



2026 GSA

Summer Meeting

Legacy Lodge at Lake Lanier Islands

August 21-23

Syllabus



Activity Directors:

Austin DeBeaux, MD

Devin Weinberg, MD, PhD





GEORGIA SOCIETY
of ANESTHESIOLOGISTS

2026 GSA Summer Meeting

August 22-23, 2026 – Buford, GA

Jointly provided by American Society of Anesthesiologists and
The Georgia Society of Anesthesiologists

Accreditation Statement

This activity has been planned and implemented in accordance with the accreditation requirements and policies of the Accreditation Council for Continuing Medical Education (ACCME) through the joint providership of American Society of Anesthesiologists and The Georgia Society of Anesthesiologists. The American Society of Anesthesiologists is accredited by the ACCME to provide continuing medical education for physicians.

Physician Continuing Education

The American Society of Anesthesiologists designates this live activity for a maximum of 6.0 *AMA PRA Category 1 Credit(s)*[™]. Physicians should claim only the credit commensurate with the extent of their participation in the activity.

CME Session Learning Objectives

Yawar Qadri, MD, PhD, Emory University: Leading Edge Pain Interventions

At the end of this presentation, the learners will be able to:

- Describe new pharmacologic therapies for pain management and their proposed mechanisms.
- Evaluate emerging regional anesthesia techniques and their current evidence base.
- Recognize indications, benefits, and limitations of implantable pain therapies.
- Identify promising future directions in pain medicine and areas where evidence is still evolving.

Basem Abdelmalak, MD, Cleveland Clinic: Non-Operating Room Anesthesia (NORA) - Complexities, Opportunities, and Quality Monitoring & Process Improvement

At the end of this presentation, the learners will be able to:

- The scope of NORA practice in the USA
- The sources of complexity and challenges (and solutions) in NORA
- Clinical, administrative aspects and improving efficiency in NORA
- NORA related policies, protocols and guidelines
- Safety of NORA
- How to monitor and improve quality metrics

Caitlin Bradley, MD, Grady: Cardiac Trauma

At the end of this presentation, the learners will be able to:

- Describe the incidence and types of cardiac and trauma
- Explain how to better predict outcomes of cardiac trauma based on type of injury
- Review trauma protocols for cardiac trauma
- Discuss new technologies for cardiac trauma salvage

Basem Abdelmalak, MD, Cleveland Clinic: ENT Anesthesia: Airway Management and Beyond

At the end of this presentation, the learners will be able to:

- Review The Difficult ENT airway
- Explain the Difficult Airway Algorithm
- Evaluate available videolaryngoscopes, and bronchoscopes utilized in airway management.
- Describe the equipment and technique for awake intubation
- Discuss Jet ventilation and High Flow NC oxygenation, and ventilation
- Outline other important ENT Anesthesia issues beyond airway management
- Justify clinical pearls in airway management for bronchoscopy, and IP

Elizabeth Lange, MD, Emory University: Updates in Neuraxial Labor Analgesia

At the end of this presentation, the learners will be able to:

- Participants will be able to delineate evidence-based practice and SOAP Center of Excellence best practices for neuraxial labor analgesia.
- Compare the onset time, block quality, and side effects of combined spinal-epidural (CSE) analgesia against dural puncture epidural and traditional epidural techniques for labor.
- Evaluate the clinical efficacy of programmed intermittent epidural bolus (PIEB) versus continuous epidural infusion (CEI).
- Optimize local anesthetic and adjuvant drug selections to maximize maternal comfort while minimizing motor block.

Akbar Herekar, MD, MCG: Preoperative Optimization in the Era of AI

At the end of this presentation, the learners will be able to:

- Describe the current evidence supporting preoperative optimization, including carbohydrate loading, ERAS pathways, and multimodal prehabilitation.
- Explain how algorithmic clinical decision support and agentic AI can operationalize complex, individualized evidence-based perioperative pathways that were previously too resource-intensive to deliver.
- Integrate personalized prehabilitation measures, such as VO₂ max, grip strength, protein targets, and staged exercise progression, into a patient-specific preoperative plan.
- Evaluate the opportunities, limitations, and team-based implementation considerations of AI-augmented perioperative optimization in the preoperative clinic.

Target Audience

This conference is intended for anesthesiologists, anesthesiology assistants, residents, fellows, AA and medical students.

Planner, Faculty and Staff Disclosure

Name	Role	Relevant Financial Relationships
Austin DeBeaux, MD	Activity Director	Has no relevant financial relationships with ineligible companies
Devin Weinberg, MD, PhD	Activity Director	Has no relevant financial relationships with ineligible companies

Andrea Corujo-Rodriguez, MD	Planner	Has no relevant financial relationships with ineligible companies
Ragini Gupta, MD	Planner	Has no relevant financial relationships with ineligible companies
Gautam Sreeram, MD	Planner	Has no relevant financial relationships with ineligible companies
Yawar Qadri, MD, PhD	Faculty	Independent Data Monitoring Committee: Uniqure
Basem Abdelmalak, MD	Faculty	Consultant, Advisor, Speaker: Medtronic, Mindray North America
Caitlin Bradley, MD	Faculty	Has no relevant financial relationships with ineligible companies
Elizabeth Lange, MD	Faculty	Has no relevant financial relationships with ineligible companies
Akbar Herekar, MD, MCG	Faculty	Has no relevant financial relationships with ineligible companies

All relevant financial relationships for this activity have been mitigated.

All other planners, faculty, reviewers, moderators, and staff have disclosed no relevant financial relationships with ineligible companies.

Disclosure Policy

The American Society of Anesthesiologists remains strongly committed to providing the best available evidence-based clinical information to participants of this educational activity and requires an open disclosure of any potential conflict of interest identified by our faculty members. It is not the intent of the American Society of Anesthesiologists to eliminate all situations of potential conflict of interest, but rather to enable those who are working with the American Society of Anesthesiologists to recognize situations that may be subject to question by others. All disclosed conflicts of interest are reviewed by the educational activity course director/chair to ensure that such situations are properly evaluated and, if necessary, mitigated. The American Society of Anesthesiologists educational standards pertaining to conflict of interest are intended to maintain the professional autonomy of the clinical experts inherent in promoting a balanced presentation of science. Through our review process, all American Society of Anesthesiologists CME activities are ensured of independent, objective, scientifically balanced presentations of information. Disclosure of any or no relationships will be made available for all educational activities.

Disclaimer

The information provided at this CME activity is for continuing education purposes only and is not meant to substitute for the independent medical judgment of a healthcare provider relative to diagnostic and treatment options of a specific patient's medical condition.

Instructions on How to Receive CME Credit

In order to receive CME credit, participants must follow these steps at the conclusion of the conference:

1. Access conference evaluation here: [Course: 2026 GSA Summer Meeting](#)
2. Sign-in using your ASA member login credentials or you can create an ASA account at no charge.
3. Select “Enroll Now” in the upper right corner
3. Complete all evaluation questions.
4. Your credit will be made immediately available for download.

It is highly recommended that you claim credit within two weeks of the conference.

American Society of Anesthesiologists will report your CME credit directly to the Accreditation Council for Continuing Medical Education (ACCME).

To view your credits and download your transcript, create a free account at: www.cmepassport.org.

CME Passport is a secure and free platform provided by ACCME, the national accrediting authority for CME.



ASA: Working for You

Maig S. de Lanza, MD, MBA, FASA | First Vice President

August 22, 2026



Disclosures & Objectives

- Nothing to disclose
- Objectives: Participants will learn
 - ASA's focus on delivering value for members
 - How ASA is implementing our Strategic Plan nationally, and in the states, to address current challenges
 - Key trends facing the specialty in the marketplace, legislative, and regulatory arenas

Special "Thank you" to...

ASA Director & Alternate Director



William R. Lane, Jr., MD, MBA, FASA
Director, Georgia Society of Anesthesiologists



Steven L. Sween, MD, FASA
Alternate Director, Georgia Society of Anesthesiologists

ASA Past Presidents

- 1965 – Perry P. Volpitto, MD
- 1970 – John E. Steinhaus, MD, FACA
- 1999 – John B. Neeld, Jr., MD, FACA

Anesthesiologists of Note

- Michelle Au, MD, Georgia House of Representatives (District 50)

Special "Thank you" to...

ASA Committee Chairs

- Matthew A. Klopman, MD, FASA, Chair, Committee on Occupational Health
- Sona S. Arora, MD, FASA, Chair, Abstract Review Subcommittee on Geriatric Anesthesia
- Rachel A. Hadler, MD, Chair, Committee on Palliative Care

State Component Officers

- Stephen Anderson, MD, President
- William Hallows, Jr., MD, President-Elect
- Caryl Bailey, MD, FASA, Vice President
- Joanna Schindler, MD, FASA, Secretary/Treasurer
- Rachel Steckelberg, MD, Immediate Past President

We are ASA: Leaders in Patient Safety

Mission: Advancing the practice and securing the future

Vision: A world leader improving health through innovation in quality and safety

Values: Patient safety, physician-led care and scientific discovery

Strategic Pillars

1. Advocacy
2. Patient Safety, Quality & Practice Advancement
3. Educational Resources
4. Member Engagement
5. Leadership & Professional Development
6. Research & Scientific Discovery
7. Stewardship of the Society & Specialty

the
ANESTHESIOLOGY[®]
annual **meeting**

American Society of **Anesthesiologists**[®]

San Diego ✦ **October 16–20, 2026** ✦ **#ANES26**

Breakthrough ideas.
Stimulating research.
Extensive CME.

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way to interact with
my profession."*

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**The countdown to
next year begins now!**

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you can use, connections that matter,
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your business first.



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opens by scanning the
QR code or visiting:
asahq.org/ADVANCE27



ASAPAC Update



Thank You Georgia ASAPAC Contributors!

**More than
150
contributors in
2026 to date!**



asapac.asahq.org/honorroll

Special Thank You to....

Special Thank You to Georgia 2026 YTD ASAPAC Contributors: Council Chair Level

- Kurt Briesacher
- Heather Dozier
- William Hallowes
- Julius Hamilton
- Judith Handley
- Anne Hartney-Baucom
- Akbar Herekar
- Keith Johnson
- Michael Kissel
- Matthew Klopman
- William Lane
- Steffen Meiler
- Gordon Morewood
- Oluwatosin Oladipupo
- Gaurav Patel
- Devendra Shantha
- John Stephenson
- Cinnamon Sullivan
- Steven Sween

ASAPAC Update

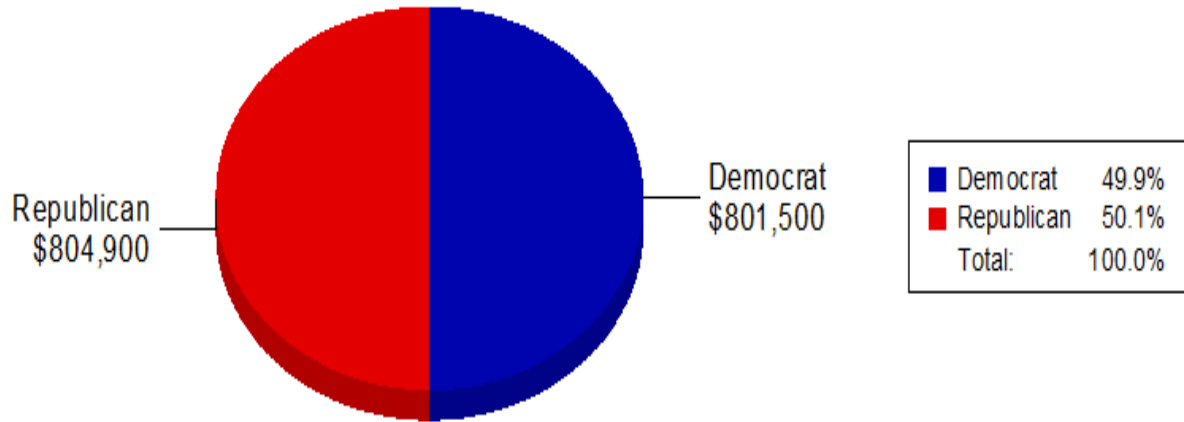


Why Contribute? Our Dollars Make a Real Difference

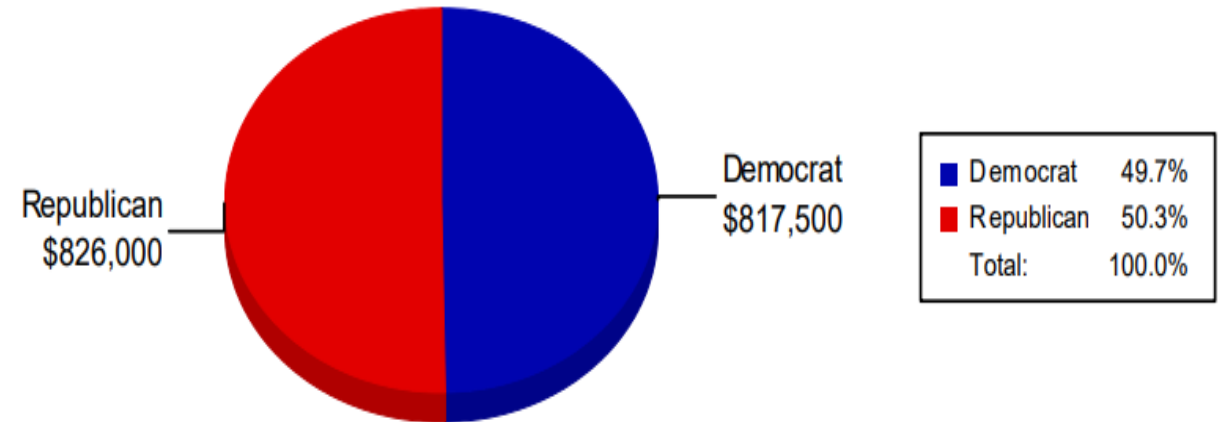
- Patient safety and quality of care
- Economic strength and sustainability of our practices
- Assure physician-led team-based care
- Advocating for scientific discovery, the cornerstone of what we are
- Assuring adequate support and advocacy for education and training the next generation of anesthesiologists
- **The power of unity and combined resources!**

ASAPAC's Balanced Giving: 2022 Election Cycle vs. 2024 Election Cycle

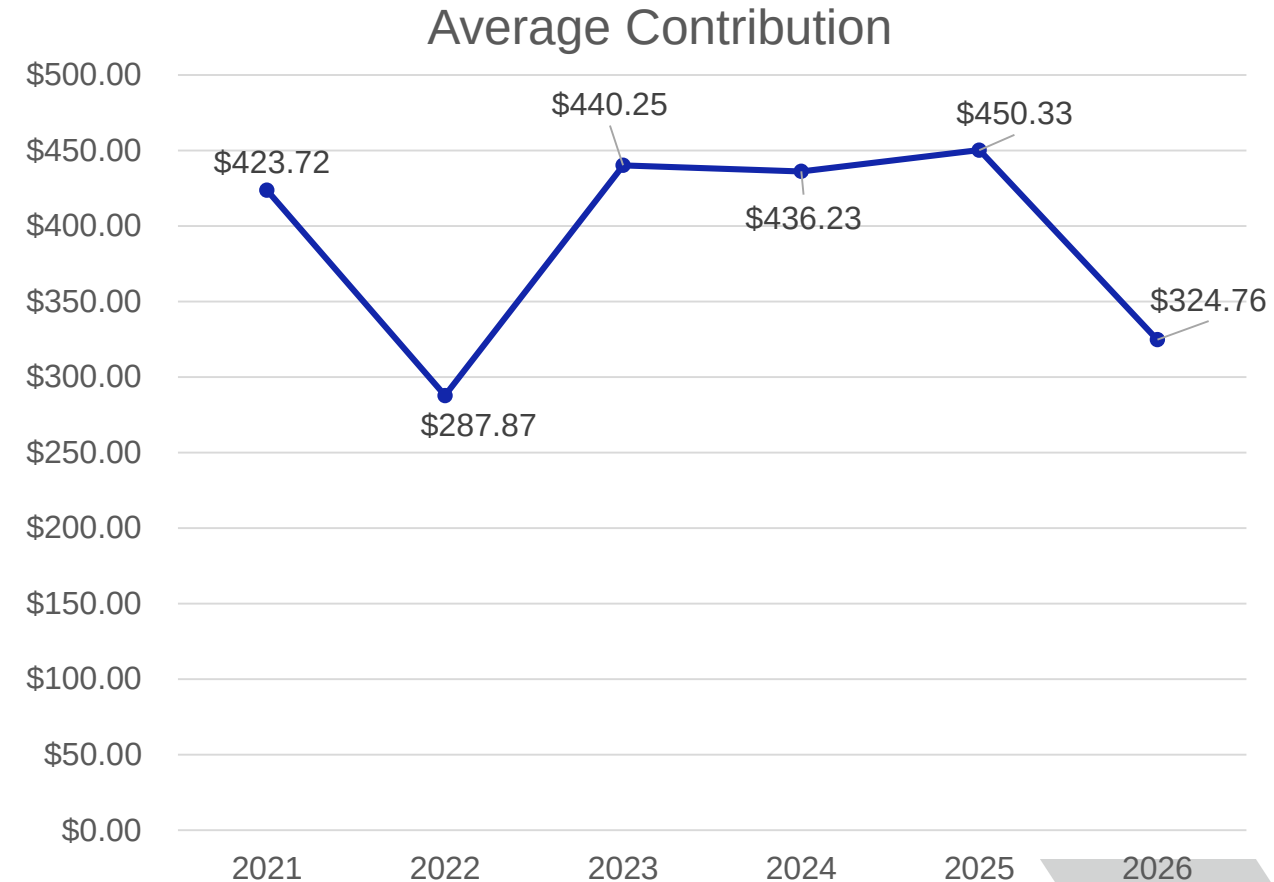
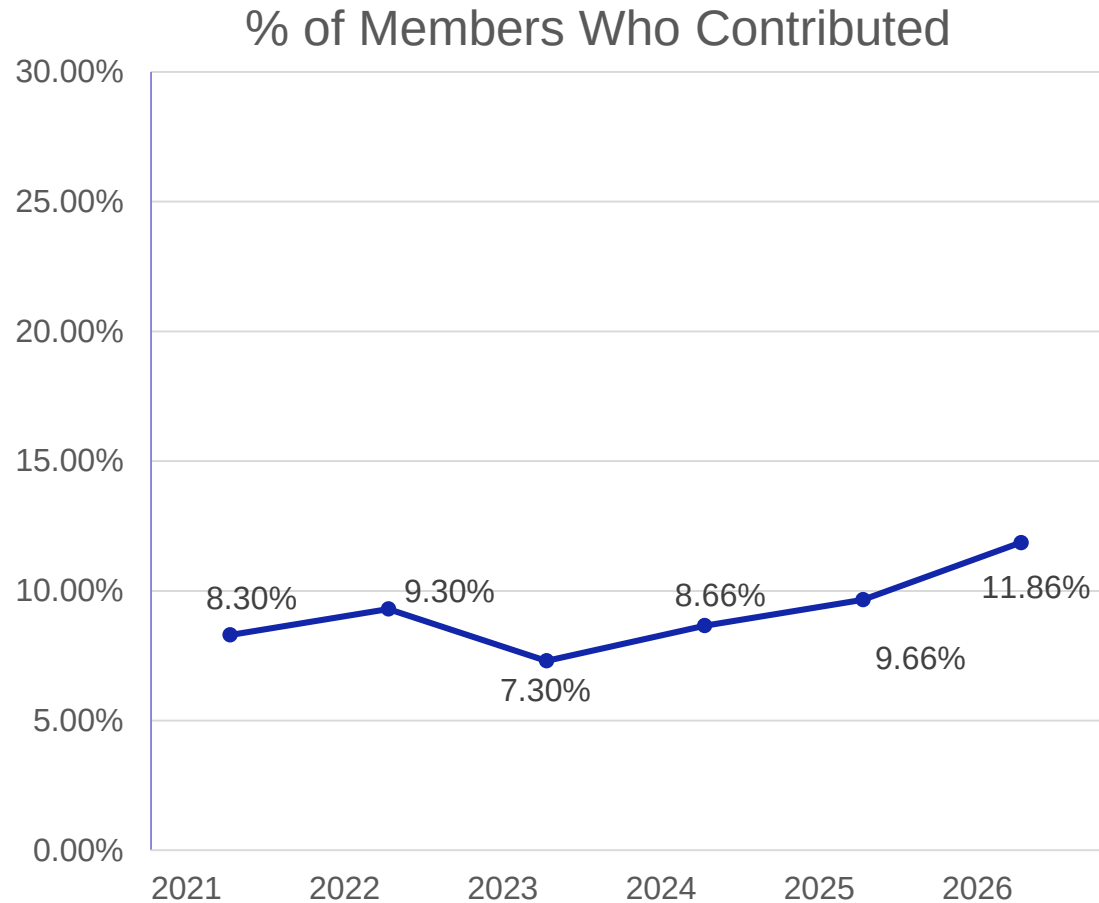
2022 Election Cycle Total Expenditures by Party



2024 Election Cycle Total Expenditures by Party



ASAPAC Activity by Georgia Members

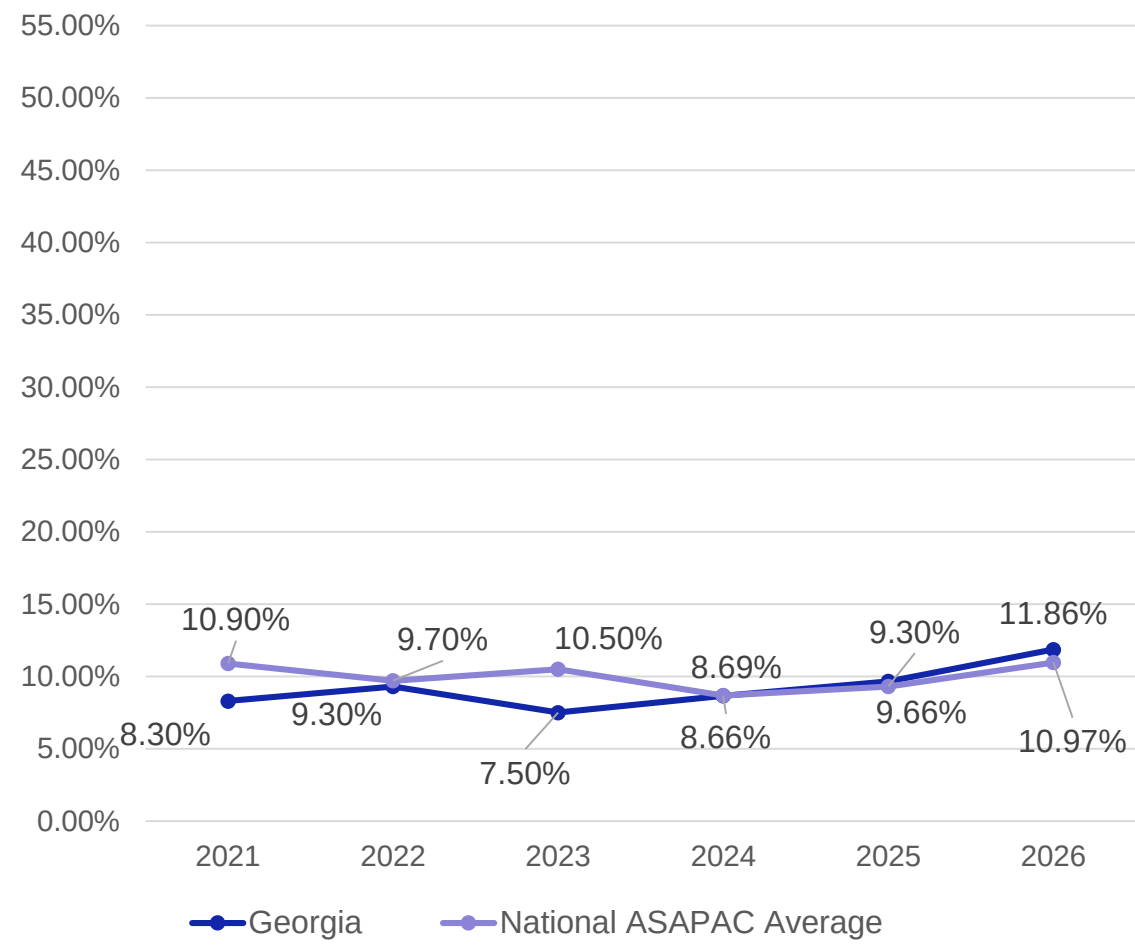


ASAPAC's Fiscal Year 2026 national average participation rate is 10.97%, as of June 30, 2026. (Fiscal Year 2026 runs from October 1, 2025 – September 30, 2026).

ASAPAC's Fiscal Year 2026 national average contribution is \$365.22, as of June 30, 2026. (Fiscal Year 2026 runs from October 1, 2025 – September 30, 2026)

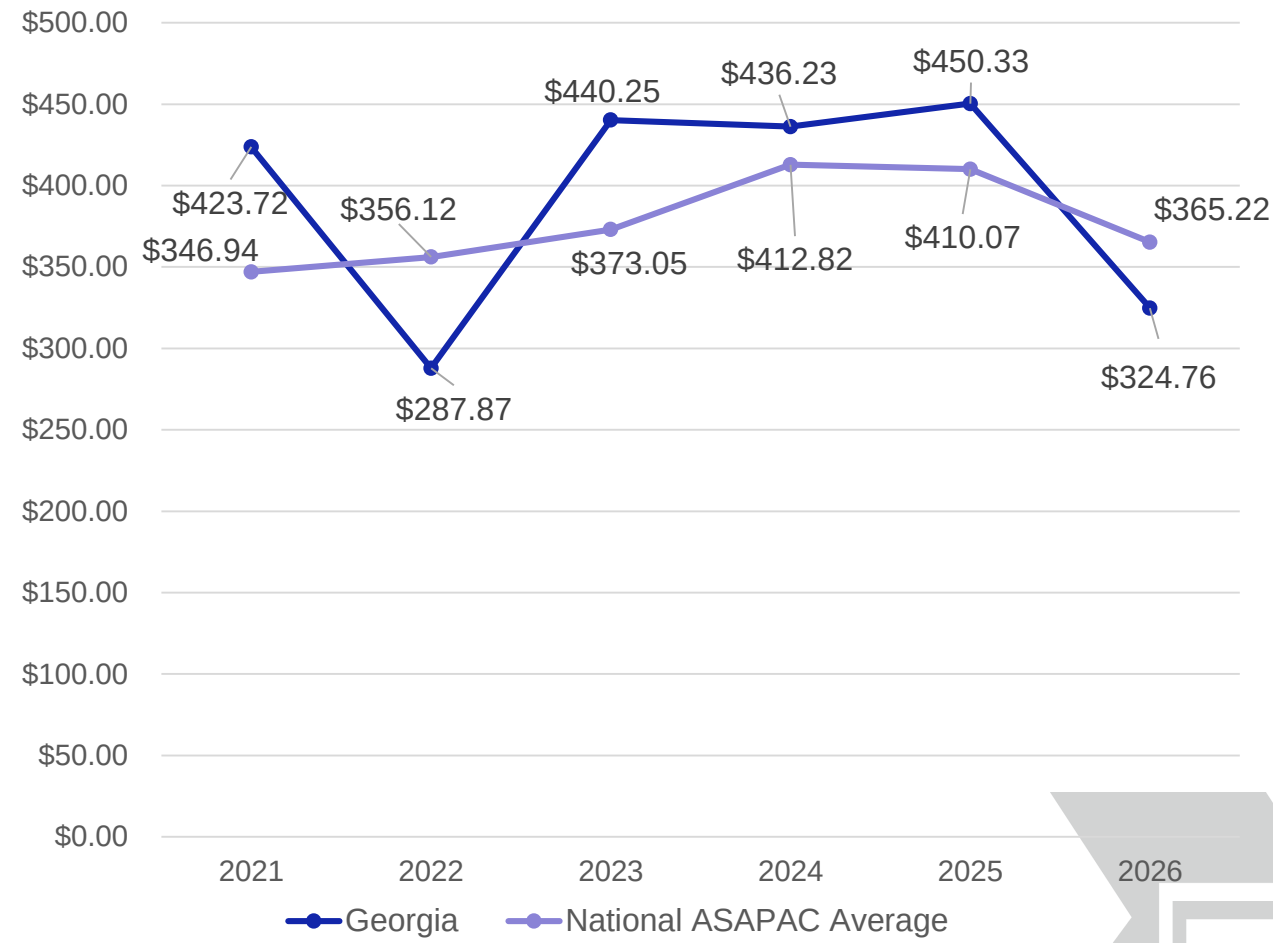
Georgia ASAPAC Member Averages vs. National ASAPAC Averages

% of Members Who Contributed



ASAPAC's Fiscal Year 2026 national average participation rate is 10.97%, as of June 30, 2026.
(Fiscal Year 2026 runs from October 1, 2025 – September 30, 2026).

