analysis of metabolic genes and transporters differentially regulated in 93 primary ACCs vs 100 metastatic tumors vs. 35 normal adrenals from 4 primary and two metastatic data sets. 2752 metabolism related genes and transporters were evaluated identifying 25 up-regulated and 93 down-regulated ($p < 0.05$) genes in all six datasets. Pathway analysis revealed lipid, arachidonic acid, SLC transport and steroid regulation mechanisms as the top differentially regulated pathways. Survival analysis of the differentially expressed genes and transporters in TCGA data in UALCAN identified up-regulation of SLC7A11, DHFR, TYMS, RRM2, GGH and down-regulation of SLC27A2, SLC9A9, BDH2, DPYS, BHMT2, STAR as hub prognostic metabolic signatures. Correlation analysis showed significant correlation ($p < 0.0001$) between SLC11A1/xCT and other up-regulated hub metabolic signatures. Analysis of miRnet identified has-mir-214-3p, has-mir-147a and has-let-7b-5p as potential miRNA targets for the metabolic signature genes.

Conclusions: SLC7A11/xCT was identified through metabolic pathway analysis as a novel biomarker in ACC. Ferroptosis regulating mir-214-3p via the SLC7A11/xCT network was significantly associated with poor overall survival in ACC. Further translational studies are needed to validate this gene as a potential therapeutic target for clinical translation.

IN MEMORIAM

Orlo H. Clark, MD

August 7, 1941 – October 11, 2022



Founding member of our society and past President, Dr. Orlo Herrick Clark passed peacefully on October 11, 2022. He was a world-renowned endocrine surgeon and a mentor and friend to countless endocrine surgeons across the globe. He was a true pioneer in our field, a towering figure with numerous scientific and clinical contributions to the understanding and treatment of thyroid cancer, primary and secondary hyperparathyroidism, and adrenal and endocrine pancreatic disease. He was a driving force in establishing endocrine surgery as the highly respected subspecialty of general surgery it has become. He was

a founding member of both the American Association of Endocrine Surgeons and the International Association of Endocrine Surgeons.

Dr. Clark spent his entire career at the University of California, San Francisco where he created prestigious research and clinical fellowships in endocrine surgery that were among the very first of their kind anywhere in the world. Over the past several decades many dozens of endocrine surgeons trained and performed research under his tutelage. Former trainees and fellows of Orlo Clark have served not only as leaders in the AAES, but also of medical societies and in surgical departments around the world.

Dr. Clark received innumerable awards and accolades throughout his career, culminating in the Oliver Cope Meritorious Achievement Award from the AAES in 2006. In 2017 the AAES established the Orlo and Carol Clark Distinguished Lecturer in Endocrine Surgery, selected annually by the AAES President.

In addition to serving as President of the AAES from 1993-1994 and the International Association of Endocrine Surgeons from 1995-1997, he served as President of the Northern California Chapter of the American College of Surgeons (1986), the San Francisco Surgical Society (1987), the American Thyroid Association (1999), and the Pacific Coast Surgical Association (2009). Orlo was most proud, however, of the fellows he trained and mentored, and the many cherished friends that he and his wife Carol made around the world during his illustrious career.

Orlo Clark was a beloved and irreplaceable figure in our field, and he will be dearly missed.



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