Average Contribution



ASAPAC's Fiscal Year 2026 national average contribution is \$365.22, as of June 30, 2026.
(Fiscal Year 2026 runs from October 1, 2025 – September 30, 2026)

Fiscal Year 2026 Participation: Residency Programs

Platinum Status

Residency programs who achieve 100% ASAPAC participation

- Corewell Health
- Cleveland Clinic Florida
- Jersey Shore University Medical Center
- Mayo Clinic Arizona
- Mount Sinai
- Sunrise Health GME Consortium
Anesthesiology
- Tulane University
- University of Arizona
- University of Texas at Tyler Health Science Center

Gold Status

Residency programs who achieved at least 50% ASAPAC participation

- Henry Ford Health
- Cleveland Clinic South Pointe
- University of North Carolina – Chapel Hill
- Baylor Scott & White

2024 Election Cycle Total Contributions

Organization	Dollar Amount	
American Society of Anesthesiologists PAC	\$3,882,491	American Medical Association \$2,096,338
American Dental Association PAC	\$2,228,047	
American Academy of Dermatology Association PAC	\$2,046,801	BlueCross BlueShield \$2.9 million
American Association of Orthopaedic Surgeons PAC	\$1,957,954	
American College of Radiology PAC	\$1,653,916	
American College of Emergency Physicians PAC	\$1,613,599	
American Academy of Ophthalmology	\$904,559	
American College of Ob-Gyns	\$798,388	
American Osteopathic Information Association	\$753,495	
American College of Cardiology PAC	\$670,778	
American College of Surgeons	\$662,453	
American Academy of Neurology	\$539,868	

2024 Election Cycle Contributions, according to Federal Election Committee (FEC) two-year financial summary as of December 31, 2024.

ASAPAC QR Code – Don't Leave Home Without It!



**Fiscal Year 2026 ends on September 30, 2026.
Contribute today!

Advocacy Update



LEGCON 2026 Program

State Issues

Defend Anesthesiologists-Delivered
and Led Care

Block Abusive Insurer Policies

Safeguard Medical Titles

Improve Medicaid Payments

Securing and Strengthening Hospital
Bylaws

Federal Issues

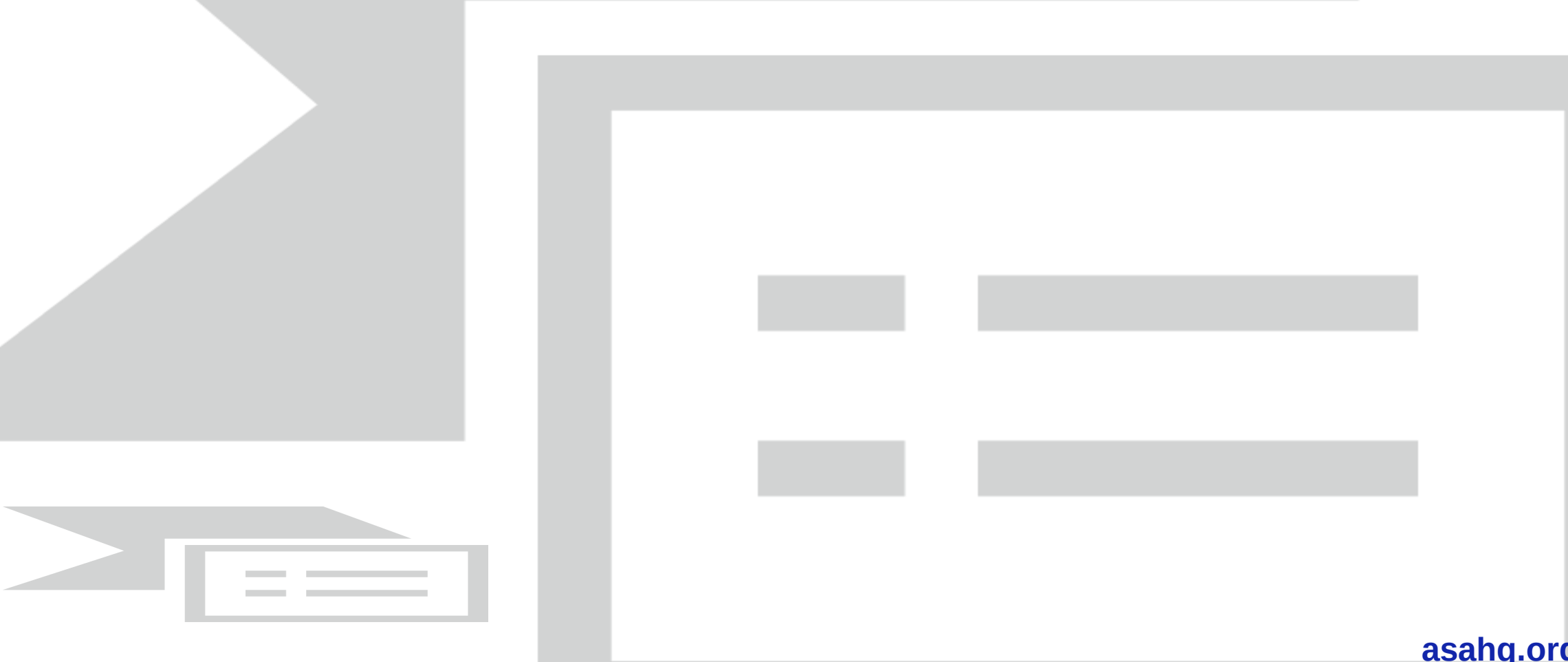
Halt Insurer Abuse Under the
No Surprises Act

Protect Veterans Care

Invest in NIH Research
Funding

Improving Medicare Payments

Anesthesiologist-led Care



Preserving Anesthesiologist-led Care - *Federal*

What's happening

- ASA is successfully defending pro-anesthesiologist-led and delivered care models in both the U.S. Department of Veterans Affairs (VA) and the Centers for Medicare and Medicaid Services (CMS)



Why it matters

- ASA Board Designated Funds (BDF), along with the active engagement of Congressional allies, Veteran Service Organizations (VSO), AVAA and other supporters, have supported preservation of national policies that endorse and affirm the role of anesthesiologists



Jewish War Veterans (JWV)

“JWV urges VA to maintain VHA Directive 1123 as the National Standard of Practice for CRNAs...

JWV calls on...the VA Office of Inspector General to look into the circumstances surrounding the bylaws changes.”

- JWV statement before a Joint Committee meeting of the Senate and House VA Committees, March 3, 2026

Statement of
Jewish War Veterans of the USA 119th
Congress Legislative Priorities Before
the Joint House and Senate Veterans
Affairs Committees

March 3, 2026



Presented by
Scott P. Stevens, CWO4, USA (R)
National Commander 2025-2026

Preserving Anesthesiologist-led Care - *Federal*

What's next

- Over 100 members of Congress urge VA Secretary to preserve anesthesiologist-led care
 - “The current framework promotes established best practices utilized by the nation’s top hospitals without introducing untested or uncertain alternatives.”
- Developing support mechanisms for local VA anesthesiologists
 - Resources to strengthen bylaws



June 29, 2026

We write to urge you and your senior leadership team to provide long-overdue clarity regarding the Department of Veterans Affairs (VA) anesthesia safety standards by affirming and maintaining the current policy framework under Directive 1123.

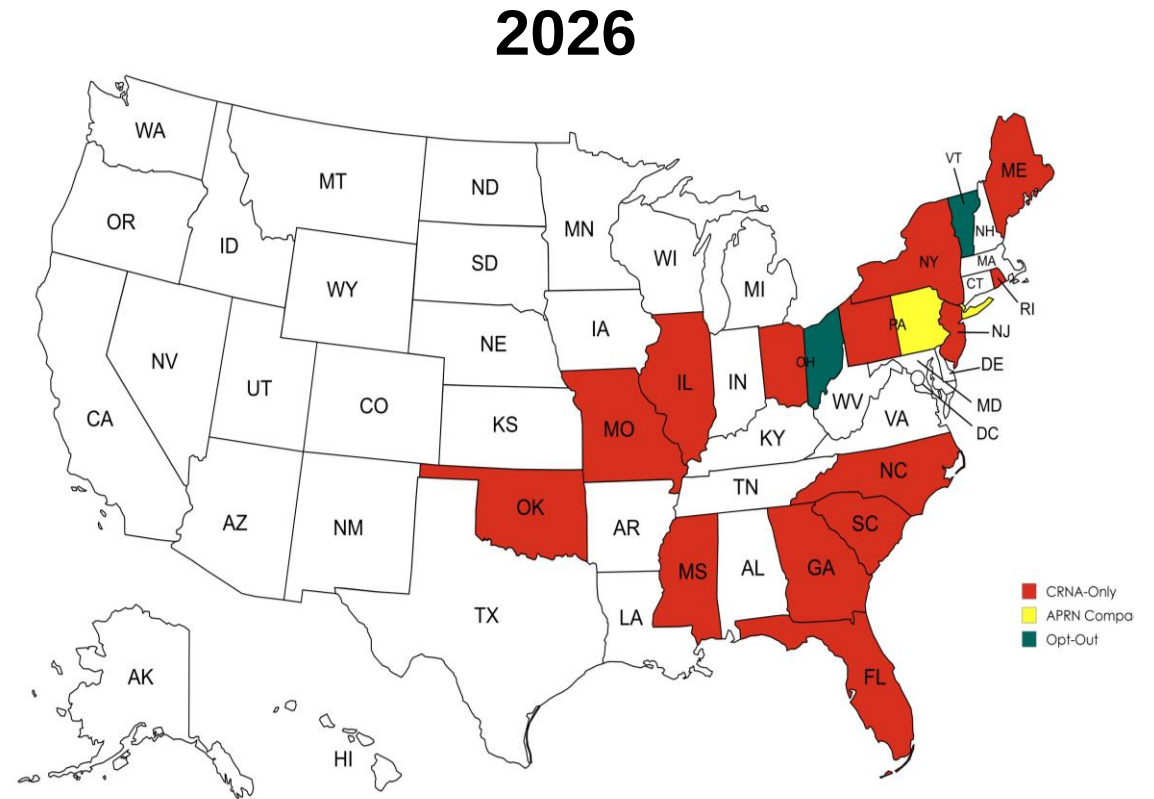
Preserving Anesthesiologist-led Care - States

What's happening

- Defeating state proposals to weaken anesthesiologists-delivered and led care
 - Defeated 10 state nurse anesthetists practice expansion

Why it matters

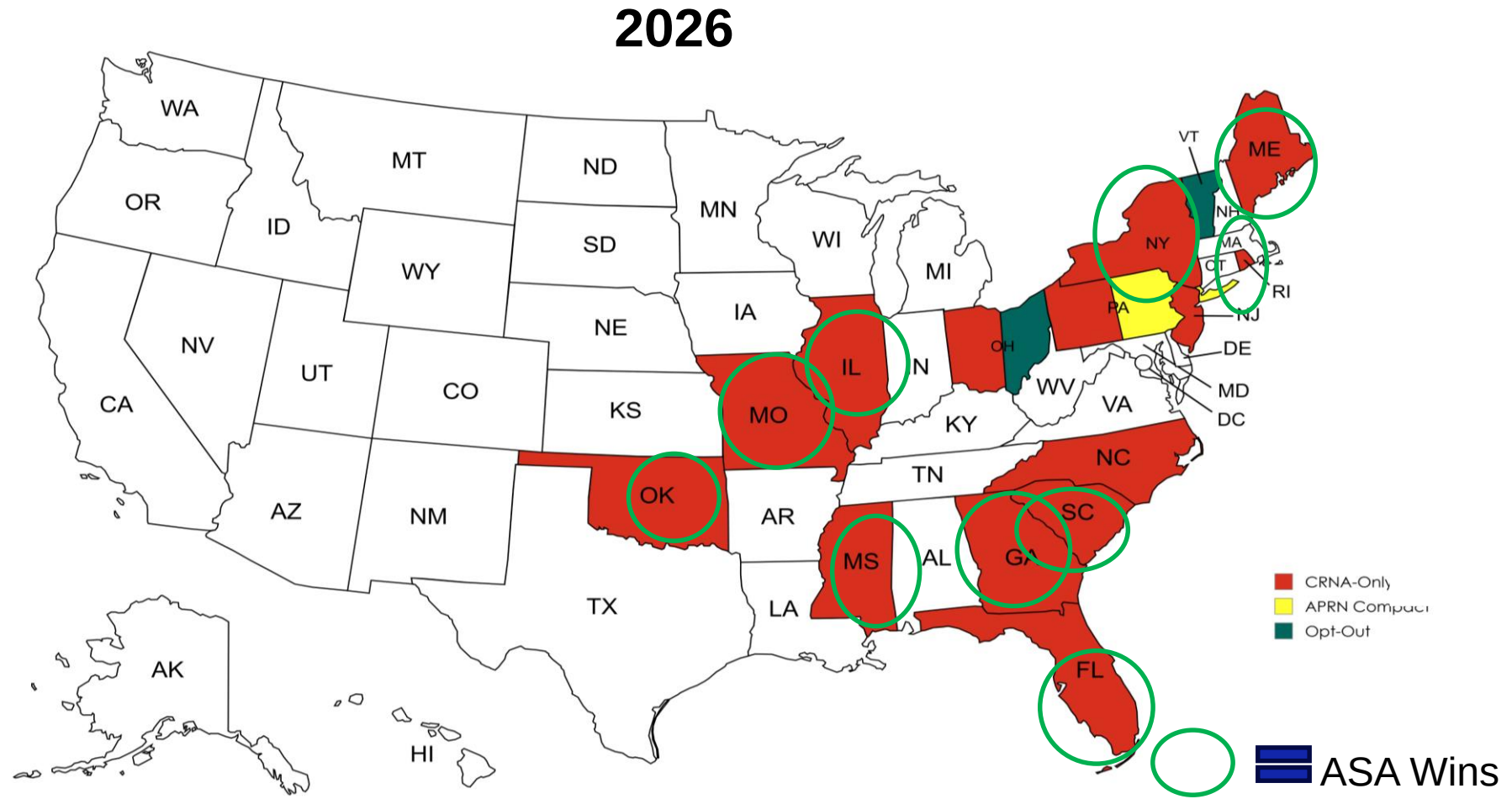
- States are the key battlegrounds for preserving safe models of anesthesia care



Preserving Anesthesiologist-led Care - States

What's next

- Coordinating with State Component Societies



Certified Anesthesiologist Assistants (CAA)

What's happening

- Engaging proactive efforts to implement “The 50 State Strategy”
 - CAA practice authority in 24 state/jurisdictions
 - 9 states since 2021/**3 in 2025: VA, TN, SC**
 - **TN** issued first CAA license in 2026
 - **MO, NV, TN** opened new AA training programs in 2026

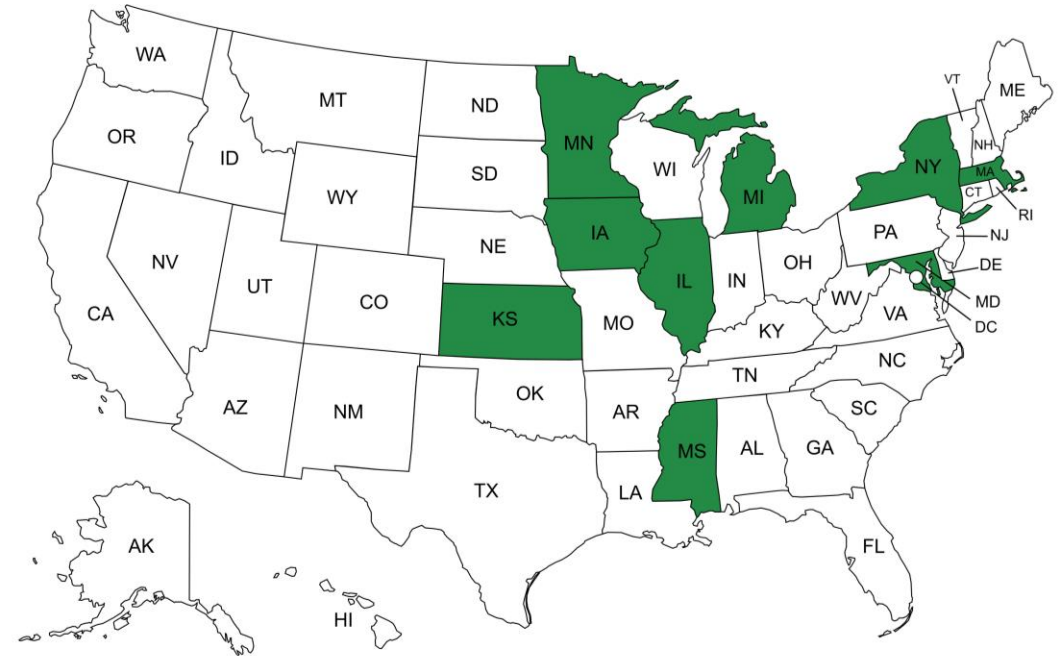
Why it matters

- Expanding a high-functioning, animus-free anesthesiologist-led team-based model

What's next

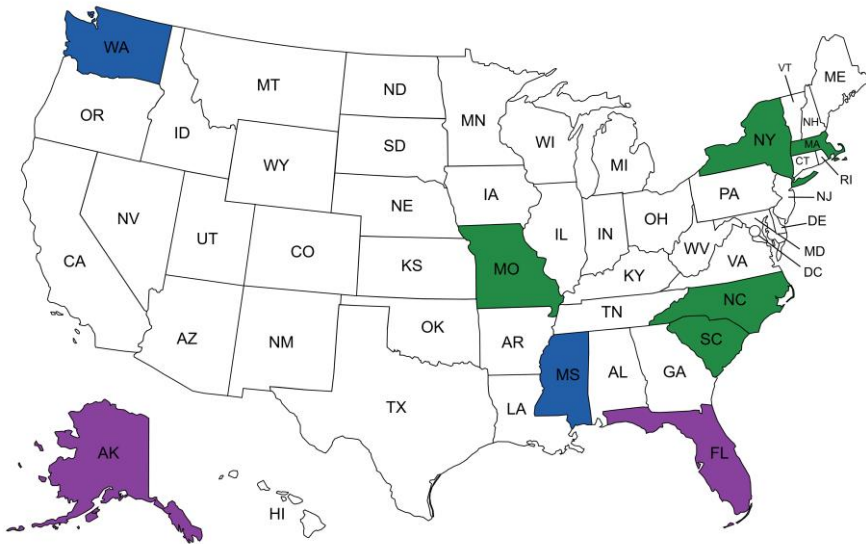
- Coordinating with State Component Societies for 2027

2026



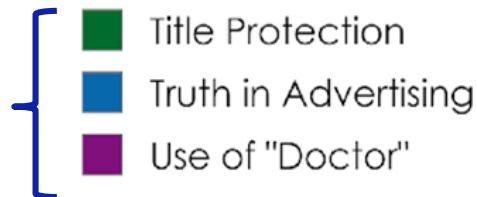
Truth & Transparency: Medical Title Protection

2026



Created with mapchart.net

ASA/Component
Initiatives



What's happening

- Proactively protecting medical titles from appropriation by non-physicians
 - 9 states since 2021/**3 in 2025: CO, WV, WI**

Why it matters

- Medical title laws protect the integrity of physicians and their specialties and support transparency for patients

What's next

- Coordinating with 9 State Component Societies in 2026

UConn Advocacy Win



Issue

Misleading title
Improper 'resident' use
Patient confusion risk



Action

Rapid response
Escalated immediately
Engaged leadership



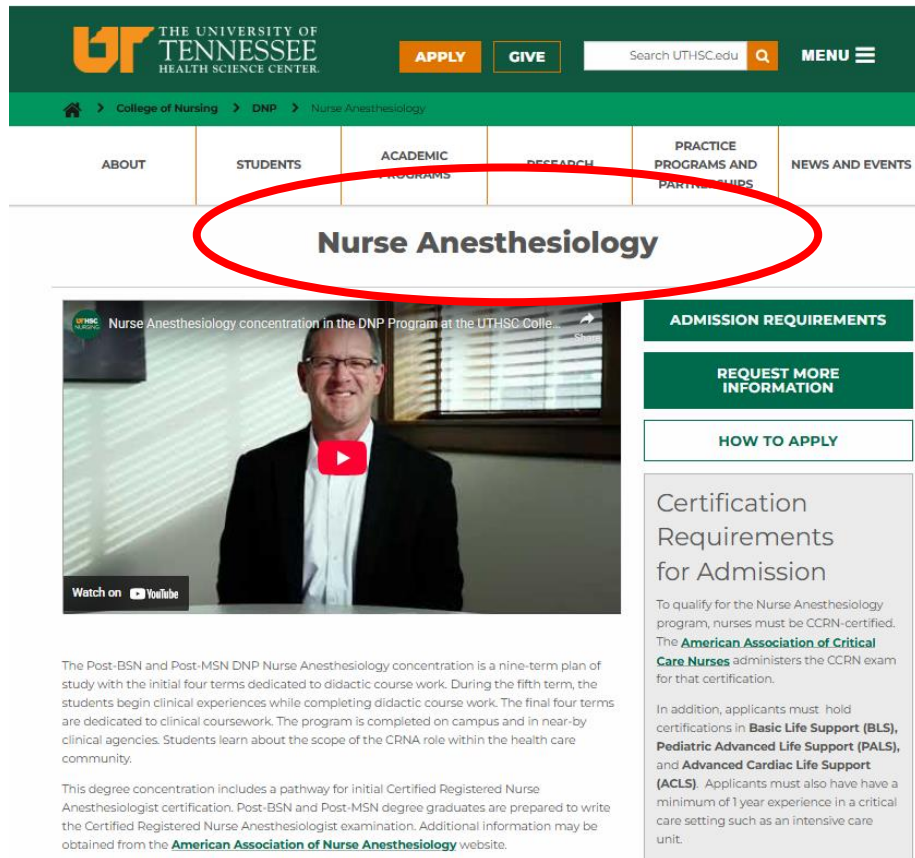
Outcome

Title prohibited
Swift correction
Standards reinforced

Result: Clear roles → Stronger patient trust & safety

Title Protection Laws Matter – ASA – Tennessee Society of Anesthesiologists

Before



THE UNIVERSITY OF TENNESSEE HEALTH SCIENCE CENTER

APPLY GIVE Search UTHSC.edu MENU

College of Nursing > DNP > Nurse Anesthesiology

ABOUT STUDENTS ACADEMIC PROGRAMS RESEARCH PRACTICE PROGRAMS AND PARTNERSHIPS NEWS AND EVENTS

Nurse Anesthesiology

Nurse Anesthesiology concentration in the DNP Program at the UTHSC College of Nursing

Watch on YouTube

ADMISSION REQUIREMENTS

REQUEST MORE INFORMATION

HOW TO APPLY

Certification Requirements for Admission

To qualify for the Nurse Anesthesiology program, nurses must be CCRN-certified. The American Association of Critical Care Nurses administers the CCRN exam for that certification.

In addition, applicants must hold certifications in **Basic Life Support (BLS)**, **Pediatric Advanced Life Support (PALS)**, and **Advanced Cardiac Life Support (ACLS)**. Applicants must also have a minimum of 1 year experience in a critical care setting such as an intensive care unit.

The Post-BSN and Post-MSN DNP Nurse Anesthesiology concentration is a nine-term plan of study with the initial four terms dedicated to didactic course work. During the fifth term, the students begin clinical experiences while completing didactic course work. The final four terms are dedicated to clinical coursework. The program is completed on campus and in near-by clinical agencies. Students learn about the scope of the CRNA role within the health care community.

This degree concentration includes a pathway for initial Certified Registered Nurse Anesthesiologist certification. Post-BSN and Post-MSN degree graduates are prepared to write the Certified Registered Nurse Anesthesiologist examination. Additional information may be obtained from the website of the [American Association of Nurse Anesthesiology](#) website.

After



THE UNIVERSITY OF TENNESSEE HEALTH SCIENCE CENTER

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College of Nursing > DNP > Nurse Anesthesia

ABOUT STUDENTS ACADEMIC PROGRAMS RESEARCH PRACTICE PROGRAMS AND PARTNERSHIPS NEWS AND EVENTS

Nurse Anesthesia

The Post-BSN and Post-MSN DNP Nurse Anesthesia concentration is a nine-term plan of study with the initial four terms dedicated to didactic course work. During the fifth term, the students begin clinical experiences while completing didactic course work. The final four terms are dedicated to clinical coursework. The program is completed on campus and in near-by clinical agencies. Students learn about the scope of the CRNA role in the health care community.

This degree concentration includes a pathway for initial Certified Registered Nurse Anesthetist certification. Post-BSN and Post-MSN degree graduates are prepared to write the Certified Registered Nurse Anesthetist examination. Additional information may be obtained from the website of the [national professional organization](#).

The UTHSC College of Nursing Nurse Anesthesia concentration received continued IFNA recognition in May, 2021, having completed all requirements of the Anesthesia Program Approval Process established by the [International Federation of Nurse Anesthetists](#).

Accreditation

The University of Tennessee Health Science Center's College of Nursing Post-BSN DNP Nurse Anesthesia Concentration is accredited by Council on Accreditation of Nurse Anesthesia

ADMISSION REQUIREMENTS

REQUEST MORE INFORMATION

HOW TO APPLY

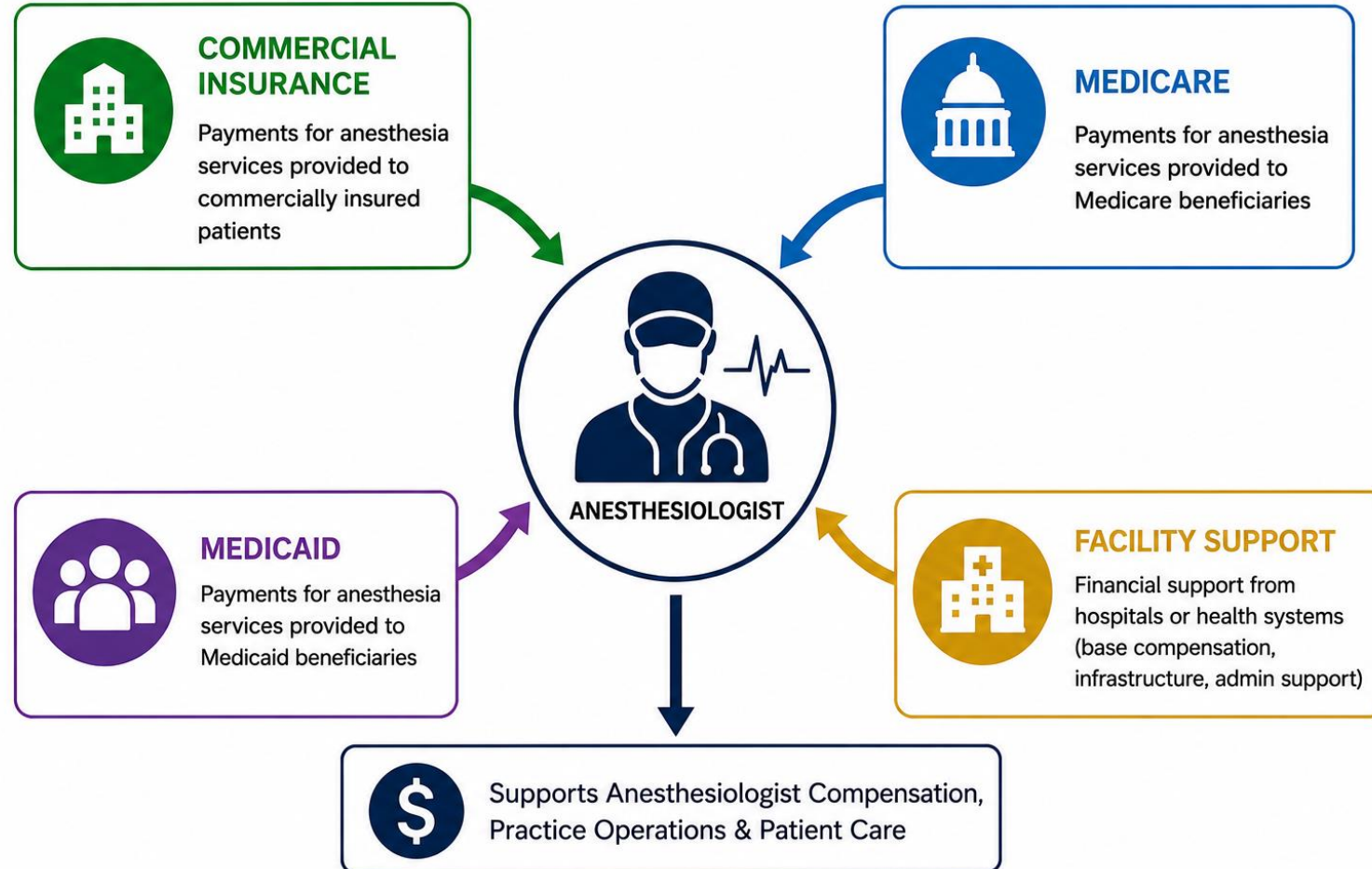
Certification Requirements for Admission

To qualify for the Nurse Anesthesia program, nurses must be CCRN-certified.

Economic Advocacy



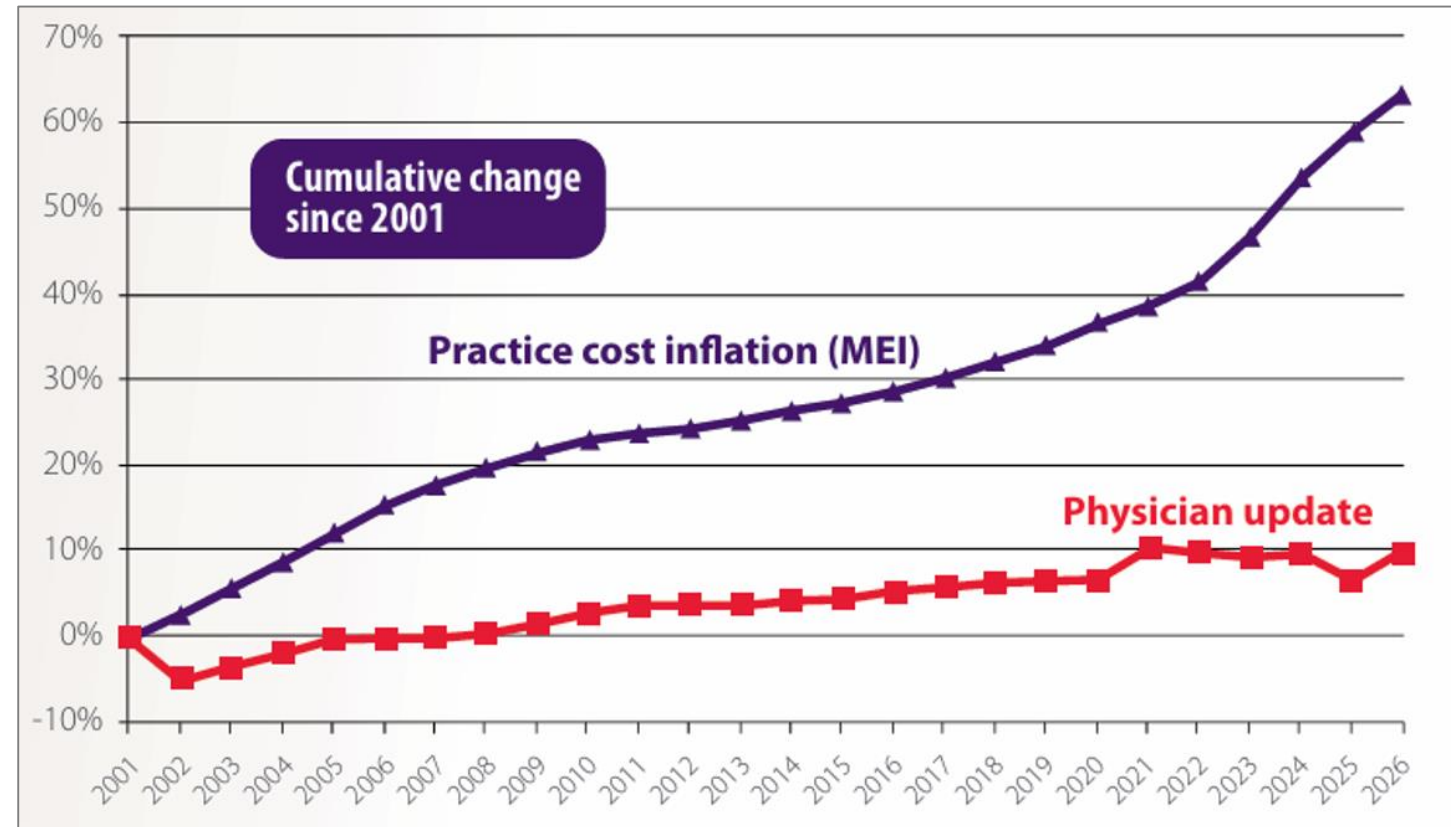
ASA Work on Revenue Stream



Payment Advocacy: Medicare Payment Reform

Medicare Physician Updates Compared to Inflation in Practice Costs (2001–2026)

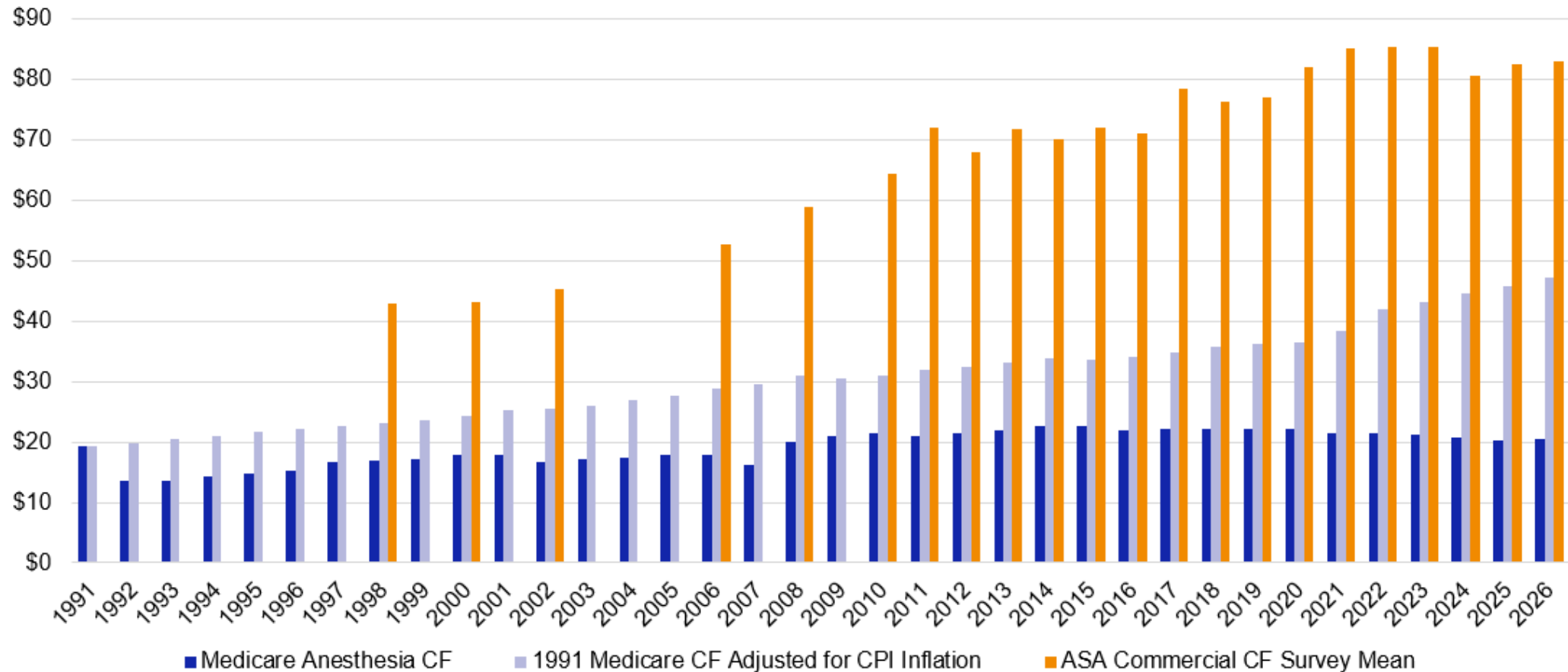
Adjusted for inflation in practice costs, Medicare physician payment **declined 33%** from 2001 to 2026.



Source: American Medical Association. Medicare physician payment continues to fall further behind practice cost inflation [Infographic]. Updated January 2026. Available <https://www.ama-assn.org/system/files/2026-medicare-updates-inflation-chart.pdf>

Payment Advocacy: Medicare Payment Reform

Traditional/FFS Medicare Anesthesia Payment Trends



2015 and 2024 had two distinct Medicare CFs due to rate updates during the year. Data for those years reflects blended rates based on the duration each conversion factor was in effect.

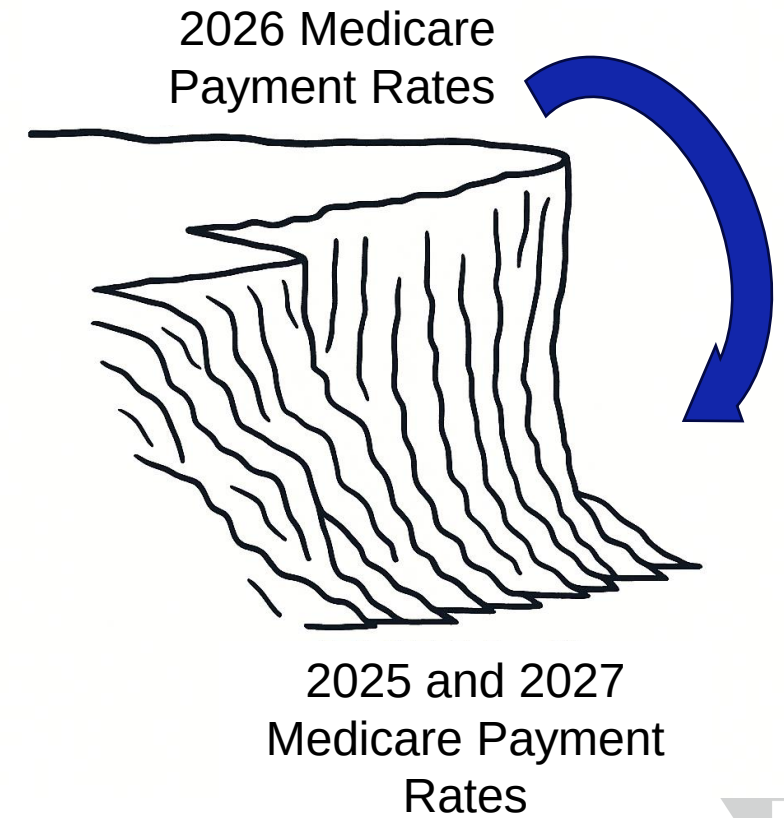
Medicare Payment Reform

What's happening

- Unsustainable payment system
 - Long-term reforms needed
 - Immediate action required now

Why it matters

- Urgent need to reform a large, significantly underfunded, national payer
- One-time 2.5% Congressional fix expires at the end of 2026



Medicare Payment Reform

What's next

Patient First Act

- Annual mandatory inflation update (MEI-1%)
- Budget neutrality reforms
- MIPS replaced with Patient Outcome Improvement National Tabulation System (POINTS)
- Enhanced role for physician specialties to develop measures
- Preserves roles for NACOR and other QCDRs
- Reform of alternative payment models (APM)

Drs. Joyce, Murphy, and Schrier Introduce Bipartisan Patients First Act

July 15, 2026

WASHINGTON, DC – Today, Reps. John Joyce, M.D. (PA-13), Greg Murphy, M.D. (NC-03), and Kim Schrier, M.D. (WA-08), respective chairs of the GOP and Democratic Doctors Caucuses, introduced the bipartisan Patients First Act—comprehensive Medicare Access and CHIP Reauthorization Act (MACRA) reform legislation.

ASA's Rural Access Bill

ASA-Led Medicare Rural Pass-Through Bill Advances

- U.S. House Way and Means Committee approved H.R. 9642, the Medicare Access to Rural Anesthesiology Act, by a unanimous vote
- Modernizes the rural anesthesia pass-through program
- Allows eligible small, low-volume rural hospitals to use more generous Medicare Part A cost-based payments to recruit and retain anesthesiologists



House Ways and Means Committee Chairman Jason Smith (R-Mo.) led the committee's unanimous approval of H.R. 9642 by a vote of 41–0.

Medicaid Challenges

What's happening

- Implementation of Medicaid reforms included in the OBBBA may reduce Medicaid payments and increase uncompensated care

Why it matters

- Reforms will exacerbate challenges in an already troubled program
 - State budgets will be squeezed – payment cuts
 - Hospitals will be stressed by uncompensated and under-compensated care

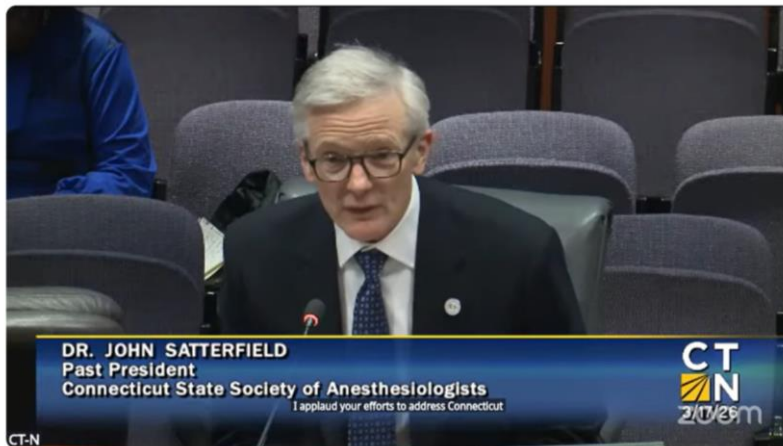


President Trump signs One Big Beautiful Bill Act (OBBBA) into law on July 4, 2025.

Medicaid Challenges

What's next

- Working with ASA State Component Societies to protect and where possible improve Medicaid payments rates
- Supporting anesthesiologists' ability to bill higher paying dental CPT codes; typically, administrative change



CSSA Past President, John Satterfield, MD, testifies in Connecticut legislature on Medicaid payments for anesthesia services.

Payment & Practice Management

Dental Anesthesia and Medicaid: Evolving Policies, Challenges, and Opportunities

Chris D. Glover, MD, MBA, FASA Michael C. Lewis, MD, FASA Tal Levy, MD, MBA Jason Hansen, MS, JD

The intersection of dental care, anesthesia services, and Medicaid has always been complex. For decades, anesthesiologists and dentists have debated who provides the sedation or anesthesia service, where care occurs, and how reimbursement is managed. That debate continues to evolve with sometimes varying professional society stances on state reforms reshaping how dental anesthesia reaches vulnerable populations, particularly those covered by Medicaid. This article explores the current landscape of Medicaid reimbursement for dental anesthesia services, highlights state programs that may serve as advocacy models for anesthesiologists, and discusses broader implications for anesthesiologists, dentists, and policymakers.

Background

One of the findings from an ASA Medicaid survey reveals recurring concern on how Medicaid reimbursement favors Current Dental Terminology (CDT) codes over Current Procedural Terminology (CPT) codes. Some state Medicaid programs pay CDT anesthesia codes at significantly higher rates than comparable physician anesthesia services. Dentists, oral and maxillofacial surgeons (OMS), and dental anesthesiologists hold the authority to bill them. This practice is changing.

Similar to medicine's CPT codes, the American Dental Association (ADA) maintains CDT codes to standardize reporting of dental procedures, including anesthesia. Relevant codes include:

- D9222: Deep sedation/general anesthesia – first 15 minutes
- D9223: Deep sedation/general anesthesia – each subsequent 15-minute increment
- D9230: Inhalation of nitrous oxide/analgesia, anxiolysis
- D9239: Intravenous (conscious) sedation/analgesia – first 15 minutes
- D9243: Intravenous (conscious) sedation/analgesia – each subsequent 15-minute increment
- D9248: Non-intravenous (moderate) conscious sedation

supports small practices and allows children and special-needs patients to receive care in familiar environments.

Nebraska: Dental office anesthesia

Beginning August 1, 2023, Nebraska Medicaid has authorized anesthesiologists and nurse anesthetists to bill specified CDT anesthesia codes for anesthesia services in dental offices.

As dental-specific codes, these historically were restricted by state Medicaid programs to qualified dentists, in some circumstances at rates significantly higher than comparable physician services. Recently, some states have explicitly authorized anesthesiologists to bill CDT codes for Medicaid patients when services occur in specified settings (i.e., office-based or community dental clinic). That recognition reflects the essential role anesthesiologists play in ensuring safe and accessible dental care, particularly for pediatric patients and those with disabilities. While these changes can be slow moving, as is often the case with state Medicaid programs, new opportunities for patients in need who often have limited financial resources are being explored.

State programs

States have pioneered a variety of reimbursement models to address access gaps in dental anesthesia services.

Illinois: Expansion of billing rights

Illinois permits anesthesiologists and CRNAs to bill CDT codes for dental procedures in offices, outpatient clinics, hospital outpatient centers, and ambulatory surgical treatment centers. The policy acknowledges that restricting billing to dentists unnecessarily limits access for Medicaid beneficiaries.

Montana: Mobile anesthesia

Montana enables mobile anesthesiologists to deliver anesthesia in community dental offices. Providers may bill a \$471.17 facility fee under CDT D9999 per patient, per day, covering services and supplies when the office is not owned by the anesthesiologist. Other services remain billable under the standard fee schedule. The model

Oregon: Flat fee model

Oregon authorizes a flat \$800 reimbursement for general anesthesia during dental visits (CPT 00170), effective October 1, 2023. The rule applies only to dental clinic settings and offsets costs for anesthesiologists in nonhospital environments. Administrative simplicity creates advantages, but eliminating time-based billing risks underpayment for prolonged cases.

Washington: Expanding access

Washington's program focuses on Medicaid clients aged 0-20 and developmentally disabled patients of all ages. It permits mobile anesthesiologists and CRNAs to provide sedation and anesthesia directly in dental offices, greatly expanding access. The program allows billing under D9222, D9223, D9239, and D9243, and it enforces strict unit caps to prevent misuse.

Emerging opportunities

These initiatives expand access but necessitate patience and advocacy with policymakers and dental stakeholders. Working in partnership with state dental societies in this space is important, as Medicaid policymakers need to understand we are all striving for a collaborative effort to provide needed care. Those interested in pursuing policies in their own state should be familiar with their state's respective dental and nursing practice acts since regulatory concerns about scope of practice and patient safety may arise. Seek allies in the dental and oral surgeon communities, given their collaboration with ASA initiatives. For example, the American Association of Oral and Maxillofacial Surgeons (AAOMS) has consistently affirmed its stance that CRNAs should not independently provide anesthesia in dental offices without dentist or physician supervision.

For patients, the stakes remain clear. Medicaid beneficiaries, particularly those with extensive dental needs or disabilities, often struggle to access care. Hospitals oversubscribe their ORs, and hospital costs remain high. Alternatively, many dental offices lack the staff or infrastructure for even moderate sedation. This, combined with poorly designed reimbursement models, discourages participation when they underpay any class of providers or impose excessive administrative burdens.

Integrating anesthesiologists into dental settings can:

1. Expand access by bringing anesthesia to community practices
2. Reduce costs by avoiding hospital ORs for routine dental care
3. Improve outcomes by enabling timely treatment and reducing the trauma of untreated disease.

Continued on page 34

State Efforts

2025 Louisiana Society of Anesthesiologists Initiative

- 12.5% increase in the conversion factor for all services for patients aged 16 and older with payment going from \$15.38/unit to a new payment of \$17.30/unit.
- 81% increase for epidural for vaginal delivery with the payment going up from \$312.98 currently to \$566.98.
- 86% increase for C-section following epidural for planned vaginal delivery with the payment going up from \$77.05 currently to \$156.59.



Dear Members,

On behalf of the **Louisiana Society of Anesthesiologists (LSA) Board of Directors**, I wanted to take a moment to share some great news about recent advocacy efforts at the Louisiana Legislature.

While Medicaid reimbursement rates are declining in many parts of the country, your LSA team has successfully secured an increase in Louisiana. These rate increases were officially approved during the 2025 legislative session and announced by the Louisiana Department of Health on September 30. You can view the full announcement [here](#):

Physician Reimbursement Rates

Key Highlights of the Increases:

- 12.5% increase in the conversion factor for all services for patients aged 16 and older with payment going from \$15.38/unit to a new payment of \$17.30/unit.
- 81% increase for epidural for vaginal delivery with the payment going up from \$312.98 currently to \$566.98.
- 86% increase for C-section following epidural for planned vaginal delivery with the payment going up from \$77.05 currently to \$156.59.

Please refer to the attached document for the full breakdown of changes across all billing categories, including exact reimbursement amounts.

Fighting "Big Insurance"



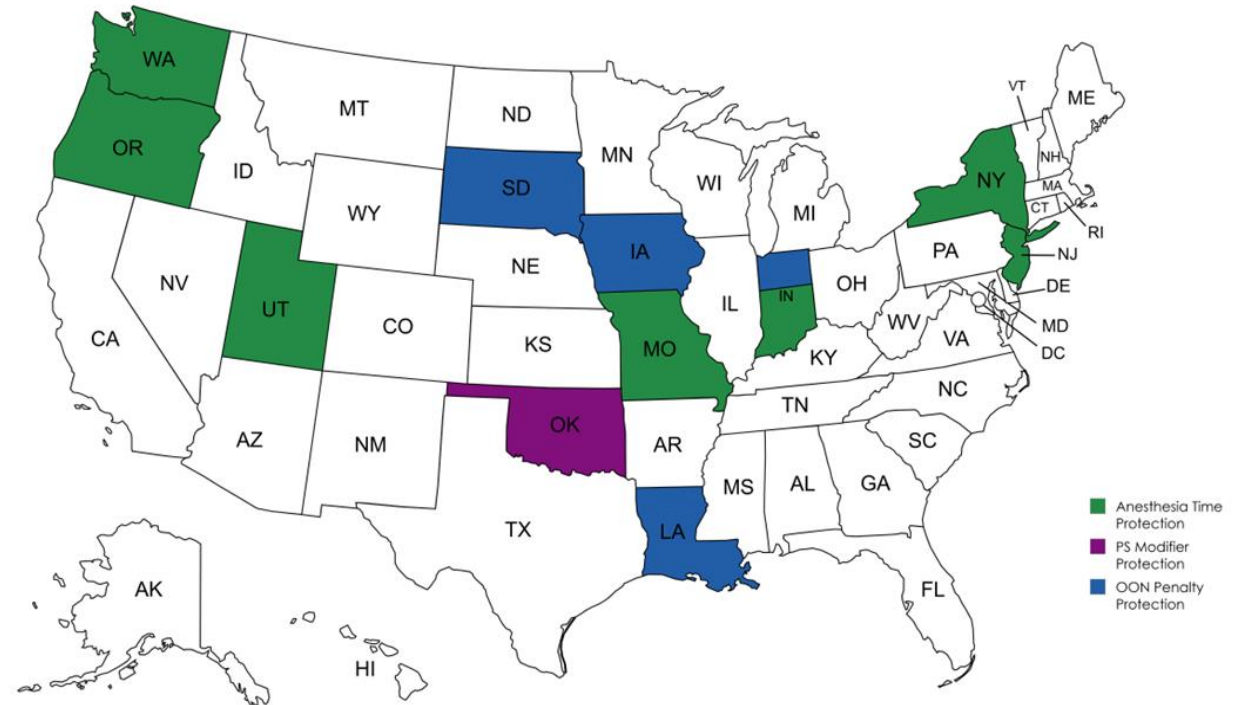
Fighting “Big Insurance” - States

What’s happening

- “Big insurance” continues to roll out state initiatives to reduce commercial payment rates for anesthesia services

Why it matters

- Persistently inadequate payment rates from public payers requires increased focus on appropriate market-based commercial rates

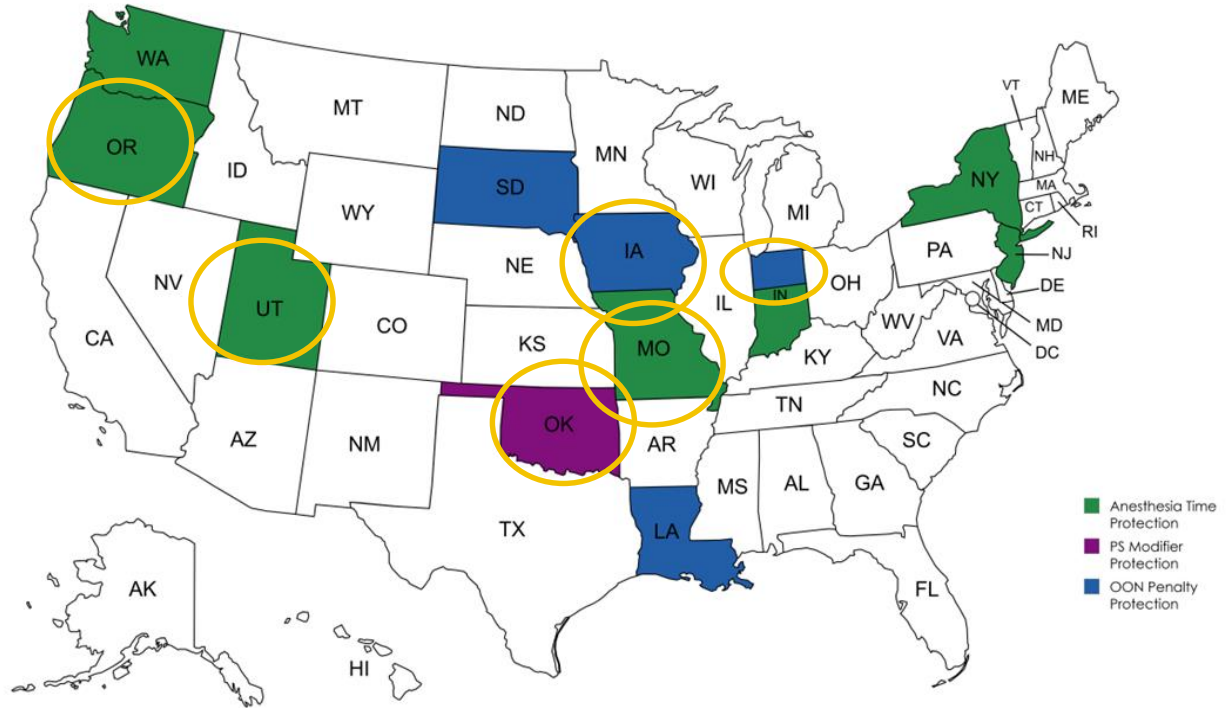


Created with mapchart.net

Fighting “Big Insurance” - States

What's next

- Working with ASA State Component Societies to block insurers' policies
 - Anesthesia time – 4 states enacted new laws in **2025 (CT, IL, MD, OK)**. 3 states enacted new laws in **2026 (MO, OR, UT)**
 - Facility payments – 2 States enacted new laws in **2026 (IN, IA)**
 - PS modifier – 1 state enacted new law in **2026 (OK)**



Created with mapchart.net



Fighting “Big Insurance” - *Federal*

What's happening

- Anesthesiologists continue to successfully navigate No Surprises Act (NSA) Independent Dispute Resolution (IDR) process to secure appropriate payment rates
 - 80-90% win rate in IDR process
- Insurers launching initiatives to discourage and limit physician and provider access to IDR process
 - Public Relations campaign - Health Affairs, “The Substantial Costs of the No Surprises Act Arbitration Process,” (September 2025)
 - Litigation directed at practices and revenue cycle companies

Why it matters

- The NSA IDR process is the most important lever available to anesthesiologists to secure reasonable rates from payers

Fighting “Big Insurance” - *Federal*

Foundational engagement

- Support for all TMA litigation efforts – amicus briefs

What’s next

- ASA filed Amicus Brief in United Healthcare (Pennsylvania) v. Northstar on March 10, 2026 – **April 28, 2026 – United’s suit is dismissed and closed**
- Awaiting release of TMA III – calculation of insurer QPA
- Building support for the No Surprises Enforcement Act legislation

IN THE UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF PENNSYLVANIA

UNITEDHEALTHCARE OF PENNSYLVANIA, INC. d/b/a UNITEDHEALTHCARE COMMUNITY PLAN,	Case No. 25-cv-7187
	Hon. Mark. A. Kearney
vs.	Plaintiff,
NORTHSTAR ANESTHESIA OF PENNSYLVANIA LLC,	
	Defendant.

**MOTION FOR LEAVE TO FILE AMICUS CURIAE BRIEF OF
THE AMERICAN SOCIETY OF ANESTHESIOLOGISTS
IN SUPPORT OF NORTHSTAR ANESTHESIA**

The American Society of Anesthesiologists hereby moves for leave to file an amicus curiae brief in support of NorthStar Anesthesia. The ASA’s amicus brief will provide the Court with important context about the complexity of eligibility determinations. The ASA believes that this information will aid the Court as it evaluates whether common mistakes in complicated eligibility determinations should be subject to fraud claims or whether addressing eligibility mistakes should be left to the Centers for Medicare and Medicaid Services through their administrative authority over the independent-dispute-resolution (IDR) process. The ASA moves for leave under Local Rule 7.1.

The ASA, which includes more than 59,000 members comprised of anesthesiologists and others involved in the medical specialty of anesthesiology, is interested in this case because of the importance of the independent-dispute-resolution process to the resolution of disputes between providers and insurers under the No Surprises Act. Given that 24% of all disputes closed from April 2022 through January 2026 were closed based on eligibility determinations—899,309 disputes out of 3,696,802, according to numbers from the Centers for Medicare and Medicaid

Advocacy Priority: NSA Operations Rule

- **Batching expanded:** Anesthesiologists can batch claims by CPT body-part range, with a cap of 50 claims per batch.
- **More payer transparency:** Payers must provide CARCs/RARCs so practices can determine whether disputes qualify for federal or state IDR.
- **Federal IDR registry required:** Payers must register and maintain contact/operational information in the Federal IDR portal.
- **Shorter cooling-off period:** Batched claims cooling-off period reduced from 90 days to 30 days.
- **Stronger open negotiation requirements:** Payers must formally respond within 15 days using standardized notices and improved portal workflows.
- **Administrative fee cut:** Federal administrative fee reduced from \$115 to \$15; IDR fees unchanged.
- **Anesthesia add-on codes included:** Codes 99100, 99116, 99135, and 99140 may be batched/bundled with anesthesia codes.

Pain Medicine - *MAC LCD to Limit PNBs*

What's happening

- Medicare Administrative Contractors (MAC) have issued proposed local coverage determination (LCD) to classify Peripheral Nerve Blocks (PNBs) as “experimental and investigational.”

Why it matters

- If finalized, the policy would significantly restrict coverage and payment for PNBs
 - Remove an effective non-opioid pain relief modality from patients' treatment options

What's next

- Continue to lobby MACs
- Coordinate with the Pain Medicine Coalition (PMC) and other organized pain groups
- Congressional sign-on letter

Congress of the United States

Washington, DC 20515

The Honorable Mehmet C. Oz, MD, MBA
Administrator
Centers for Medicare & Medicaid Services
7500 Security Boulevard
Baltimore, Maryland 21244-1850

March 16, 2026

Dear Administrator Oz:

We write to express our concerns regarding several proposed Local Coverage Determinations (LCDs) titled “Peripheral Nerve Blocks and Procedures for Chronic Pain” - DL40267, DL40265, DL40263, DL40261, DL40300 that were proposed by five Medicare Administrative Contractors (MACs) (Palmetto GBA, WPS, CGS, National Government Services (NGS) and Noridian) on September 25, 2025. These policies will deny Medicare patients access to proven non-opioid pain treatments and undermine the collective fight against the opioid abuse epidemic. We strongly urge CMS to ensure that these LCD policies are withdrawn by the MACs.

Since the release of these draft LCD policies, we have heard concerns from the pain medicine

"These policies will deny Medicare patients access to proven non-opioid pain treatments and undermine the collective fight against the opioid abuse epidemic. We strongly urge CMS to ensure that these LCD policies are withdrawn by the MACs."

Congressional Request to CMS

Economic and Payment Update





Impact of MAHA and Deregulation on Payment

- Make American Healthy Again (MAHA) agenda influences multiple policy decisions
 - Focuses on chronic disease management, preventive care, nutrition, health screenings
 - Intends to shift more procedures to lower cost settings
 - Expects to publish more cost and quality performance data
 - Approves aggressive changes on how models, payment, and regulations are developed
- Deregulatory Environment Is Not Consistent
 - ASA has responded to multiple deregulatory Requests for Information
 - HHS or CMS may issue deregulatory proposed rules in the second half of 2026

Proposed 2027 Quality Payment Program Updates

- "Traditional MIPS*" will be replaced by MIPS Value Pathways in 2029
- Other MIPS Proposed Changes:
 - Removal of Prevention of Postoperative Nausea and Vomiting Measures
 - Addition of Anesthesia Patient Experience measure
 - Addition of Intraoperative Hypotension Measure (IOH)
 - Anesthesiology specialty measure set reduced to four measures.
- MIPS Value Pathway (MVP) Changes
 - Expansion of Anesthesia MVP available measures (Avoidance of Cerebral Hyperthermia and Glucose Management)
 - Requirement for anesthesiologists to report at least one core measure: Smoking Abstinence, Multimodal Pain Management, or IOH

- MIPS = Merit-based Incentive Payment System

Alternative Payment Models (MIPS, Advanced, and Other)

Finalized “**Ambulatory Specialty Model**” (ASM) for 2027 Implementation

- Focused on Low Back Pain
- Mandatory for anesthesiologists yet unclear how anesthesiologists would report or participate (about 1,200 anesthesiologists, pain medicine, and interventional pain management physicians)
- Not consistent with MIPS or APM policies; very burdensome of anesthesia groups
- ASA conducts direct outreach to affected individuals

Published Multiple MAHA-related "Models"

- Enhancing Lifestyle and Evaluating Value-based Approaches Through Evidence (ELEVATE Model)
 - Funds 30 proposals to awardees to collect quality and cost data on whole-person functional or lifestyle medicine interventions
- Advancing Chronic Care with Effective, Scalable Solutions (ACCESS)
 - Enables clinicians to offer innovative technology-supported care that improves patients' health and complements traditional care

Alternative Payment Models (MIPS, Advanced, and Other)

CMS Finalized its “**Transforming Episode Accountability Model (TEAM)**” for 2026

- Focuses on FIVE surgical episodes
- About 15% of hospitals will be required to report TEAM
- Anesthesiologists should identify ways to engage hospital executives and participate

Implementation of the “**Wasteful and Inappropriate Service Reduction Model**” (WISeR) for 2026

- Use AI to ferret out potential fraud, waste, and abuse
- Requires prior authorization processes in six states for skin and tissue substitutes, electrical nerve stimulators, and knee arthroscopy for knee arthritis
- Not transparent, not tested, and will increase burden on groups
- ASA has connected affected physicians with CMS officials; advocated for "Gold Card" program
- Anesthesiologists should work with their facility administrators and surgical colleagues to ensure procedures have approval and will be paid
- Contact ASA at gra@asahq.org if your burden or denials increase with WISeR

Other Advocacy Priorities



Research

Recent

- Submission of formal comments opposing White House Office of Management and Budget (OMB) changes to federal grant awards and management, including NIH
 - Adds new layer of review by political appointee

Coalition advocacy – increased anesthesiology-related research funding and support

- Foundation for Anesthesia Education and Research (FAER)
- Partnering with Anesthesia Research Council (ARC)
- Member of the Ad Hoc Committee on Medical Research (AAMC-led coalition)
- Member of Friends of AHRQ

Grassroot Action

- LEGCON 2026 – Support for NIH funding/protecting and enhancing the over \$320 million for anesthesiologist-investigators in over 50 institutions

Anesthesiology Workforce

Advocate for a robust and resilient anesthesia workforce

- Data and research (CAWS, workforce analytics)
- Policy advocacy (federal recommendations)
- Workforce planning (summits, long-term strategy)

September 5, 2025

The Honorable Linda McMahon
Secretary, Department of Education
Office of Postsecondary Education
400 Maryland Ave SW, 5th Floor
Washington, DC 20202

Re: Preserving Federal Loan Access for Physicians and Other Health Professionals Under OBBBA Implementation

Secretary McMahon,

On behalf of the physicians and care team members of undersigned organizations, we respectfully urge you to ensure that the Department of Education's implementation of the One Big Beautiful Bill Act (OBBBA, P.L. 119-21) preserves access to affordable federal student loans for medical students and other health professions students. While OBBBA made several structural changes to federal student financial aid programs, it did not alter the Secretary's long-standing authority under the Higher Education Act to allow medical students to borrow additional Unsubsidized Direct Loans above statutory limits. Maintaining this exception is essential to sustaining the pipeline of future physicians and addressing America's increasing medical workforce shortages.

As medical professionals, we understand the financial realities of medical education. In 2023-24, the institutions and over \$60,000 at medical school, particularly student loans, more than half of that lack borrower protections, potentially discourage students from entering medicine, even though these are essential to practice.

Student loan deferment during the COVID-19 pandemic (REDI Act) enjoys broad support from medical students and other health professions students, and we encourage you to ensure that the REDI Act enjoys broad support from medical students and other health professions students, and we encourage you to ensure that the REDI Act enjoys broad support from medical students and other health professions students.

Does not unintentionally limit the ability of medical students and other health professions students to borrow additional Unsubsidized Direct Loans beyond the statutory limit.

Medical students and other health professions students, and we encourage you to ensure that the REDI Act enjoys broad support from medical students and other health professions students.

...we respectfully urge you to ensure that the Department of Education's implementation of the One Big Beautiful Bill Act (OBBBA, P.L. 119-21) preserves access to affordable federal student loans for medical students..."

Coalition Request to Secretary of Education, Linda McMahon, 9/5/2025

Workforce: ASA-endorsed Legislation

— Endorsements and Support

- **H.R. 2028, the Resident Education Deferred Interest (REDI) Act**
 - Permits residents to qualify for interest-free deferment on their student loans while serving in a medical or dental internship or residency program
- **S. 2439/ H.R. 4731, the Resident Physician Shortage Reduction Act**
 - Funding for 14,000 additional residency positions
- **S. 1380, the Specialty Physicians Advancing Rural Care (SPARC) Act**
 - Authorizes a loan repayment program to encourage specialty medicine physicians to serve in rural communities experiencing a shortage of specialty medicine physicians

Practice Guidelines and ASA Statement



ASA Guidance Documents

ASA produces several guidance documents to assist practitioner and patient decisions about appropriate health care for specific clinical circumstance.

- Practice Standards: Minimum level of clinical practice as defined by the ASA
- Practice Guidelines: Recommendations developed based on a systematic review and supported by evidence of sufficient quality, quantity, and consistency
- Practice Advisories: Similar to practice guidelines but with most or all recommendations supported by evidence of limited quality, quantity, or consistency

ASA's Guidelines and Advisories

ASA's guidelines and advisories reflect best evidence-based practices in:

- Conflict of interest disclosure
- Systematic review development
- Evaluation of evidence and recommendations
- Statistical methods and rigor
- Transparency and documentation

ASA Committee Statements and Resources

Committee Statements: May focus on clinical management of individual patients, systems of care, or professional behavior such as privileging or ethical behavior. Statements may be developed based on a literature review, collective opinion, or consensus of a convened expert panel.

Resources from Committees: Cover a wide array of clinical and non-clinical topics such as occupational health and wellness and physician-led care.

2026 – Ketamine Guidance

Guidance on the Safe Use of Ketamine Outside of Acute Pain Management and Procedural Sedation

- Originally published February 11, 2025; Updated June 17, 2026
- The update acknowledges additional proposed uses for mental health conditions, such as post-traumatic stress disorder
- ASA Committee on Trauma and Emergency Preparedness (COTEP) and ASA Committee on Pain Medicine
 - The guidance, which is intended for all non-anesthetic uses of ketamine, recommends that the administration of ketamine for non-anesthesia purposes adhere to the same standards as other anesthetics and follow the same prescribing principles as other sedating medications
 - Patients should only be prescribed the drug for a medical indication as part of a comprehensive treatment plan, by an appropriately trained and licensed medical professional who monitors the patient with periodic face-to-face visits
 - Intravenous and intramuscular ketamine should only be administered in a monitored setting under the care of a licensed health professional where appropriate rescue equipment is immediately available, the guidance says

ASA Annual Report and User Advisory Co



Learn More About How ASA is Working for You

Annual Report

Advocacy Education Financials Media Meetings Membership

2025 Strategy in Action

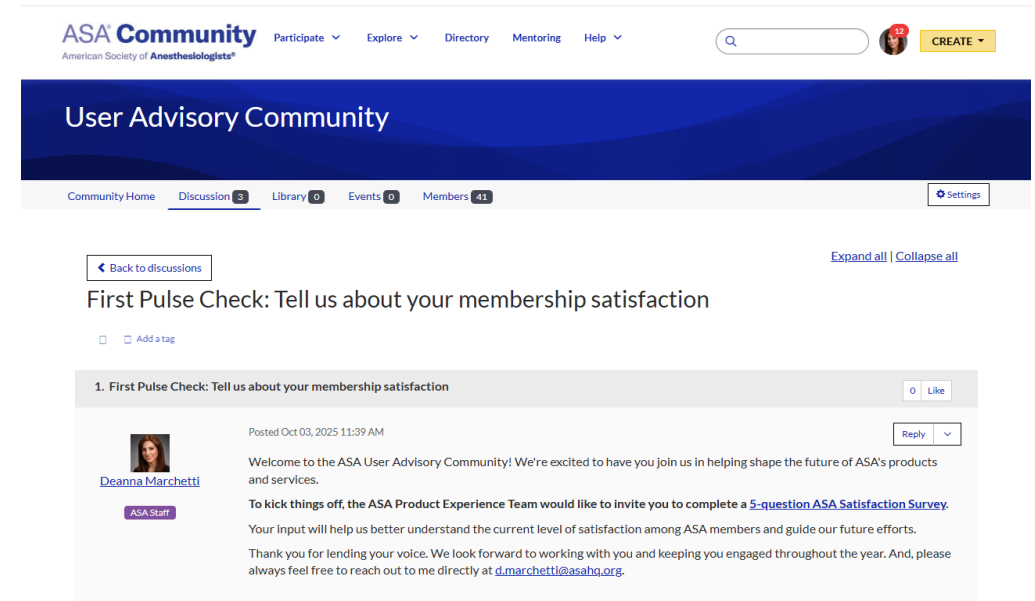
See the 2025 Annual Report:
<https://www.asahq.org/annualreport>



ASA User Advisory Community (UAC)

Goal of the UAC:

- An online community of ASA's everyday members representing diverse subspecialties, career stages, and practice settings coming together to help shape the products, services, and digital tools that support you in clinical practice, research, and education.
- **The UAC provides ASA members a way to:**
 - Share feedback on current and future ASA offerings
 - Participate in usability testing of digital tools and platforms
 - Identify unmet needs and propose innovative solutions
 - Serve as a trusted sounding board for new ideas before launch
 - Weigh in on quick questions and pulse-checks



Join the UAC!
<https://www.asahq.org/member-center/user-advisory-community>

Support for Advocacy and Foundations



American Society of
Anesthesiologists®

asahq.org

Questions?



ASAPAC



**ASA Grassroots
Network**



ASA Foundations

Updates in Pain Therapies

From Molecules to Devices



Georgia Society of Anesthesiologists

Yawar J Qadri, MD PhD

Learning objectives

- 1 Describe new pharmacologic therapies for pain management and their proposed mechanisms
- 2 Evaluate emerging regional anesthesia techniques and their current evidence base
- 3 Recognize indications, benefits, and limitations of contemporary neuromodulation and implantable pain therapies
- 4 Apply evidence-based principles when considering novel pain interventions in clinical practice

Conflicts:
NIH 5U01NS124613-03 – Injector for
trial on PPF block for SAH
IDMC work for uniQure

Duke (T32/Pain/OR) → Emory (Pain)
Community in 09/26

AI-assisted

Roadmap

Molecules

NaV1.8
Depot local
anesthetics
Others

Blocks

Fascial plane blocks

- PENG
- TTPB/PIP

PPF block
TKA pathways

Devices

Algometers
Cryoneurolysis
Peripheral Nerve
Stimulation

Evidence

Selection
Comparator
Durability

Recurring slide logic

Mechanism

Best evidence

Ideal candidate

Reason for caution

What counts as an advance?

New target

A novel receptor, channel, nerve, or neural network

New delivery

Same biology, but longer duration, fewer systemic effects, or better targeting

New indication

A known therapy moved into a new phenotype or earlier disease stage

New evidence

Better trials or comparative data for an old idea

Novelty should not be enough

The question is whether something changes a patient trajectory

PART 1

Molecules

New analgesic pharmacology is shifting toward **peripheral mechanisms** and **smarter delivery** rather than simply stronger central suppression

Mechanism → Evidence → Candidate → Caution

Why analgesic pharmacology is hard

- Pain is not one pathway; it is a sensory, emotional, cognitive, and contextual phenotype
- A biologically important target may only produce a modest effect
- Postoperative models are useful for regulatory trials, but they may not map cleanly onto perioperative workflows or chronic pain states
- Opioid-sparing matters only when outcomes improve

Key warning

A “statistically significant” pain-score difference may not be a clinically meaningful recovery difference



Pain score $\neq$ recovery

Multimodal and pre-emptive analgesia

A compelling idea met a complicated evidence base

RETRACTION WATCH LEADERBOARD

4 of 10

Four anesthesiologists in the current top 10

1	2	3	4	5	6	7	8	9	10
240	172	124	124	104	92	91	61	58	58

Orange = anesthesiology • size ~ retraction count

Retraction Watch • updated Aug 10, 2026

1988–93

1

Mechanistic promise

Central sensitization suggested analgesia before incision could prevent amplified postoperative pain.¹

1995–2005

2

Timing controversy

Reviews found no universal benefit from ‘before vs after’ dosing; effects varied by technique and outcome.^{2, 3}

2009

3

Evidence contaminated

Reuben fabricated 21 papers over 15 years, undermining prominent COX-2 and multimodal claims.^{4, 5}

2010s

4

ERAS scales multimodal care

Enhanced Recovery pathways made opioid-sparing multimodal analgesia a standard component of perioperative care.^{6, 7}

TODAY

5

A more durable framing

Judge each component by independent, procedure-specific evidence, not by timing or protocol membership alone

TAKE-HOME

The scandals weakened specific claims but not the independently supported rationale for pre-emptive, multimodal, opioid-sparing care

Woolf & Chong. Anesth Analg. 1993. PMID 8346839 • Møiniche et al. Anesthesiology. 2002. PMID 11873051 • Ong et al. Anesth Analg. 2005. PMID 15728066
Shafer. Anesth Analg. 2009. PMID 19299814 • Rittner et al. Anaesthesist. 2009. PMID 19902152 • Beverly et al. Anesthesiol Clin. 2017. PMID 28526156

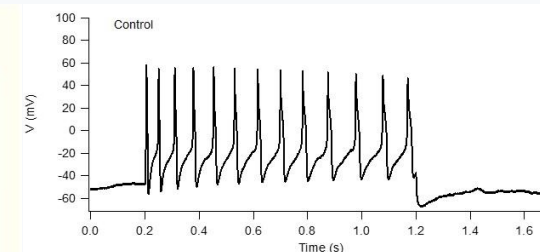
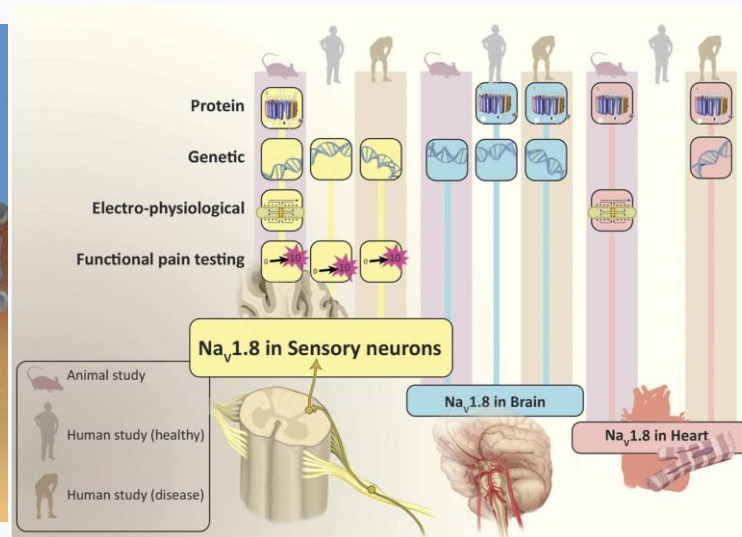
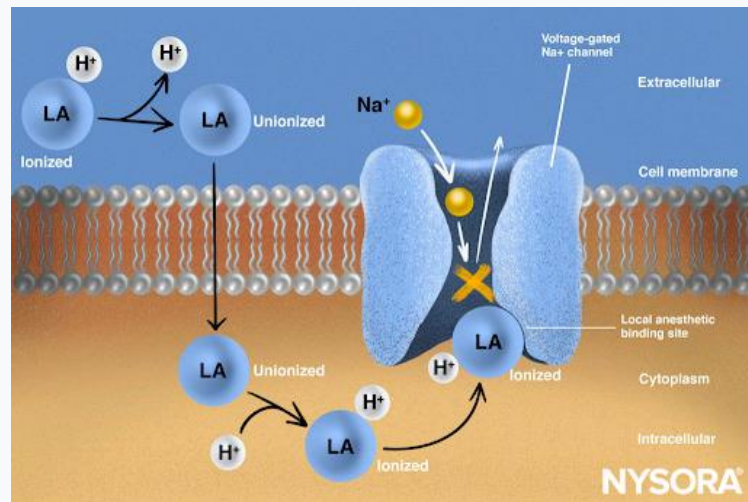
Suzetrigine: NaV1.8 inhibition as a clinical analgesic strategy

Peripheral
nociceptor

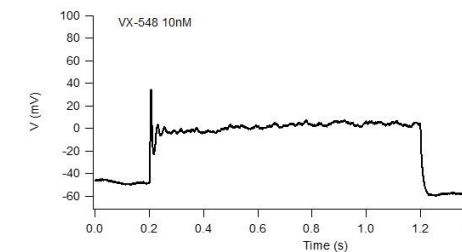
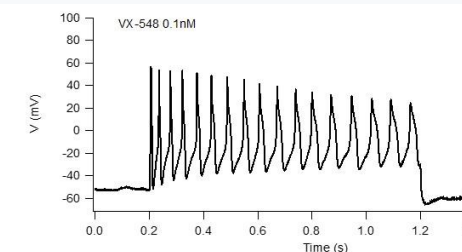
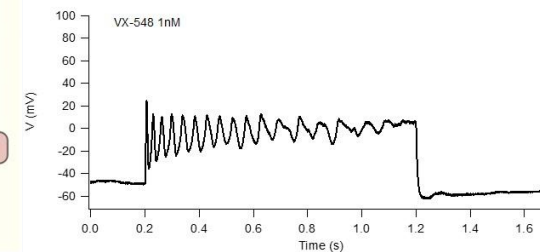
NaV1.8
channel

Less
firing

Pain signal
reduced



Illustrative rat DRG recording • ICE Bioscience



Proposed advantage

Targets peripheral sodium-channel signaling, avoid cardiac targets and central opioid reward, respiratory depression, or sedation pathways

Practical constraint

A new mechanism still has to compete with multimodal analgesia, cost, workflow, and drug-interaction realities

FDA. JOURNAVX approval. 2025 • Bertoch et al. Anesthesiology. 2025. PMID 40117446.
Osteen et al. Pain Ther. 2025. PMID 39775738.

Suzetrigine: what the pivotal trials tell us and do not tell us

Trial models

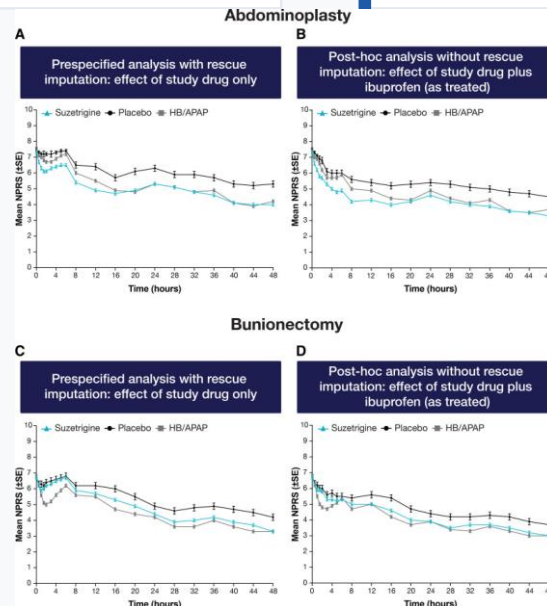
Abdominoplasty and bunionectomy postoperative pain. Both are useful regulatory models, but they are not all acute pain.

Signal

Improved 48-hour pain-intensity outcomes versus placebo; not clearly superior to hydrocodone/acetaminophen

Interpretation

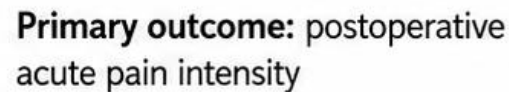
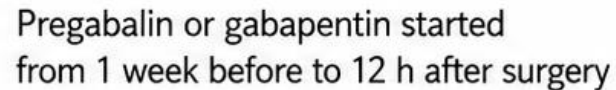
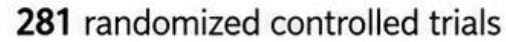
Validates the target more than it transforms all perioperative analgesia today



**Best use case remains an open clinical question:
who benefits enough to justify routine use?**



Verret et al. | Anesthesiology 2020
Systematic review & meta-analysis



Postoperative time period

6 h

-10 [-12 to -9]

12 h

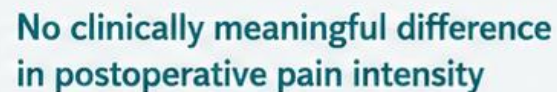
-9 [-10 to -7]

24 h

-7 [-8 to -6]

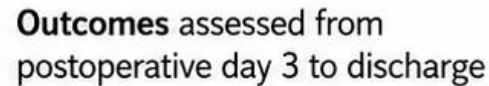
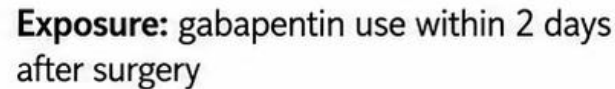
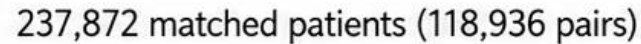
48 h

-3 [-5 to -1]



Verret M, et al. *Anesthesiology*. 2020;133:265-279.
PMID: 32667154.

Park et al. | JAMA Intern Med 2022
Propensity-matched cohort study



Gabapentin was associated with higher risk of adverse events

Outcome

Gabapenti

No gabapentin
(2%)

**Relative Risk
(95% CI)**

Delirium

3.4%

2.6%

New antipsychotic use

0.8%

1.17 (1.07-1.29)

Pneumonia

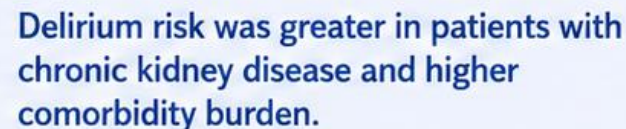
[illegible]

1.11 (1.03-1.20)

In-hospital death

1

1.02 (0.88-1.18)



Park CM, et al. *JAMA Intern Med.* 2022;182(11):1117-1127.
PMID: 36121671.

Khan et al. | Postmarketing analysis
Reported events and product-use terms



Word size reflects frequency; color reflects affected system.



Khan MS, et al. *Anesthesiology*. 2026.
PMID: 42456770.

~6%

New persistent opioid use post-op
classic US claims definition



1 / 1,000 OUD diagnosis or
opioid-related overdose *one*
large opioid-naïve surgical
cohort



2 / 10,000
OUD threshold needed for
ICER's suzetrigine economics



Brummett 2017, PMID 28403427 • Jivraj 2020, PMID 32243330 • Brat 2018, PMID 29343479 • ICER Acute Pain Report 2026

Value: why ICER still found suzetrigine attractive

1 UPFRONT DRUG COST COMPARISON



2 ICER MODEL RESULT



- Despite the higher acquisition cost, ICER's base-case model found suzetrigine **slightly cost-saving and more effective** versus HB/APAP.
- This result was driven mainly by modeled **avoidance of opioid use disorder (OUD)** and its downstream costs and harms.



This is a model-based value conclusion, not a statement of better acute analgesia.

3 KEY THRESHOLD / ASSUMPTION



ICER estimated that suzetrigine would meet common cost-effectiveness thresholds if a 1-week opioid course causes an excess of at least **2 in 10,000 OUD cases** over the next 3 years.

4 FAIR-PRICE / THRESHOLD CONTEXT

Weekly price to achieve cost-effectiveness thresholds (QALY-based)



Takeaway: The economic case depends much more on avoiding downstream opioid harm than on clearly superior acute pain relief.

Source: ICER Final Report, March 31, 2025 (12-month check-up May 20, 2026).

“Opioid-sparing” is not the same as better

Less opioid

Fewer adverse effects

Better function

Earlier discharge

Clinically useful trial endpoints

Pain at rest and with movement, PONV, sedation, sleep, ambulation, length of stay, refill requests, function

Endpoints that need context

MME reduction without side-effect reduction; PACU pain score without later trajectory; responder rates without durability



Intraoperative Methadone and Postoperative Pain Control

Systematic review & meta-analysis

1 STUDY OVERVIEW

- Question:** Does a single intraoperative dose of methadone improve postoperative analgesia?
- Design:** Systematic review and meta-analysis
- Population:** Adult surgical patients
- Comparator:** Shorter-acting intraoperative opioids

2 KEY FINDINGS



Lower postoperative opioid consumption



Generally lower postoperative pain scores



Higher patient satisfaction



No clear increase in side effects



3 CLINICAL INTERPRETATION

Takeaway: A single intraoperative methadone dose can provide prolonged postoperative analgesia and reduce opioid requirements. The value comes not just from opioid sparing, but from accompanying improvements in pain control and satisfaction.



4 CAUTION / CONTEXT

- Evidence comes from mixed surgical populations and comparators
- Magnitude of benefit may vary by procedure and dosing strategy
- Interpret alongside patient-centered outcomes and safety

Buprenorphine vs Full Agonist Opioids

for Postoperative Pain Management

A Systematic Review and Meta-analysis of RCTs



Need for Change

The postoperative period **strongly associated** with overdose.



Key Findings Support Buprenorphine

Pain Intensity

-0.36

Greater relief

(41 comparisons, 2,587 subjects)
Hedges' g = -0.36
95% CI = -0.59 to -0.14

Rescue Analgesia



Reduced rescue

(19 studies, 1,535 subjects, OR 0.40)
95% CI = 0.26 to 0.63, p < 0.001

Dose



Small doses for pain
(mean = 0.76 mg sublingual)

Duration



~ 8.5 Hours

Long-lasting relief
(9 studies, SD 1.84)



Buprenorphine Safety Profile

- Reduced respiratory depression
- Reduced abuse potential



History and FDA Pain Approvals

- Developed as an analgesic
- Almost 60-year track record
- Extensively studied for acute pain



RAPM | Regional Anesthesia & Pain Medicine

Costa GPA, Avila-Quintero VJ, De Aquino JP, et al. Efficacy and safety of buprenorphine versus full agonist opioids for acute postoperative pain management: a systematic review and meta-analysis of randomized controlled trials. *Reg Anesth Pain Med*. 2025;50(6):513–522.



Extended-release local anesthetics: can delivery replace a catheter?

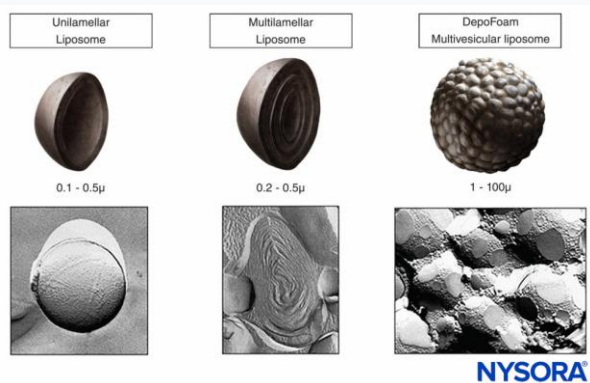
- Concept: prolong local-anesthetic exposure at the surgical site or nerve target
- Examples: liposomal, polymer-depot, and collagen-matrix formulations
- Mechanistic logic: sustained sodium-channel blockade, with local anti-inflammatory effects in selected depots
- Clinical question: better than saline, plain bupivacaine, a catheter, or a modern multimodal pathway?

Potential win

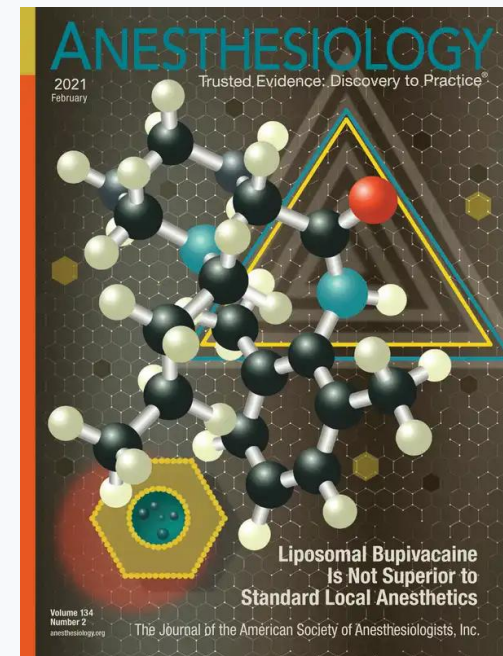
Longer analgesia without catheter management

Potential miss

Longer exposure without better recovery or cost-effectiveness



Hussain et al. Anesthesiology. 2021. PMID 33372953. • Ilfeld et al. Anesthesiology. 2021. PMID 33372949.
Hamilton et al. JAMA Surg. 2022. PMID 35385072.



Beyond the liposome: delivery platform now shapes the clinical claim

NEXT-GENERATION EXTENDED-RELEASE AGENTS

POLYMER + ANTI-INFLAMMATORY

Bupivacaine/Meloxicam

MECHANISM	Biochronomer® depot co-releases bupivacaine and low-dose meloxicam to sustain delivery in the acidic wound environment
EVIDENCE	Phase III trials improved 72-h pain and opioid endpoints versus bupivacaine HCl; the label covers selected procedures
CANDIDATE	Surgical-site instillation when 72-h coverage and catheter-free delivery fit the pathway
CAUTION	NSAID boxed warnings and contraindications; avoid direct cartilage exposure; evidence remains procedure dependent

BIORESORBABLE MATRIX

Collagen scaffold

MECHANISM	Type-I collagen implants dissolve in the wound while bupivacaine diffuses locally
EVIDENCE	MATRIX-1/2 reduced pain and opioid use versus placebo collagen matrix after open inguinal hernia repair; labeled benefit is up to 24 h
CANDIDATE	Open inguinal hernia repair when placement above and below mesh is practical
CAUTION	Narrow indication, bovine-collagen implant, 300-mg dose, and placebo—not plain bupivacaine—as the pivotal comparator

IN-SITU DEPOT / OTHER CARRIERS

Sucrose acetate isobutyrate

MECHANISM	Sucrose acetate isobutyrate forms a local depot for slow bupivacaine release; other carriers pursue the same exposure-shaping goal
EVIDENCE	POSIMIR reduced 72-h pain with movement and opioid rescue versus placebo after arthroscopic subacromial decompression
CANDIDATE	Only the subacromial space after arthroscopic decompression, under direct visualization
CAUTION	Boxed warning for inadvertent intravascular injection; use in other procedures is not established

THE ADOPTION TEST

Do not ask only “does it last?” Ask whether it beats the real comparator within multimodal care!
Does it improve recovery, adverse effects, discharge, or cost

Pharmacology watch list: promising, but not magic

Still opioids—but better?

Oliceridine

Biased μ -opioid signaling

Cebranopadol

Dual NOP/MOP receptor agonism

Cannabinoids

Plausible mechanisms, but perioperative efficacy and product consistency remain problematic

Cyclobenzaprine SL

Newly FDA approved for fibromyalgia

Ketamine / esketamine

NMDA antagonism; most useful in selected opioid-tolerant or high-pain pathways

Block adjuncts: less may be more

Dexamethasone, dexmedetomidine, MgSO₄

Different block-prolonging mechanisms

Perineural vs IV use?

Mixing dilutes [LA] → not much faster, often not as long

PART 2

Blocks

The continuing growth of fascial plane blocks

Mechanism → Evidence → Candidate → Caution

The modern regional anesthesia question

Old question

Can I anesthetize this nerve?

Newer questions

Can I safely reduce pain while maintaining function and helping recovery?

motor-sparing?

rebound pain?

safer?

**improve
recovery?**

pathway fit?

The block is not the endpoint; recovery is

Fascial-plane blocks: easy to perform, harder to explain

Why they spread

Potential spread along tissue planes; systemic absorption may contribute

Why they're popular

Superficial targets, ultrasound visibility, relative technical ease, and perceived safety

Why evidence is messy

Small trials, heterogeneous procedures, variable injectate, and frequent comparison to no block

2026 American Society of Anesthesiologists Practice Guideline on Perioperative Pain Management Using Local and Regional Analgesia for Cardiothoracic Surgeries, Mastectomy, and Abdominal Surgeries

Girish P. Joshi, M.B.B.S., M.D. (co-chair),
Edward R. Mariano, M.D., M.A.S. (co-chair),
Nabil M. Elkassabany, M.D., M.S.C.E., M.B.A.,
Monica Harbell, M.D., Rebecca L. Johnson, M.D.,
Jinlei Li, M.D., Ph.D., Lena Napolitano, M.D.,
Gary Schwartz, M.D., Santhanam Suresh, M.D., M.B.A.,
Karla E. Wyatt-Thompson, M.D., M.S.,
Anne Burns, B.Sc.Pharm. (patient representative),
Madhulika Agarkar, M.P.H., Anne Marbella, M.S.,
Stephanie Ramirez, M.A., M.P.H.,
Nancy Sullivan, B.S., Aaron Boschichak, M.S.,
Stacey Uhl, M.S., Karen B. Domino, M.D., M.P.H.

ANESTHESIOLOGY 2026; 144:19–43



Table 1. Recommendation Statements

Recommendation	Strength of Recommendation	Strength of Evidence
Open surgeries		
1. For adults undergoing open cardiothoracic surgeries including lobectomy, aortic valve replacement, coronary artery bypass graft, mitral valve repair, and septal repair, we recommend fascial plane blocks to reduce pain and/or opioid requirements in the first 24 h postoperatively.	Strong	Moderate
2. For adults undergoing open abdominal, retroperitoneal, and pelvic surgeries, we recommend fascial plane blocks to reduce pain and/or opioid requirements in the first 24 h postoperatively. Fascial blocks also improve patient satisfaction.	Strong	Moderate
Mastectomy		
3. For adults undergoing mastectomy, we recommend fascial plane or paravertebral blocks to reduce pain and/or opioid requirements in the first 24 h postoperatively. Fascial plane blocks also improve patient satisfaction and quality of recovery.	Strong	Moderate
Minimally invasive surgeries		
4. For adults undergoing minimally invasive cardiothoracic surgeries including lobectomy, valve repair/replacement, and esophageal procedures, we suggest regional techniques including neuraxial and fascial plane blocks to reduce pain in the first 24 h postoperatively.	Conditional	Low
5. For adults undergoing minimally invasive abdominal surgeries including cholecystectomy, appendectomy, bariatric, gastrectomy, and liver resection surgeries, we recommend fascial plane blocks to reduce pain and/or opioid requirements in the first 24 h postoperatively.	Strong	Moderate
6. For adults undergoing minimally invasive hernia repair, we suggest fascial plane blocks to reduce pain in the first 24 h postoperatively.	Conditional	Low
Pediatrics		
7. For children (younger than 18 yr) undergoing open cardiothoracic surgeries, we recommend fascial plane blocks to reduce pain and/or opioid use in the first 24 h postoperatively.	Strong	Moderate
8. For children (younger than 18 yr) undergoing open hernia repair, we suggest a fascial plane block to reduce pain in the first 24 h postoperatively.	Conditional	Low

ESP anatomy: broad posterior spread does not guarantee a deep block

FASCIAL PLANE BLOCKS • ORIGIN, SPREAD, MECHANISM

2016 • THE ORIGIN

A superficial route to thoracic analgesia

FIRST REPORT	Forero et al. reported two cases of thoracic neuropathic pain with multidermatomal sensory change
WHY	An easy-to-see target with distance from pleura and neuraxis aided adoption
APPEAL	Superficial needle path, catheter option, and perceived safety when neuraxial or paravertebral techniques are undesirable
LIMIT	Adoption followed case reports, not head-to-head evidence of superior analgesia

CADAVER + CT EVIDENCE

Anterior spread is real—but inconsistent

POSTERIOR	Cadaver work consistently shows long craniocaudal spread deep to erector spinae and frequent dorsal-ramus staining
VARIABLE	Anterior spread varies: Ivanusic found none in six injections; other studies show paravertebral or foraminal spread at higher volume
CT STUDY	84 patients, 30 mL at T7: PVB 96.5%, foramina 77.9%, epidural 20/84; position changed extent
MEANING	“Spread present” does not guarantee dense, reliable ventral-ramus or sympathetic blockade

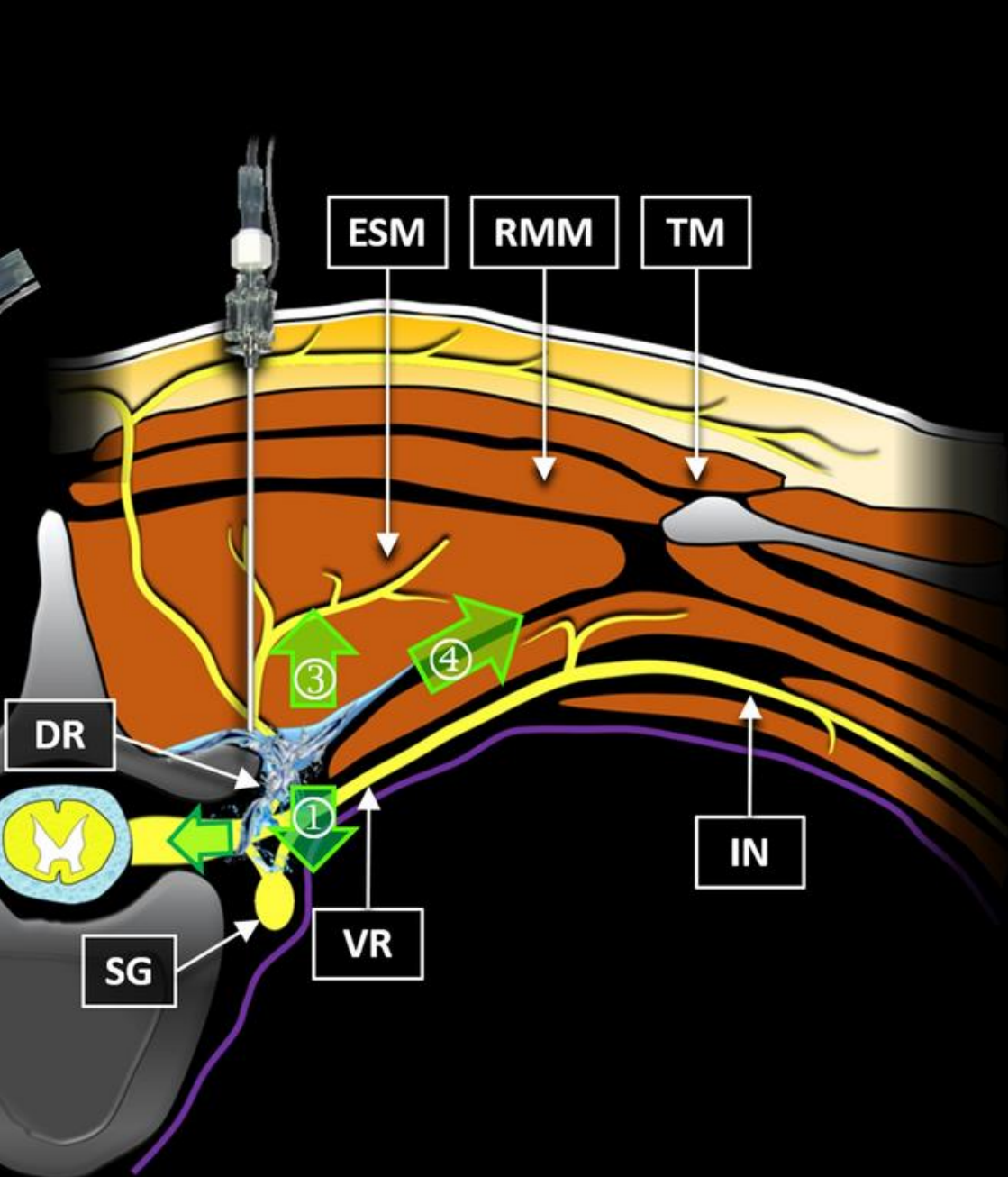
WHAT MAY BE REACHED

One injection, several possible targets

COMMON	Erector-spinae fascial plane + dorsal rami; broad longitudinal spread can cover the posterior thorax
VARIABLE	Intercostal, paravertebral, foraminal, and epidural spread depend on level, volume, anatomy, and position
CLINICAL	Wide sensory coverage may coexist with inconsistent deeper PVB-like spread
BOTTOM LINE	An anatomically plausible block is not necessarily consistent

ADOPTION

ESP gained traction because it is superficial, simple and perceived as safer. Those are legitimate advantages, not proof of reliable PVB-like spread.



Author/Year	ESP injections	Epidural space	Paravertebral space	Ventral rami	Dorsal rami	Sympathetic chain	Intercostal space
Thoracic ESP block (16 studies)							
Aponte 2019 ²⁰	T7 (n=6)	No	No	No	Yes (n=4)	NA	NA
Forero 2016 ¹	T5 (n=4)	No	No	Yes (n=1)	Yes (n=2)	No	Yes (n=2)
Ivanusic 2018 ¹⁵	T5 (n=20)	No	No	Yes (n=1)	Yes (n=14)	No	No
Chin 2017 ⁴⁹	T7 (n=2)	No	No	NA	NA	NA	Yes (n=2)
Shibata 2020 ²⁴	T4 (n=5)	NA	No	No	Yes (n=5)	NA	No
Vidal 2018 ⁵⁰	T4/5/10 (n=9)	No	Yes (n=9)	NA	NA	NA	Yes (n=9)
Nielsen 2019 ¹³⁹	T5 (n=5)	No	Yes (n=3)	Yes (n=3)	Yes (n=3)	NA	NA
Elsharkawy 2019 ¹⁴³	T10–11 (n=6)	No	Yes (n=3)	Yes (n=3)	Yes (n=6)	NA	Yes (n=4)
Govender 2020 ¹⁴⁴	T8 (n=1) T10 (n=1)	No	Yes (n=2)	Yes (n=2)	Yes (n=2)	NA	Yes (n=2)
Yang 2018 ⁴⁸	T5 (n=10)	NA	Yes (n=10)	Yes (n=10)	Yes (n=10)	Yes (n=10)	No
Dautzenberg 2019 ¹⁴¹	T2 (n=11) T8 (n=11)	NA	Yes (n=5)	Yes (n=5)	Yes (n=5)	NA	NA
Choi 2019 ¹²⁸	T5 (n=14)	Yes (n=1)	Yes (n=7)	Yes (n=7)	Yes (n=14)	Yes (n=1)	No
Altinpulluk 2019 ¹⁴²	T9 (n=8)	Yes (n=5)	Yes (n=6)	Yes (n=6)	Yes (n=8)	NA	NA
Adhikary 2018 ⁴⁷	T5 (n=3)	Yes (n=3)	Yes (n=3)	Yes (n=3)	Yes (n=3)	NA	Yes (n=3)
Diwan 2019 ¹⁴⁰	T4–5 (n=5)	Yes (n=5)	Yes (n=5)	Yes (n=5)	Yes (n=5)	Yes (n=2)	Yes (n=5)
Govender 2020 ¹³⁰	T5 (n=1) T8 (n=1)	Yes (n=2)	Yes (n=2)	Yes (n=2)	Yes (n=2)	NA	NA
Lumbar ESP block (1 study)							
De Lara Gonzalez 2019 ¹⁴⁵	L4 (n=12)	No	NA	Yes (n=2)	Yes (n=12)	NA	NA
Cervical ESP block (1 study)							
Author/year	ESP injections	Epidural space	Spinal nerve roots	Phrenic nerve	Suprascapular nerve	Long thoracic nerve	Dorsal scapular nerve
Elsharkawy 2020 ²⁵	C6 (n=5) C7 (n=5)	No	Yes (n=10)	Yes (n=3)	Yes (n=10)	Yes (n=10)	Yes (n=10)

Comparative evidence: ESP can be adequate but precision often wins early

FASCIAL PLANE BLOCKS • ESP vs PARAVERTEBRAL vs EPIDURAL

THORACIC EPIDURAL

Most reliable analgesia

STRENGTH	Dense bilateral segmental analgesia with neuraxial and sympathetic effects
TRADE-OFF	Hypotension, motor block, urinary retention, anticoagulation limits, and catheter burden
COMPARE	Small continuous-ESP trials can meet non-inferiority margins in multimodal pathways
READ CORRECTLY	One non-inferior endpoint does not prove equal density, reliability, or opioid sparing

PARAVERTEBRAL BLOCK

Precision often improves early analgesia

2023 REVIEW	10 RCTs / 624 patients: similar overall; PVB favored resting pain at 12 h
2023 META	Thoracoscopy meta-analysis favored PVB for analgesia and opioid use
2026 UPDATE	25 studies / 1,847 patients: PVB was superior at 0–6 h and reduced 24-h opioid consumption; later pain was similar
PATTERN	Precision matters most when early analgesic intensity matters most

ERECTOR SPINAE PLANE

A safety-oriented surrogate

STRENGTH	Superficial and forgiving when deeper or physiologically burdensome blocks are undesirable
ADEQUATE	Some trials report non-inferior recovery or pain; later scores may converge
BEST FIT	A substitute when a deeper block is contraindicated, impractical, or too burdensome
NOT SUPERIOR	Convenience and safety do not make ESP more effective and may increase rescue opioid use

THE CLINICAL TRADE

ESP trades analgesic and anatomic reliability for simplicity. That may be the right trade, but it should be named as a trade.

Parasternal Blocks

Anterior chest wall, medial T2–T6 dermatomes

Indications:

- Anterior chest
- Post-sternotomy pain
- Anterior mediastinal procedures
- IMA harvest–related pain
- Parasternal drain discomfort
- Medial chest wall incisions

IPP + PSP Blocks

Pectoral region, axilla, and anterolateral chest wall.

- Axillary dissection
- Breast reconstruction
- Anterolateral chest wall incisions
- Subclavicular anterior thoracic procedures
- Pacemaker/ICD pocket creation (subpectoral)
- MICS anterior port–related pectoral manipulation

ESP Block

Posterior and lateral thoracic dermatomes

Indications:

- Thoracotomy & VATS analgesia
- Rib fractures / chest trauma
- Chest tube–related pain
- Posterolateral thoracic wall pain
- MICS
- Lateral breast & reconstruction-related pain

SAP Block

Lateral thoracic wall (T2–T9) and the axillary region.

Indications:

- Lateral chest wall pain
- VATS (lateral ports)
- Lateral thoracotomy analgesia
- Rib fractures (lateral)
- Intercostal drain pain
- Procedures extending to the axilla
- MICS via lateral mini-thoracotomy
- Lateral breast surgery or reconstruction involving the axillary

Parasternal blocks: same nerves, different planes

S-PIP / PIFB • D-PIP / TTPB / TTMPB • TARGET = ANTERIOR CUTANEOUS BRANCHES (T2–T6)

SUPERFICIAL PIP

Pecto-intercostal fascial plane block

INJECTION PLANE

Pectoralis major ↓ external/internal intercostal complex

PECTORALIS MAJOR

LOCAL ANESTHETIC — S-PIP

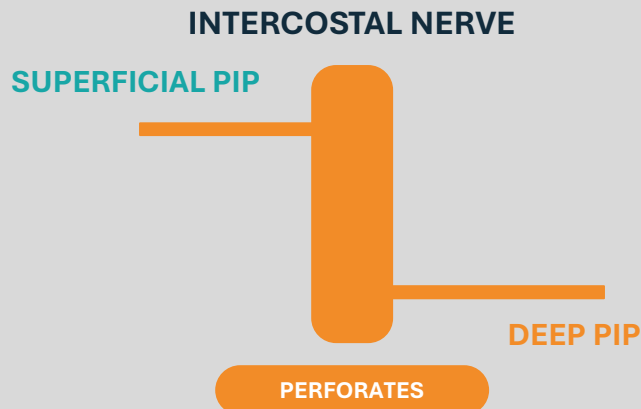
INTERCOSTAL MUSCLES

PLEURA

- Superficial, usually easy in the supine patient
- Farther from pleura and internal thoracic vessels

THE TARGET

Anterior cutaneous branch, above or below?



Both approaches seek the anterior cutaneous branches supplying the sternum and parasternal chest wall

DEEP PIP

Transversus thoracis muscle plane block

INJECTION PLANE

Internal intercostal ↓ transversus thoracis

INTERNAL INTERCOSTAL

LOCAL ANESTHETIC — D-PIP

TRANSVERSUS THORACIS

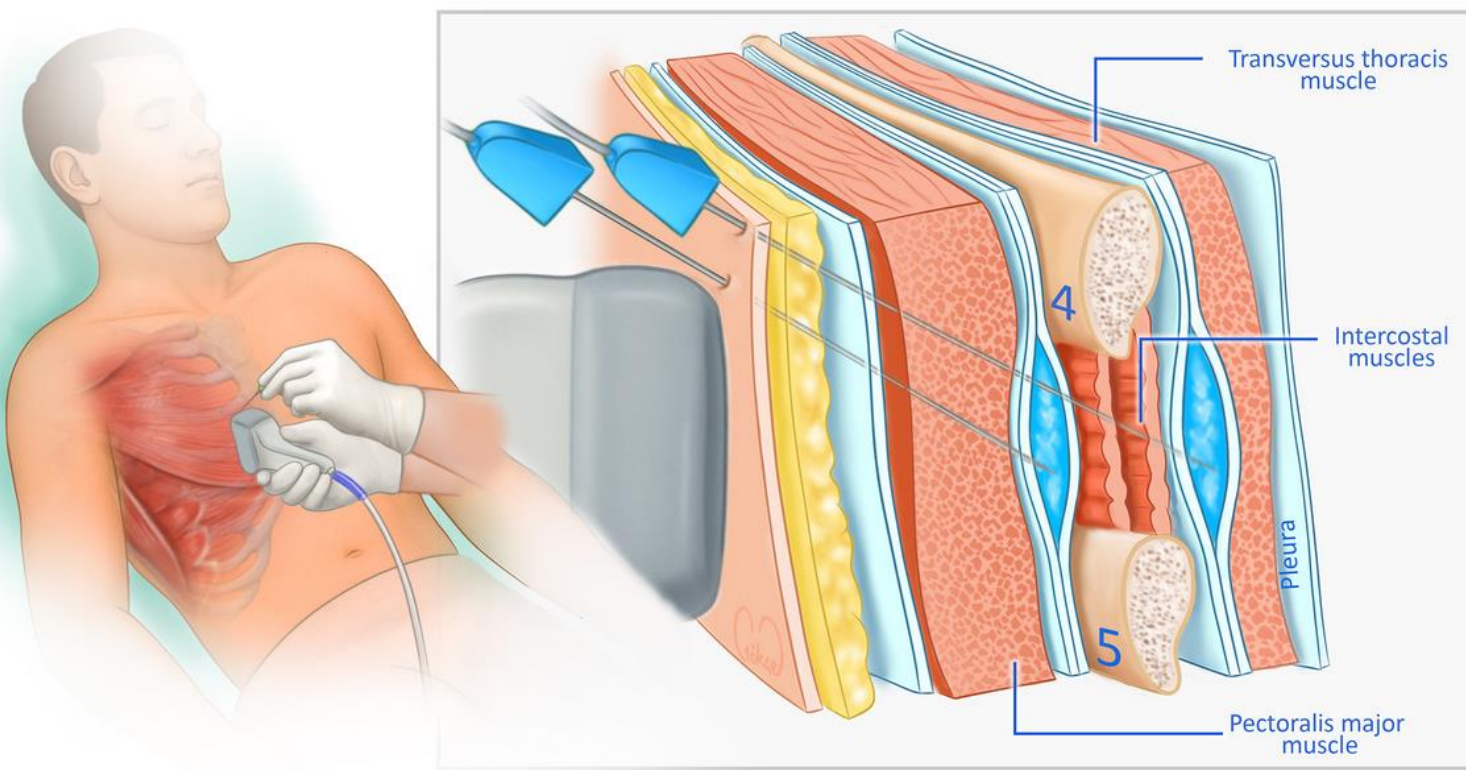
INTERNAL THORACIC VESSELS

PLEURA

- Anatomically direct: near branches before perforation
- Technically deeper; vessels, pleura and pericardium matter

WHY DEEP APPEALS

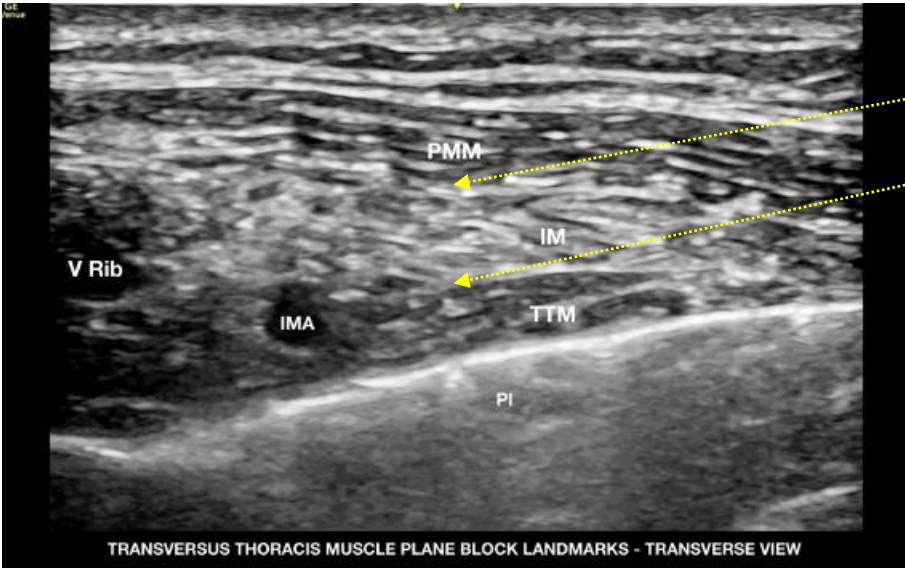
Closer to the branch origin but proximity is not proof of better outcomes



Dost et al. J Anesth Analg Crit Care. 2025. PMID 41402872.



Sepolvere et al. J Cardiothorac Vasc Anesth. 2021.



Parasternal blocks: does going deeper buy anything?

DIRECT COMPARISONS • RECENT META-ANALYSIS • CLINICAL INTERPRETATION

254-PATIENT RCT

Neither plane improved recovery

2022 PILOT n=39

24-h morphine: 13.9 vs 15.1 mg
PIFB vs TTMPB; $p=0.608$
Pain scores: no difference

2024 RCT

Neither S-PIP nor D-PIP improved QoR, pain, or analgesic use versus SoC
Pneumothorax: 1 superficial vs 4 deep.

No benefit over standard care; added deep-plane risk.

2025 META-ANALYSIS

7 RCTs + 1 observational study • n=510

24-h opioid difference

-1.23 MME

95% CI -2.51 to 0.05 • $p=0.061$



No significant differences in pain, PONV, rescue timing, extubation, or ICU stay

COMPARABLE ANALGESIA

WHAT THIS MEANS

**Choose anatomy
respect risk**

- Both S-PIP and D-PIP are reasonable sternotomy analgesic options
- Deep is closer to the target branch before perforation
- Deep also sits closer to internal thoracic vessels, pleura, and pericardium
- Technique, ultrasound window, anticoagulation context, and operator skill should drive selection

ANATOMIC PREFERENCE ≠ CLINICAL SUPERIORITY

Deep is anatomically direct. Clinical payoff for either remains uncertain

Pericapsular nerve group block: anatomically attractive, clinically nuanced

Proposed target

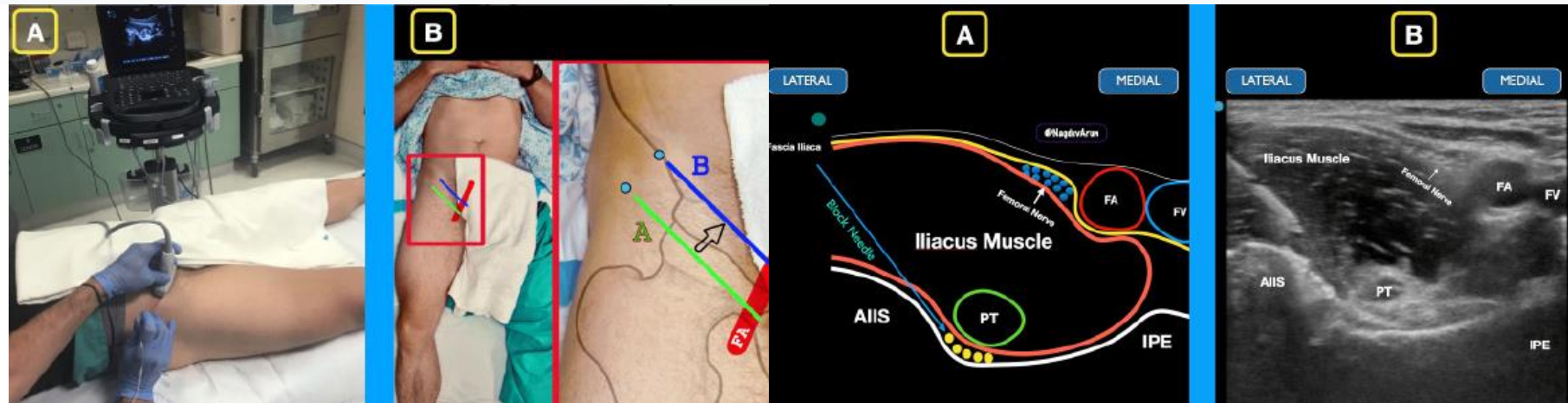
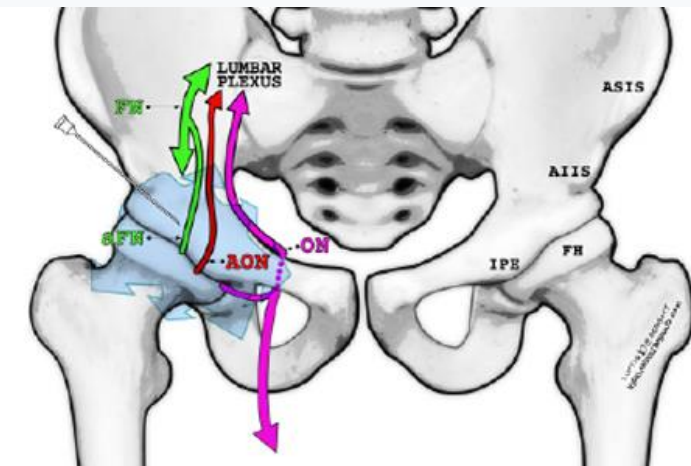
Articular branches to the anterior hip capsule from femoral, obturator, and accessory obturator contributions

Clinical appeal

Hip analgesia with less quadriceps weakness than traditional femoral or fascia iliaca approaches

Reason for caution

Volume, needle endpoint, spread to femoral nerve, surgical approach, and comparator choice affect results



Motor-sparing should be demonstrated, not assumed from the name

Bravo et al. Reg Anesth Pain Med. 2023. PMID 36948525.

Kukreja et al. Br J Anaesth. 2023. PMID 36964012. • Reysner et al. Arch Orthop Trauma Surg. 2025. PMID 40105988.

Image source: ACEP Now educational figure set

PENG: the injectate does not care about the name

ORIGINAL PROMISE • SELECTIVE ANTERIOR CAPSULAR ARTICULAR BRANCHES • MOTOR SPARING

FIGURE 3 • DISSECTION

Dye tracks to the femoral nerve

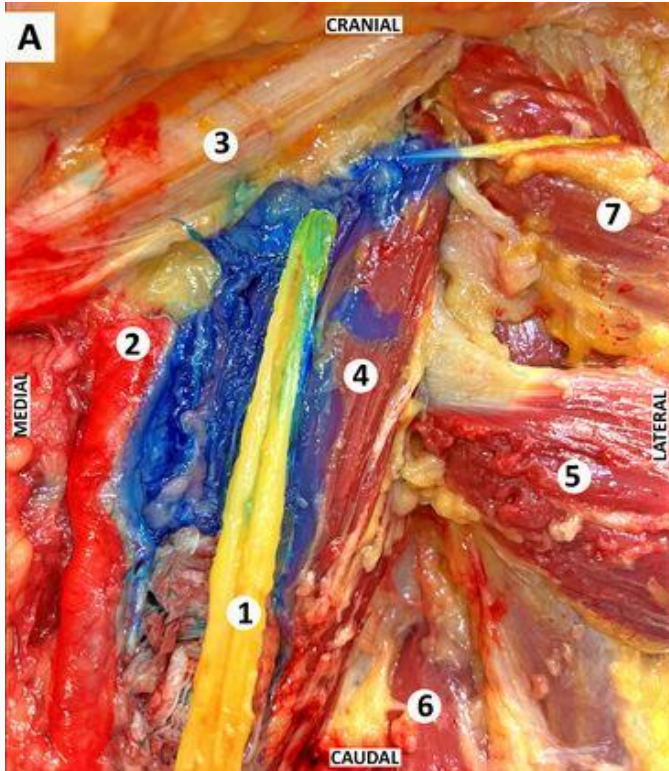


FIGURE 4 • CRYO-CROSS-SECTIONS

Iliopsoas staining, no consistent capsular spread

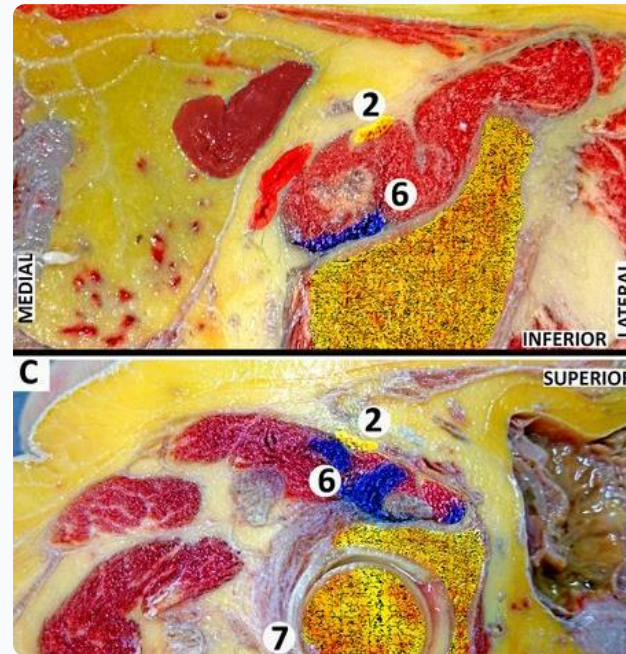
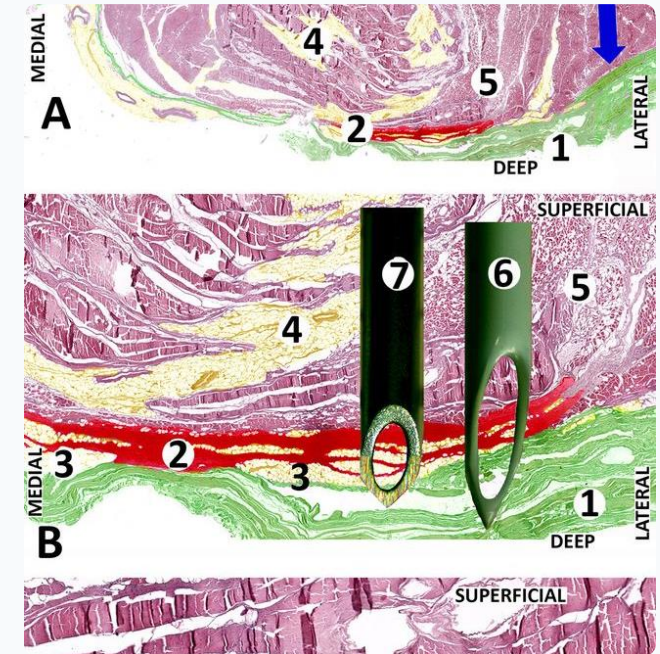


FIGURE 5 • HISTOLOGY

Subepimysial + intramuscular localization



TAKEAWAY

Motor sparing is an aspiration of PENG but not an anatomic guarantee

Pterygopalatine fossa block: a target-rich compartment

ANATOMY • APPROACH • TARGET CONTACT • CLINICAL EFFECT

ANATOMIC CROSSROADS

V2 enters a compact, connected fossa

CONTENTS	Maxillary nerve superiorly, pterygopalatine ganglion below, terminal maxillary vessels nearby
FIELD	Palate, maxillary teeth, nasal cavity, midface and portions of the naso-oropharynx
APPROACH	Suprazygomatic needle path traverses the infratemporal fossa toward the PPF
RISK	Orbit, skull base, pterygoid plexus and maxillary artery reward a disciplined trajectory

SAME NEIGHBORHOOD ≠ SAME BLOCK

Name the intervention by the intended target

V2 / PPF	Suprazygomatic PPF injection aims for local anesthetic contact with the maxillary nerve
SPG BLOCK	Transnasal, endoscopic or transoral delivery targets the pterygopalatine ganglion and mucosa
OVERLAP	Injectate may affect neighboring sensory and autonomic structures within the compartment
REPORTING	Do not pool a deep maxillary nerve block with topical or endoscopic SPG blockade

2026 CROSSOVER MRI TRIAL

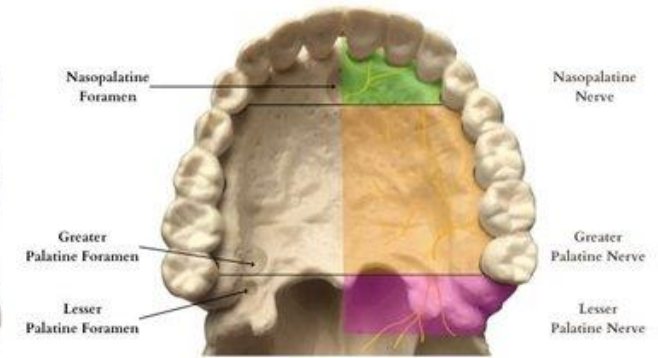
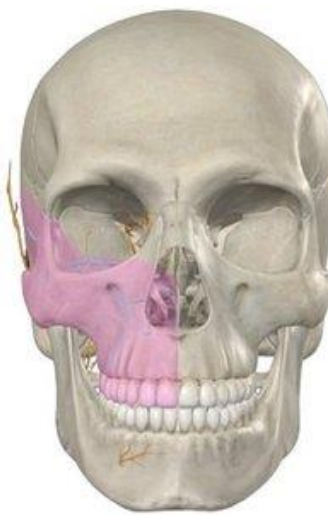
Visualization did not ensure nerve contact

CONCEPT	A target-rich fossa is the conceptual target—not proof of where the dose traveled
NEEDLE	Ultrasound improved visualization of the path, but not MRI-confirmed distribution
SPREAD	Maxillary-nerve contact: 65% landmark vs 70% ultrasound; no significant difference
EFFECT	Clinical success may still occur without confirmed contact—and contact may not assure benefit

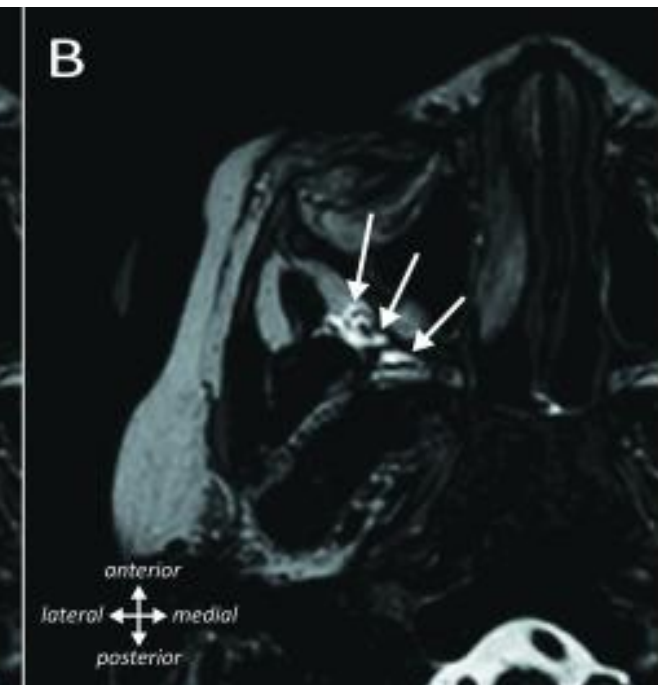
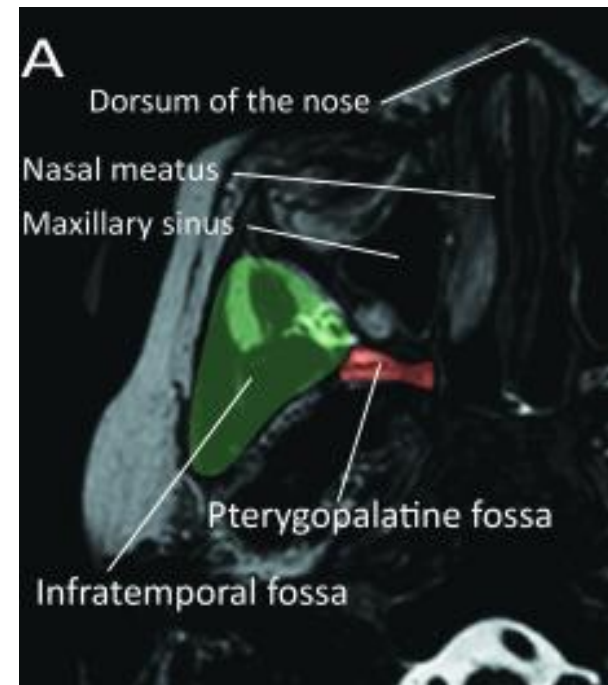
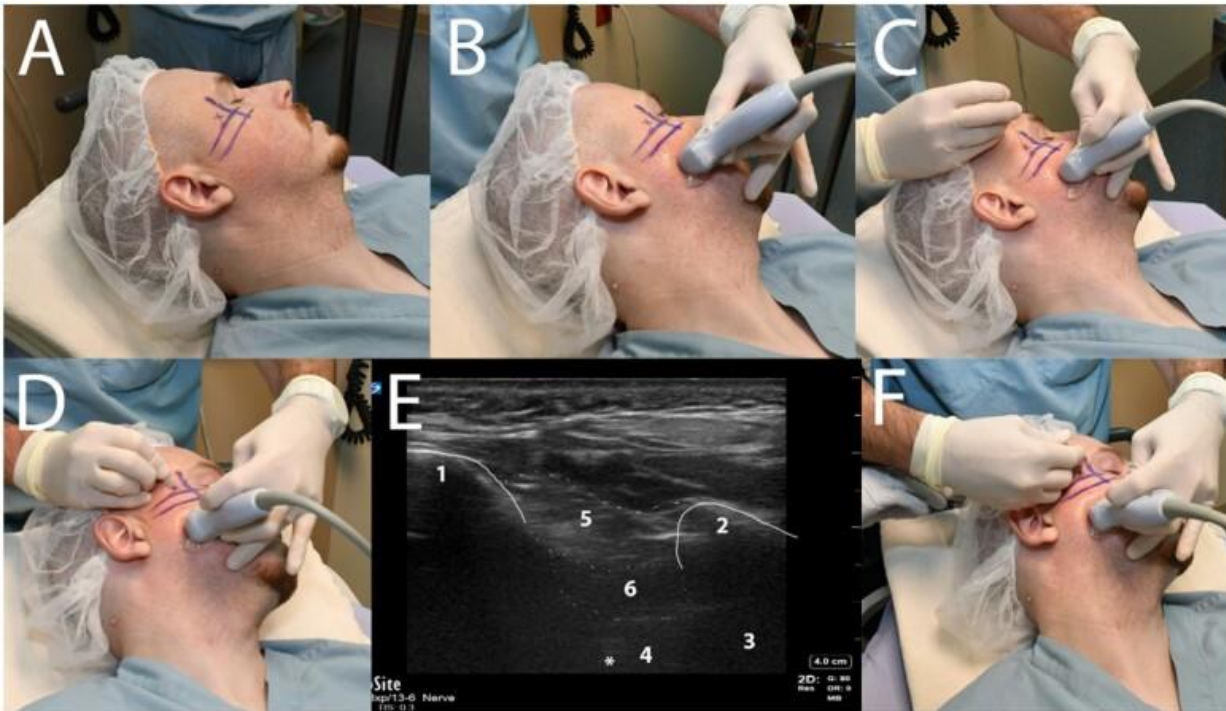
TAKEAWAY

Ultrasound improves visualization but does not guarantee success or target contact

Suprazygomatic Maxillary Nerve Block — BABY BLOCKS



Baby Blocks
Pain and Anesthesia (David W. Rich, MD)



PPF blockade: strongest evidence where anatomy matches the surgery

CLEFT PALATE • ADENOTONSILLECTOMY • FESS / NASAL SURGERY

CLEFT PALATE • BEST FIT

V2 and palate match the field

GUIDANCE	PROSPECT recommends pre-incisional bilateral suprazygomatic maxillary nerve block
BACKUP	Consider intraoral palatal nerve block if the suprazygomatic approach cannot be performed
CONTEXT	Combine with scheduled acetaminophen plus NSAID or COX-2 therapy; opioids remain rescue
DISTINCTION	SPG block lacked enough procedure-specific evidence for a PROSPECT recommendation

ADENOTONSILLECTOMY • EMERGING

A plausible V2 contribution, one positive RCT

2024 JAMA	Single-center randomized trial in pediatric intracapsular adenotonsillectomy; 53 analyzed
PACU	Lower opioid use and FLACC scores; opioid-free recovery 58% vs 26%
LIMIT	No durable postdischarge pain advantage; procedure and center specificity limit generalization
MEANING	Promising adjunct—not yet a universal tonsillectomy standard or evidence for SPG blockade

FESS / NASAL • DIFFERENT TARGET

Most adult data evaluate SPG blockade

EVIDENCE	Small randomized trials and meta-analyses suggest lower early pain and perioperative morbidity
SIGNAL	Benefits are mainly short-term; methods, timing, delivery route and comparators vary
INFERENCE	This literature does not establish equivalence to a deep V2/PPF maxillary nerve block
USE	Match procedure and target, then ask what the block adds to multimodal care

TAKEAWAY

A good anatomical target still needs procedure-specific evidence

Knee analgesia: the “new technique” doesn’t beat the pathway



Era	Standard	Incremental benefit
2005–2015	Femoral nerve block	Large
2015–2020	Adductor canal block	Moderate
2020–present	Multimodal ERAS + periarticular infiltration + dexamethasone + TXA + early PT	Additional single-shot blocks often provide only modest incremental benefit
Future	Femoral PNS?	Long term benefit?

Takeaway
For TKA, the marginal benefit of another needle has to beat a well-built pathway

PART 3

Devices

Monitoring and extended-duration peripheral therapies

Mechanism → Evidence → Candidate → Caution

We can measure nociceptive response but not subjective pain

We have moved from visible reactions to computed physiologic responses without crossing the gap to subjective experience

1950s–80s

HR • BP • sweating • movement



1990s–2000s

SPI • ANI • pupillary reflex



2010s–now

NOL • multimodal indices •
EEG features

PAIN

“An unpleasant sensory and emotional experience...”

Bio-psycho-social

Cannot be inferred solely from sensory-neuron activity

NOCICEPTION

Neural encoding of noxious stimuli

May produce autonomic, motor, and cortical responses under anesthesia

Measurable response ≠ experienced pain

Commercial monitors measure different slices of the response

MONITOR	SIGNAL SOURCE	WHAT IT INFERS	STRENGTH	LIMITATION
SPI GE	Pleth waveform + HR	Sympathetic activation	Already integrated on GE	Vascular tone, drugs, rhythm
ANI MDoloris	ECG-derived HR variability	Parasympathetic tone	Continuous, noninvasive	Arrhythmia; anticholinergics
NOL PMD-200	PPG + skin conductance + temp + motion	Multiparametric stress response	Integrates multiple signals	Proprietary; sensor/context effects
Pupillometry AlgiScan	Pupil dilation reflex / PPI	Reflex response to stimulus	Strong stimulus discrimination	Intermittent; eye access, drugs
EEG-derived qNOX / PTI	Frontal EEG features	Probability of response/arousal	Direct cortical signal	Not validated as conscious pain

No single index is a ground truth: each is a context-sensitive proxy for nociceptive balance

Does nociception monitoring improve outcomes?

2025 BJA network meta-analysis • 38 RCTs • 3,412 patients • 5 monitor types

CLEAR NETWORK SIGNAL

PUPILLOMETRY

Reduced intraoperative opioid use vs standard care

Standardized mean difference (unitless): -2.44
95% CrI -4.35 to -0.52

Trade-off: longer PACU discharge-readiness time

NO CONSISTENT NETWORK BENEFIT

NOL

ANI

SPI

**No significant opioid reduction vs standard care;
secondary outcomes showed limited clinical benefit**

NOL shortened extubation time in the network

NUANCE NOL-specific meta-analyses suggest small early pain/opioid effects but estimates are inconsistent and not clearly clinically meaningful

We can increasingly measure nociceptive response; we still cannot directly measure pain under general anesthesia

Cryoneurolysis: trading titratability for duration

Mechanism

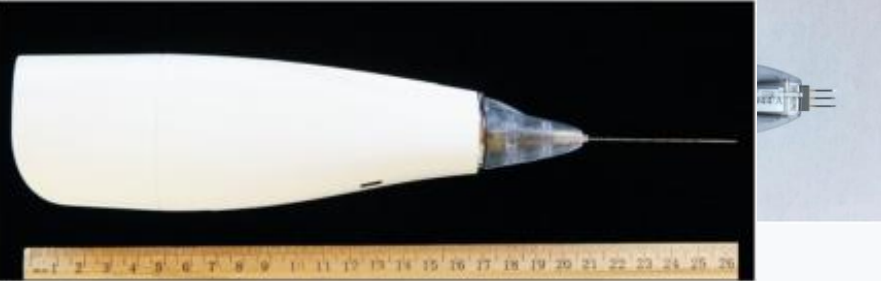
Extreme cold causes Wallerian degeneration while connective scaffolding is preserved for axonal regeneration

Clinical appeal

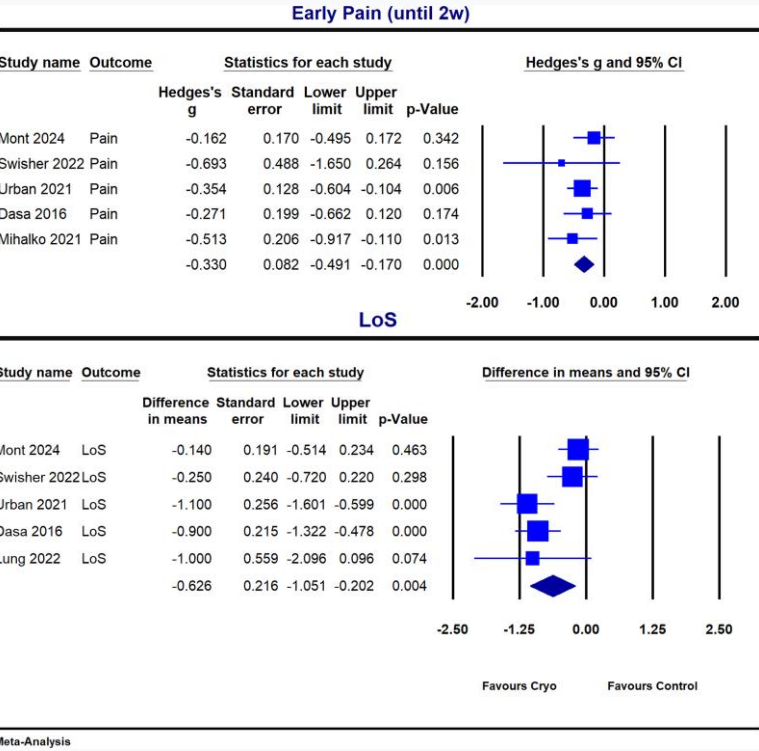
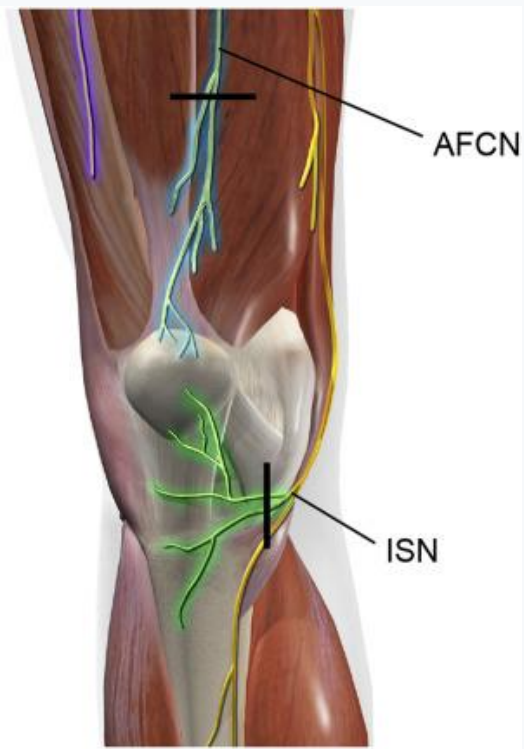
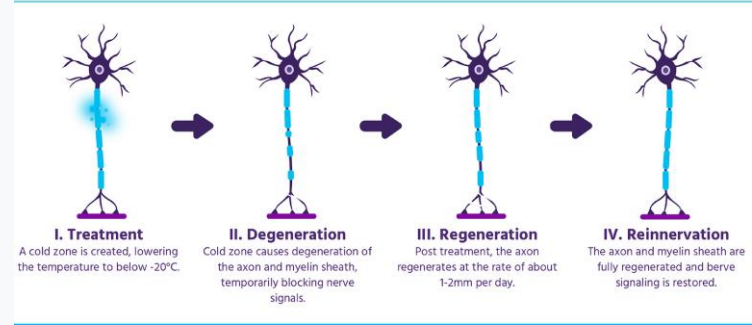
Analgesia may last weeks to months without a catheter, infusion pump, or systemic opioid

Caution

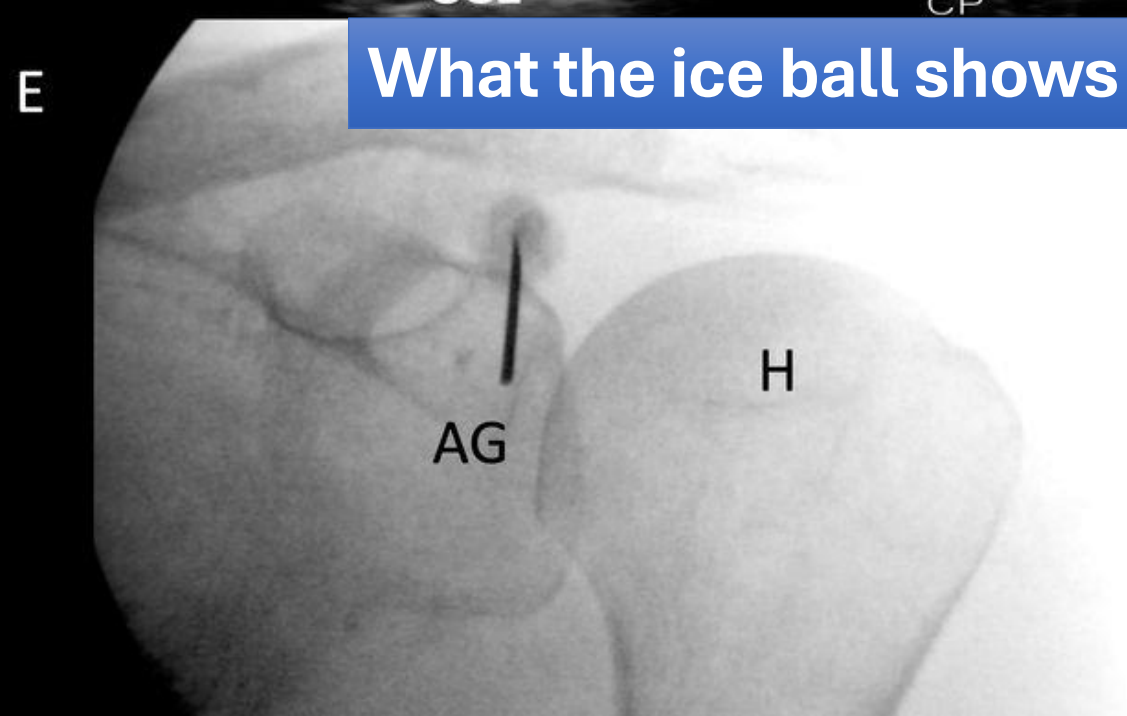
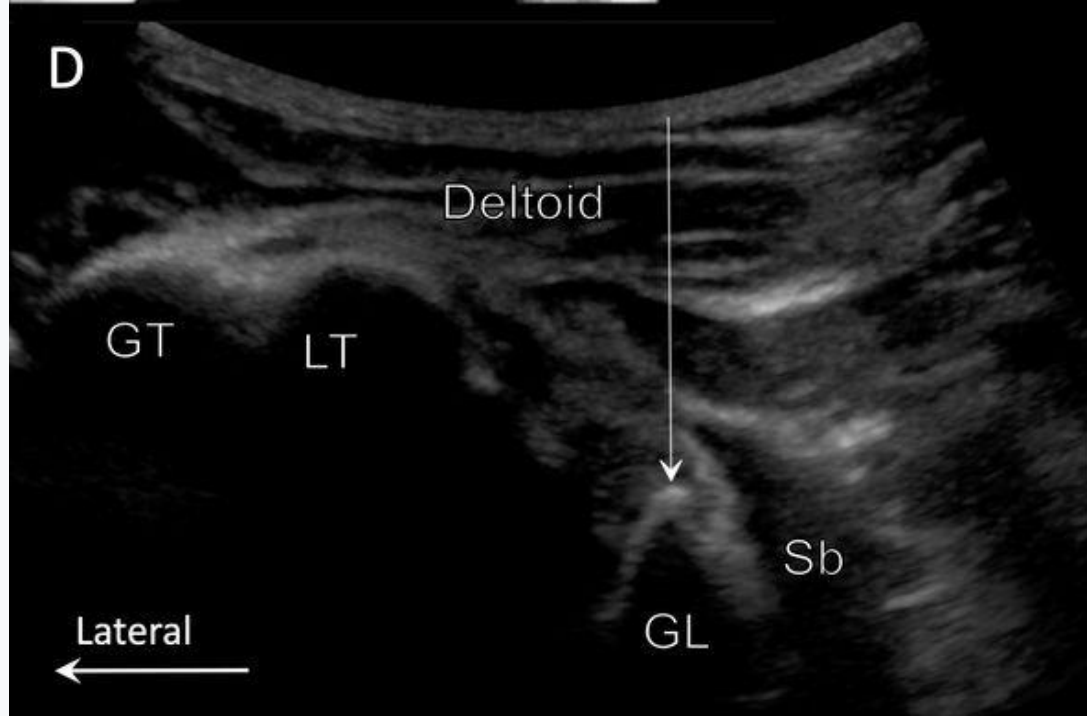
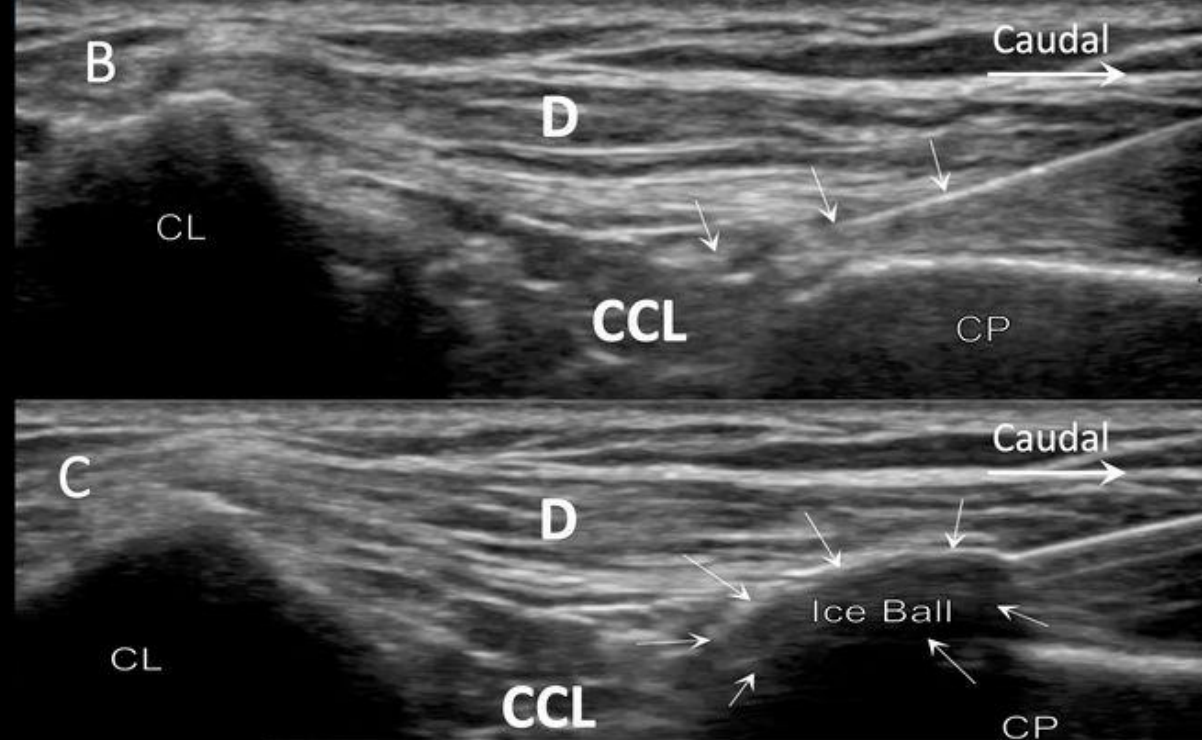
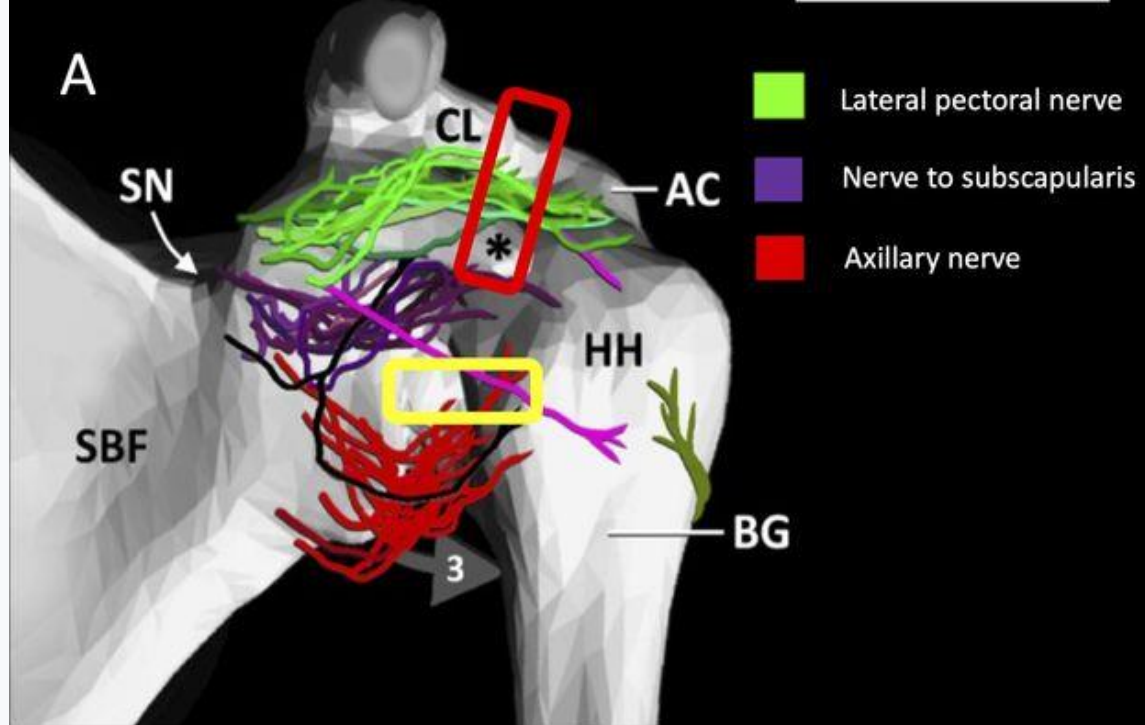
Variable onset/completeness; non-titratable after the lesion. TKA RCT missed the ITT endpoint and was positive only per protocol.



HOW IT WORKS

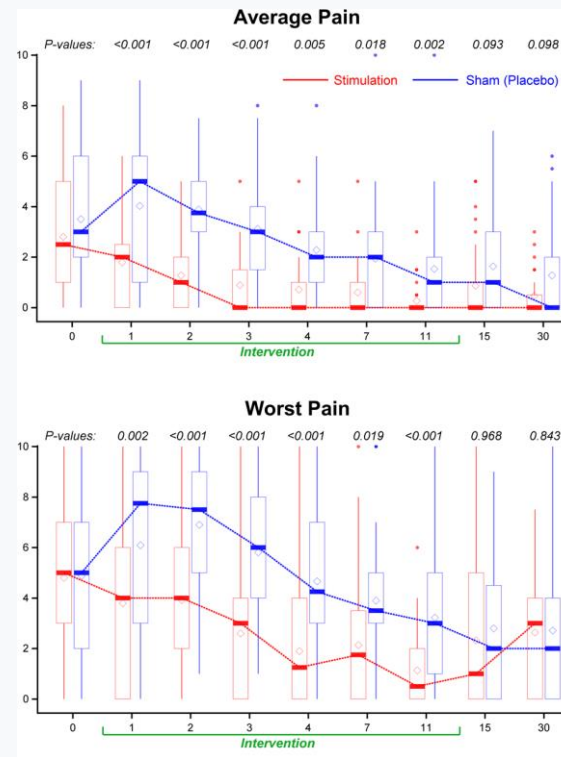


Mihalko et al. J Arthroplasty. 2021. PMID 33279353.
Swisher et al. Pain Ther. 2022. PMID 36018541. • Finneran & Ilfeld. Reg Anesth Pain Med. 2025. PMID 39909541.
Devices



Temporary peripheral nerve stimulation

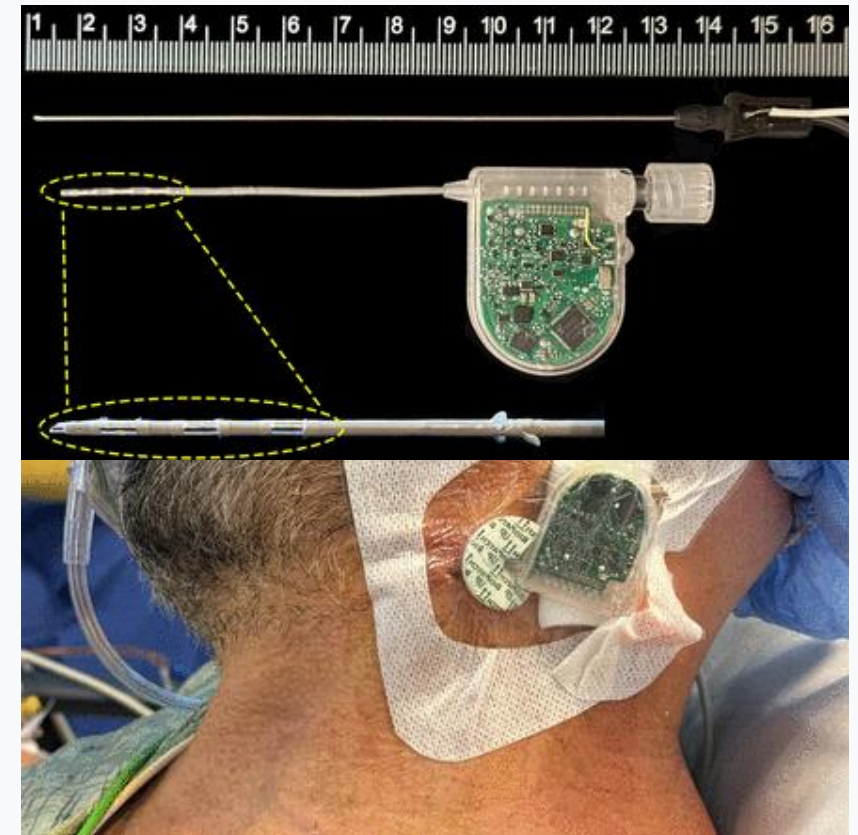
- Percutaneous lead stimulates a peripheral nerve proximal to the painful territory
- Potential mechanisms include segmental gating, altered afferent input, and network-level modulation
- Duration may outlast lead removal, but durability is not uniform across patients or targets
- Useful bridge between regional anesthesia and chronic neuromodulation



Ilfeld et al. Anesthesiology. 2021. PMID 33856424.
Finneran & Ilfeld. Reg Anesth Pain Med. 2025. PMID 39909541.

Clinical question

Should acute PNS be judged against single-shot blocks, catheters, multimodal analgesia, or for chronic pain outcomes?



PART 4

Evidence

Evidence-based adoption means comparing novel therapies to the best existing pathway—not to doing nothing

Mechanism → Evidence → Candidate → Caution

Seven filters before adopting a novel therapy

1. Mechanism

Does it fit the phenotype?

2. Comparator

What was it beaten against?

3. Effect size

Meaningful to patients?

4. Outcomes

Function, sleep, opioid, QoL?

5. Selection

Who was excluded?

6. Durability

Weeks, months, years?

7. System burden

Cost, rescue, maintenance?

Why do promising therapies disappoint?

- wrong mechanism
- wrong patient
- wrong comparator
- wrong outcome
- wrong expectations

A therapy can pass one filter and fail the decision

How novelty distorts evidence

- Highly selected trial populations do not guarantee broad practice benefit
- Sham controls are difficult for procedures and implantables
- Enriched enrollment after a successful trial phase can inflate apparent implant success
- Multiple follow-up papers from one cohort can make an evidence base look larger than it is
- Industry funding does not invalidate a study, but it should raise the bar for independent replication

Question to ask

Would I still believe this if the comparator were my best current pathway?

Can systemic lidocaine replace an adductor canal block?

OUTPATIENT TKA • RANDOMIZED 1:1 • DOUBLE-BLINDED • SHAM-CONTROLLED • n=120



NON-INFERIORITY TEST

Observed CI stayed below the prespecified 30 mg OME margin



PACU STILL FAVORED ACB

10 mg less OME • 2 points less pain at discharge

PRACTICAL READ

A credible fallback when a block is not feasible—not identical immediate analgesia.

A positive cardiac-surgery trial held by one event

2 FRENCH CENTERS • ELECTIVE CARDIAC SURGERY WITH CPB • BLINDED • SUPERIORITY • n=320

OPIOID-FREE • n=159

ketamine + dexamethasone
+ lidocaine + magnesium

OPIOID ANESTHESIA • n=161

sufentanil-based
anesthesia

PRIMARY COMPOSITE • COMPLICATION OR DEATH BY 30 DAYS

75.4%
opioid-free

vs

84.5%
sufentanil

-9.1
percentage points

RR 0.90 • 95% CI 0.80–0.99 • p=0.049

Composite: neurologic, respiratory, cardiovascular, renal complications and/or death

FRAGILITY INDEX = 1

One outcome-status change would move the primary result from statistically significant to non-significant.

Interpreting Fragility Index

Low robustness to event classification
≠ proof the effect is absent

DISCUSS: signal is there, significance or certainty?

A traffic-light model for adoption

GREEN

ready for broader use

Plausible mechanism, controlled evidence, meaningful effect size, reproducible phenotype, and rescue strategy

YELLOW

selected patients

Promising evidence, narrow phenotype, limited durability, cost or workflow constraints

RED

early adopters

Surrogate outcomes, tiny uncontrolled cohorts, unclear phenotype, no credible comparator

Reasonable clinicians can disagree but they should be explicit about why

What has actually changed?

Molecules

More selective peripheral targets and smarter delivery but first-generation effects may be incremental

Blocks

Motor-sparing, pathway integration, and prolonged analgesia matter more than novelty alone

Devices

Indications, feedback systems, and peripheral targets are expanding candidate selection but outcomes and workflow remain decisive

Take-home messages

- 1** New mechanisms deserve enthusiasm, not automatic adoption
- 2** Regional anesthesia should be judged by recovery, not just immediate analgesia
- 3** Safer does not mean more effective
- 4** Match therapy to the patient's phenotype and trajectory, not the operator's preferred procedure

Discussion

What is ready for prime time?
What still needs better evidence?

Yawar J Qadri, MD, PhD

GSA | Updates in Pain Therapies

Non-Operating Room Anesthesia (NORA) : Complexities, Opportunities, Quality Monitoring and Process Improvement

Basem Abdelmalak, MD, FASA, SAMBA-F

Professor of Anesthesiology
Director, Anesthesia for Bronchoscopic Surgery
Director, Center for Procedural Sedation
Cleveland Clinic, OH, USA

Past President Society for Ambulatory Anesthesia (SAMBA) SAMBAHQ.ORG
Past President, Society for Head and Neck Anesthesia (SHANA) SHANAHQ.COM

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[@basemcc](https://twitter.com/basemcc)

Objectives

- Identify sources of complexity in NORA and propose solutions
- Identify a framework for a successful efficient NORA service
- Outline safety issues related to sedation and anesthesia in NORA
- Discuss interventions to improve NORA outcomes

Conflict Of Interest Disclosure

- Speaker – Medtronic Inc. and Mindray North America
- Past-president, Society for Ambulatory Anesthesia (SAMBA)
- Chair: ASA Taskforce on NORA and Procedural Sedation



WWW.SAMBAHQ.ORG

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- Patients have consented to the presented pictures
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NORA: Definition

Care provided by Anesthesiology personnel for inpatients/outpatients undergoing diagnostic or therapeutic procedures performed at locations outside an operating room pavilion within the hospital

Old term: “Remote” Anesthesia

Locations for NORA Services

- Gastroenterology Endoscopy Suite
- Interventional Radiology areas including CT
- Bronchoscopy Suite
- Cardiac Catheterization Lab
- Electrophysiology Lab
- MRI (diagnostic, and surgical)
- Nuclear Medicine
- PACU (Electroconvulsive therapy)
- Pain Management procedure rooms

ICU NORA



Pro-Con Debate: Should Critically Ill Patients Undergo Procedures at Bedside or in the Operating Room?

Kunal Karamchandani, MD, FCCP, FCCM,* Matthew Evers, MD,† Travis Smith, MD,† Anthony Bonavia, MD, FCCP,† Ranjit Deshpande, MD, FCCM,‡ John C. Klick, MD, FCCP, FASE, FCCM,§ and Basem B. Abdelmalak, MD, FASA, SAMBA-F||

December 2023 • Volume 137 • Number 6

www.anesthesia-analgesia.org

Why Did NORA Exist?

- New advances in the procedures:
 - Not requiring the full capabilities of an operating room
 - Requiring complex and immobile technology
- Higher risk patients who were not previously considered candidates for any intervention, now have an option
- Economic trend for more outpatient vs. inpatient services
- Procedural sedation Vs. Anesthesia services

Growth of Nonoperating Room Anesthesia Care in the United States: A Contemporary Trends Analysis

Alexander Nagrebetsky, MD, MSc,* Rodney A. Gabriel, MD,† Richard P. Dutton, MD, MBA,§ and Richard D. Urman, MD, MBA‡

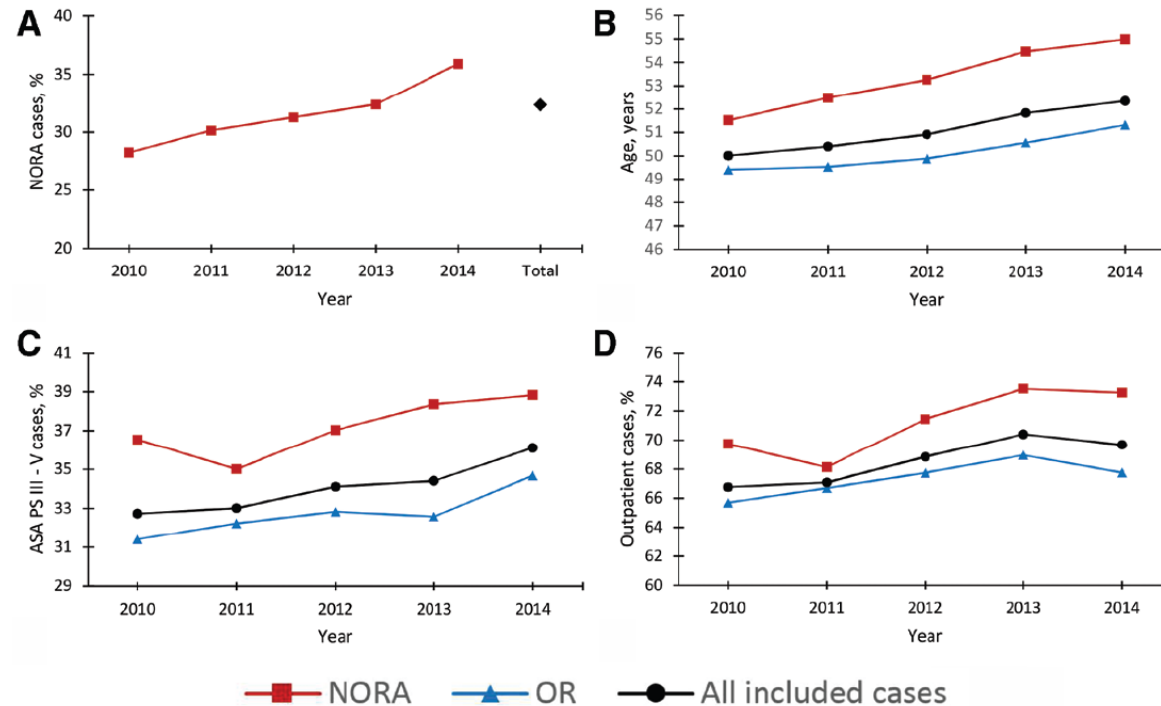


Figure 2. A, Percent of nonoperating room anesthesia (NORA) cases among all cases included in this study. B, Mean age of patients. C, Percent of cases performed in patients with American Society of Anesthesiologists physical status (ASA PS) III-V. D, Percent of outpatient cases.

in 2026
≈50%

JULY 20, 2026

NORA Steadily Expanding, Eliciting Workforce Shortage Concerns



Workforce Hot Buttons

Anesthesiology Oversight for Procedural Sedation

Basem B. Abdelmalak, MD, FASA, SAMBA-F David P. Martin, MD, PhD, FASA Donald E. Arnold, MD, FASA

Driven by advances in minimally invasive diagnostic and therapeutic procedures, the demand for anesthesia and procedural sedation outside the OR has expanded more rapidly than ever. This has placed tremendous strain on anesthesiology departments, both to fulfill anesthesia service needs and to oversee procedural sedation. Nonoperating room anesthesia (NORA) is an extension of OR anesthesiology practice, either personally performed, medically directed, or nonmedically directed. Separate from the extension of anesthesiology services to NORA settings is the procedural sedation performed by nonanesthesiologist providers in many procedural units. Because of the significant variability that may exist in sedation practices (e.g., patient preparation and monitoring, practitioner education and training, oversight of quality and safety in provided care), procedural sedation may place patients, practition-

ers, and health systems at risk. Whether or not the anesthesiology department fully embraces the role, physician anesthesiologists are responsible for patient safety and regulatory compliance everywhere procedural sedation is performed.

In 2009, The Centers for Medicare & Medicaid Services (CMS) issued the §482.52 Condition of Participation. CMS states that the director of anesthesia services is responsible for all anesthesia services throughout the hospital, including all departments in all campuses and off-site locations where anesthesia services are provided. The directive applies to all moderate and deep procedural sedation services provided by nonanesthesiologist proceduralists (asamonitor.pub/3Lu9m3f; asamonitor.pub/3DCUsG9; asamonitor.pub/3xBk3v1). Procedural sedation can be either moderate or deep (Table 1). Moderate sedation is typically provided by a nonanesthesiologist physician proceduralist who is also performing the procedure

and a sedation nurse. Deep sedation involves two nonanesthesiologist physician proceduralists – one administers and monitors deep sedation while the other performs the procedure. While the oversight includes both moderate and deep sedation, efforts (and this overview) are generally focused on moderate sedation, as it constitutes almost all the proceduralist-provided sedation services (99.8% vs. 0.2% of total sedation cases, respectively, at the author's Cleveland Clinic institution) (*Anesth Analg* 2022;135:198-208). Of note, in developing the Continuum of Depth of Sedation: Definition of General Anesthesia and Levels of Sedation/Analgesia, ASA has recognized that sedation is a continuum, and it is not always possible to predict how an individual patient will respond. Hence, practitioners intending to provide a given level of sedation should be able to rescue patients whose level of sedation becomes deeper than initially intended.



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ASA Treasurer, President, Western

Controlling the Demand and Fulfilling CMS Mandate

Anesthesia & Analgesia

■ SPECIAL ARTICLE

A Blueprint for Success: Implementation of the Center for Medicare and Medicaid Services Mandated Anesthesiology Oversight for Procedural Sedation in a Large Health System

Basem B. Abdelmalak, MD, FASA, SAMBA-F,*†‡ Talal Adhami, MD, HCMBA, AGAF, FAASLD,§ Wendy Simmons, MSN, RN,|| Patricia Menendez, MS, BSN, RN, HACPT¶ Elizabeth Haggerty, MLRHR, MBA,# and Christopher A. Troianos, MD, FASE, FASA**



American Society of
Anesthesiologists

Statement on Nonoperating Room Anesthesia Services

Developed By: Committee on Practice Parameters

Committee of Oversight: Surgical and Procedural Anesthesia

Last Amended: October 18, 2023 (original approval: October 19, 1994)

<https://www.asahq.org/standards-and-practice-parameters/statement-on-nonoperating-room-anesthesia-services>

ASA Task Force on NORA and Procedural Sedation

Commissioned by: Mary Dale Peterson, MD, MBA, FASA

Chair: Basem Abdelmalak, MD FASA

Donald Arnold, MD, FASA

Patricia Mack, MD, FASA

Sheila Barnett, MD, BSc, FASA

David Martin, MD, PhD, FASA

Ryan Chadha, MD

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Karen Domino, MD, MPH

Daniel Roke, MD, MBA

Vilma Joseph, MD, MPH, FASA

Tetsu Uejima, MD, MPH, FASA

Sources of Complexity and Challenge In NORA

- Space and equipment
- Staff
- Patients
- Procedures
- Quality and safety
- Efficiency
- Finances

Sources of Complexity and Challenge in NORA.....And Solutions

- Space and equipment
- Staff
- Patients
- Procedures
- Quality and safety
- Efficiency
- Finances

Space and Equipment Challenge



Poor Access to High Risk Patients



Facilities Design and Equipment

- The DAS or designee shall be involved in the planning and establishing of a NORA service
- Applicable elements of the ASA OR Design Manual should be incorporated
- NORA locations shall be established as close to the main OR as possible
- Such locations should be established in close proximity to each other to improve:
 - Safety
 - Effectiveness
 - Efficiency
 - Timeliness of delivering care



Statement on Nonoperating Room Anesthesia Services

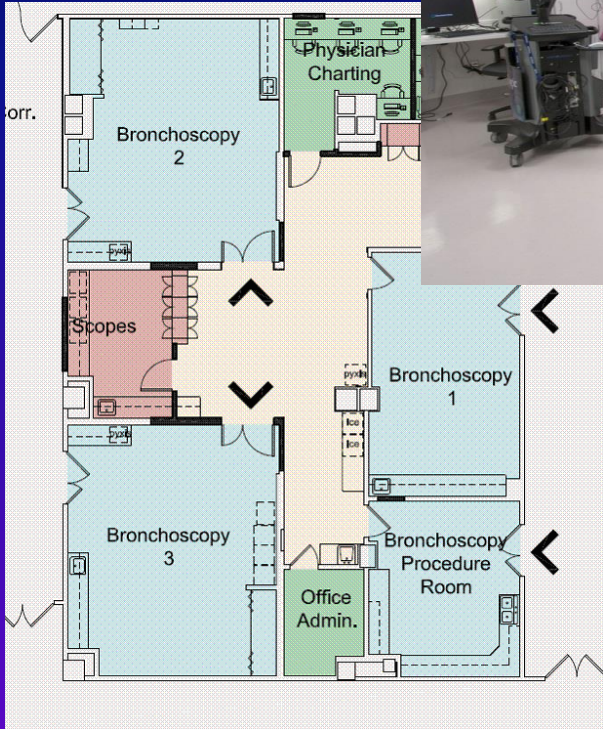
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Modern Bronchoscopy Suite



Abdelmalak BB, Gildea TR, Doyle DJ, Mehta AC. A Blueprint for Success: A Multidisciplinary Approach to Clinical Operations within a Bronchoscopy Suite. CHEST 2022; 161(4):1112-1121

A Blueprint for Success



A Multidisciplinary Approach to Clinical Operations Within a Bronchoscopy Suite

Basem B. Abdelmalak, MD; Thomas R. Gildea, MD, FCCP; D. John Doyle, MD, PhD, DPhil; and Atul C. Mehta, MD, FCCP

Modern GI Suite



Modern Interventional Radiology Suite



Sources of Complexity and Challenge in NORA

- Space and equipment
- **Staff**
- Patients
- Procedures
- Quality and safety
- Efficiency
- Finances

Staff

- We are strangers in a strange land
- This can impede teamwork
- Proceduralists may have unrealistic expectations
- COMMUNICATION
- TEAM BUILDING



Assignment Desirability

A Blueprint for Success

 Check for updates

A Multidisciplinary Approach to Clinical Operations Within
a Bronchoscopy Suite

Basem B. Abdelmalak, MD; Thomas R. Gildea, MD, FCCP; D. John Doyle, MD, PhD, DPhil; and Atul C. Mehta, MD, FCCP

- Proper planning of space, equipment, etc.
- The availability of appropriate resources
- Similarity, as possible, to the main OR
- The same electronic anesthesia record
- Starting with a core group then expand with proper training, education and support.

Assignment Desirability

A Blueprint for Success

Check for updates

A Multidisciplinary Approach to Clinical Operations Within
a Bronchoscopy Suite

Basem B. Abdelmalak, MD; Thomas R. Gildea, MD, FCCP; D. John Doyle, MD, PhD, DPhil; and Atul C. Mehta, MD, FCCP

- Clinical leaders met weekly for the first few months and regularly thereafter
- Foster teams' cohesiveness and sense of community
- Support each other through meaningful professional collaborations

Environment of Care

- Each procedure room must have:
 - Adequate pharmaceutical drugs, IV fluids, anesthesia supplies, etc
 - Adequate monitoring including capnography
 - Anesthesia machine if inhalational anesthetic are to be used

Statement on Nonoperating Room Anesthesia Services

Developed By: Committee on Practice Parameters

Committee of Oversight: Surgical and Procedural Anesthesia

Last Amended: October 18, 2023 (original approval: October 19, 1994)

Environment of Care

- Each NORA location must have:
 - Post Anesthesia Care Unit (PACU)
 - Point of care testing
 - Adequate trained staff to support the anesthesiologist

Statement on Nonoperating Room Anesthesia Services

Developed By: Committee on Practice Parameters

Committee of Oversight: Surgical and Procedural Anesthesia

Last Amended: October 18, 2023 (original approval: October 19, 1994)

Sources of Complexity and Challenge in NORA

- Space and equipment
- Staff
- **Patients**
- Procedures
- Quality and safety
- Efficiency
- Finances

Re-do PVI in EP Lab

- 61 Y/O male: 92 Kg / 6', MP I, short TM
- Admitted to re start dofetilide and for treatment of CHF
- PMH:
 - HTN, CAD with large remote anterior MI, s/p PCI , remote 4v CABG, s/p ICD for VF arrest
 - Severe LV dysfunction EF 20%
 - Longstanding atrial tachyarrhythmia (s/p surgical cryoMAZE then catheter based PVAI)

Severe Comorbidity and Aspiration Risk

- 65 Y/O male, severe AS, who has a PE
- Gastric outlet obstruction due to stomach CA, scheduled for EGD and BX
- Would you accept him in the endoscopy suite?
- MAC Vs. GA?
- RSI? with or without cricoid pressure? Or awake Intubation?
- Invasive monitors?

EGD For LVAD Patients

- Increased need due to acquired VW
- Pulsatile Vs non pulsatile
- Monitoring oxygenation and perfusion
- Pump flow and pulse index



Routine EBUS with a Twist

- 70 Y/O F
- HTN
- Chronic hoarseness
- COPD
- Rt renal mass
- LUL 6.9cm mass associated with mild left hilar adenopathy
- Scheduled for staging EBUS/TBNA

Findings



Abdelmalak, Choi, Bryson Incidental Findings of Bilateral Vocal Cord Polyps and Asymptomatic Pulmonary Embolism during EBUS Guided Mediastinal Staging: A Case Report Highlighting Teamwork in Management Decision Making, Journal of Head and Neck Anesthesia 7(1):e45, June 2023

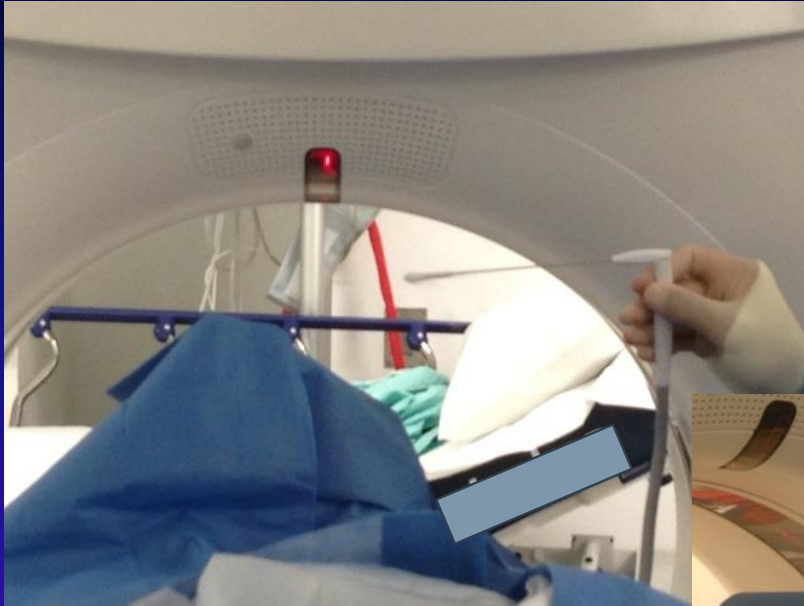
Sources of Complexity in NORA

- Space and equipment
- Staff
- Patients
- **Procedures**
- Quality and safety
- Efficiency
- Finances

CT Guided Lung Cancer Cryoablation

- 70 year old patient scheduled for cryoablation of LU lung cancer.
- A fib takes sotalol, dabigatran
- COPD uses supplemental O₂ @ 3L
- LLE embolism resulting in a BKA
- ETOH abuse, cut back to 3 beers QD

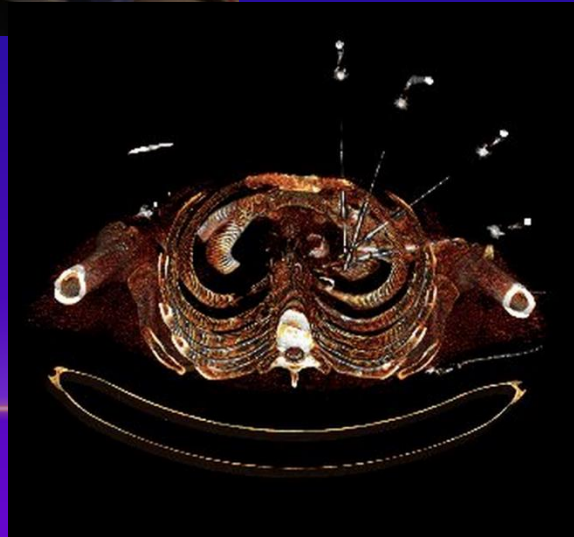
Lung Cryoablation



Issues and Complications

- Procedure specific
 - Lung parenchymal hemorrhage
 - Pneumothorax
 - Hypothermia
 - Loss of airway
- Patient specific
 - Alcohol withdrawal
 - Chronic hypoxemia

Challenges of Lung Cryoablation



NORA Service Specific issues

Anesthetic Considerations And Techniques For Advanced Diagnostic And Therapeutic Bronchoscopy

Advances in Anesthesia 32 (2014) 71–87

ADVANCES IN ANESTHESIA

Anesthesia and Upper and Lower Airway Management for Advanced Diagnostic and Therapeutic Bronchoscopy

Basem Abdelmalak, MD^{a,b,c,*}, Sonali Sethi, MD^d,
Thomas R. Gildea, MD, MS^e

6314

Anesthesia for Bronchoscopy

Basem B. Abdelmalak^{*}, Thomas R. Gildea[†] and D. John Doyle[†]

Current Pharmaceutical Design, 2012, 18, 6314-6324

Anesthesia Technique for Endobronchial Ultrasound-Guided Fine Needle Aspiration of Mediastinal Lymph Node

Mona Sarkiss, MD, PhD,^{*} Marcus Kennedy, MD,[†] Bernhard Riedel, MD, PhD,^{*} Peter Norman, MD,^{*}
Rodolfo Morice, MD,[†] Carlos Jimenez, MD,[†] and George Eapen, MD[†]

Challenges in GI NORA

- Monitoring ventilation
- Airway management
- NPO status
- LVAD patients
- CO₂ Bowel insufflation

To Tube or not To Tube in GI



Abdelmalak B. Anesthesia for Interventional Pulmonology. In: Urman RD, Gross WL, Philip BK, editors. Anesthesia Outside of the Operating Room. New York: Oxford University Press, Inc.; 2011. p. 167-74.

Indications for Intubation in GI Endoscopy

- **Patient related**
 - Emergency
 - Significant cardiac or respiratory comorbidities
 - Sepsis
 - Intestinal obstruction (esophagus, stomach, duodenum or small or large intestines)

Nonoperating Room Anesthesia

Anesthesia in the Gastrointestinal Suite

Sekar S. Bhavani, MD^{a,*}, Basem Abdelmalak, MD^{b,c}

- **Anatomical problems**
 - Complex anatomy
 - Short gut syndrome
 - Zenker's diverticulum
 - Short Roux-N-Y loop
 - Large hiatus hernia
- Morbid obesity

Anesthesiology Clin 37 (2019) 301–316

<https://doi.org/10.1016/j.anclin.2019.01.010>

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[anesthesiology.theclinics.com](https://www.anesthesiology.theclinics.com)

Indications for Intubation in GI Endoscopy

Nonoperating Room Anesthesia

Anesthesia in the Gastrointestinal Suite

Sekar S. Bhavani, MD^{a,*}, Basem Abdelmalak, MD^{b,c}

- **Procedure related**
 - Long duration of procedure
 - Complex procedure
 - Drainage of a pancreatic pseudo cyst
 - Use of large volume of fluid irrigant
 - Double balloon
- **Anesthesia related**
 - Known difficult intubation
 - Inadequate NPO duration
 - Retained food
 - CO₂ use during the endoscopy

Other Challenges

- Hypovolemia from bowel prep
- Uncorrected anemia from GI Bleed
- Bradycardia, and/or arrhythmia from bowel distension, or scope insertion
- Other complications:
 - Bleeding
 - Perforation
 - Aspiration

Sources of Complexity in NORA

- Space and equipment
- Staff
- Patients
- Procedures
- Quality and safety
- Efficiency
- Finances

Quality and Patient Safety

- Each procedure room must have basic resuscitative equipment
- Each NORA location must have:
 - Emergency drugs and emergency cart with defibrillator
 - Access to difficult airway and MH carts
 - Lead aprons and X-ray protective gear for the anesthesiology team
 - The DAS should be involved in writing NORA policies



Statement on Nonoperating Room Anesthesia Services

Developed By: Committee on Practice Parameters

Committee of Oversight: Surgical and Procedural Anesthesia

Last Amended: October 18, 2023 (original approval: October 19, 1994)

<https://www.asahq.org/standards-and-practice-parameters/statement-on-nonoperating-room-anesthesia-services>

Preop NPO Guidelines

Practice Advisory for Preanesthesia Evaluation

*An Updated Report by the American Society of
Anesthesiologists Task Force on Preanesthesia Evaluation*

Ingested Material	Minimum Fasting Period ²
Clear liquids ³	2h
Breast milk	4h
Infant formula	6h
Non-human milk ⁴	6h
Light meal ⁵	6h
Regular meal	8h

EXPERTS' OPINION

Nil per os guidelines: what is changing, what is not, and what should?

Michael V. PRESTA ¹ *, Sekar S. BHAVANI ², Basem B. ABDELMALAK ³

- Split dose bowel prep:
 - Clinical superiority
 - Better patient acceptability
- The residual gastric volume did not differ between split dose and a single dose.

- Huffman M, Unger RZ, Thatikonda C, Amstutz S, Rex DK. Split-dose bowel preparation for colonoscopy and residual gastric fluid volume: an observational study. *Gastrointest Endosc.* 2010;72(3):516-22.

- Tandon K, Khalil C, Castro F, Schneider A, Mohameden M, Hakim S, et al. Safety of Large-Volume, Same-Day Oral Bowel Preparations During Deep Sedation: A Prospective Observational Study. *Anesth Analg.* 2017;125(2):469-76.

- Bhavani SS, Abdelmalak BB. Fasting Before Anesthesia: An Unsettled Dilemma. 2017;125(2):369-71.

Recovery and Discharge Common Questions:

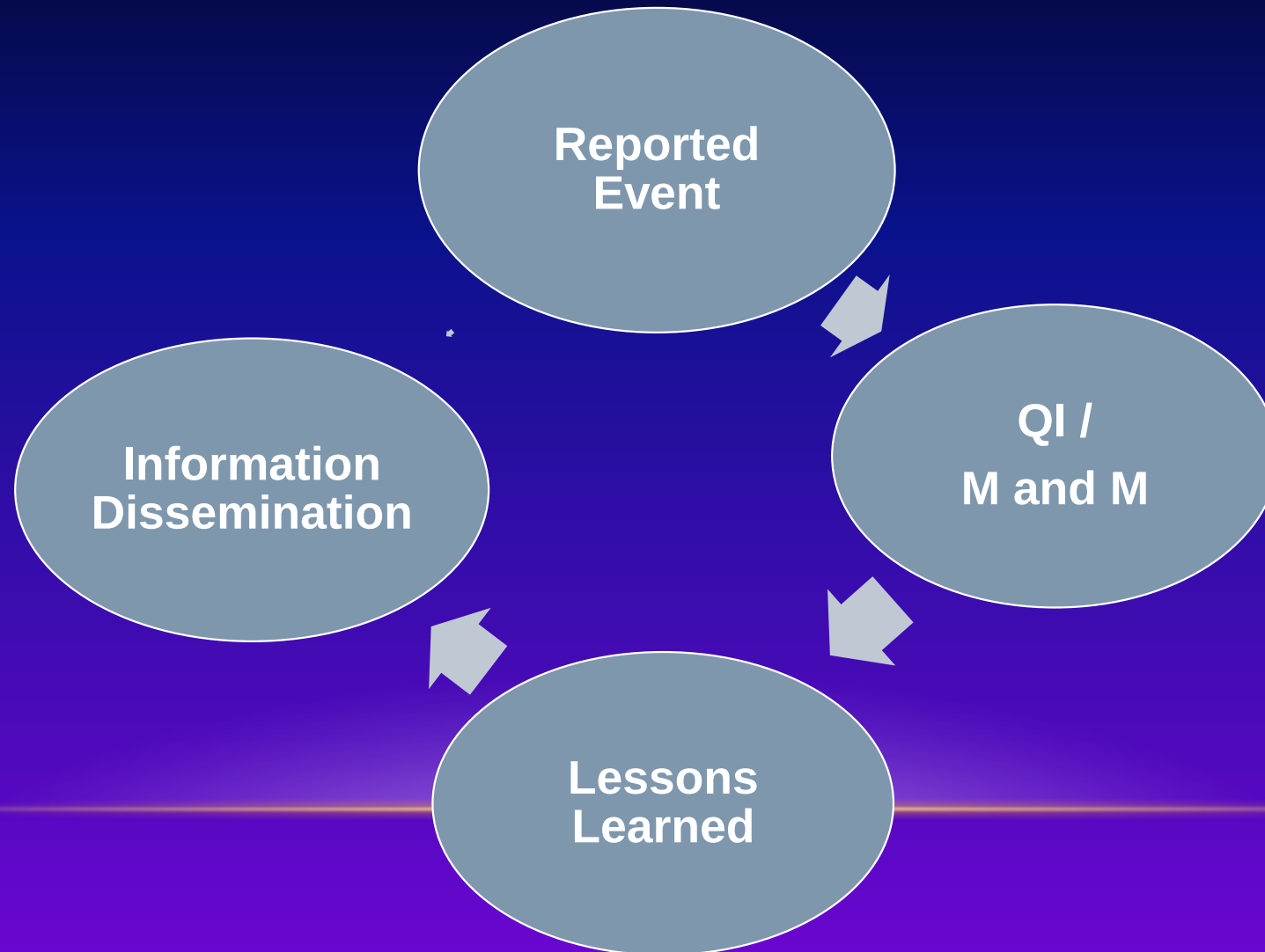
- Requirement for urination before discharge?
- Requirement for drinking clear liquids?
- Responsible adult to accompany them home?
 - Adult observation overnight???
- Minimum duration of stay in recovery?

Practice Guidelines for Postanesthetic Care

An Updated Report by the American Society of Anesthesiologists Task Force on Postanesthetic Care

Anesthesiology 2013; 118:291-307

Registry and QI Process



Patient Safety in NORA

- Overall mortality was greater in OR patients compared to NORA patients, 0.4 vs 0.2 %, respectively
- The cardiology and radiology areas had a mortality rate significantly greater than the OR of 0.5%
- Wrong patient/side procedures were higher in NORA

Patient Safety in NORA

- Closed claims study
- In MAC cases, respiratory depression was responsible for 21% MAC-related claims
- Over half of these adverse events were felt to be preventable with better monitoring¹
- Compared with OR claims, those in the NORA locations are more often associated with patient death, issues with ventilation and higher payout²

1. Bhananker SM, Posner KL, Cheney FW, Caplan RA, Lee LA, Domino KB. Injury and liability associated with monitored anesthesia care: a closed claims analysis. *Anesthesiology*. 2006;104(2):228-34.

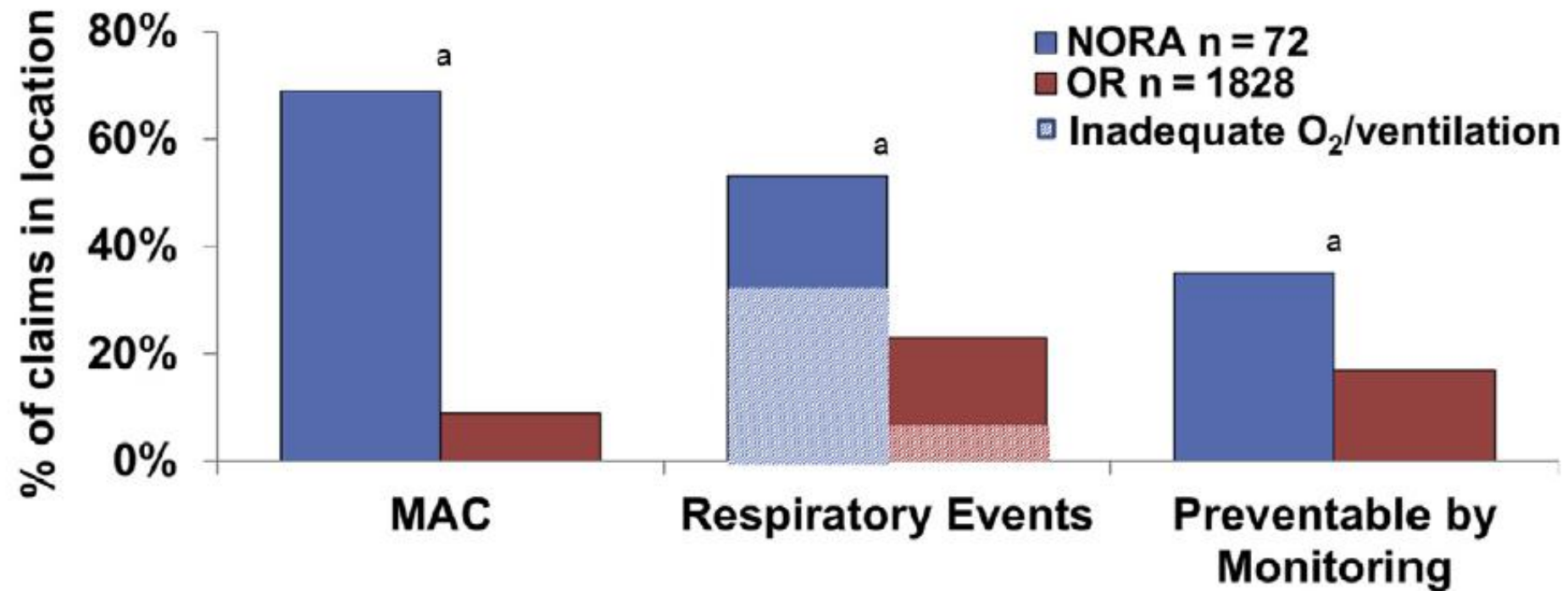
2. Metzner J, Posner KL, Domino KB. The risk and safety of anesthesia at remote locations: the US closed claims analysis. *Curr Opin Anaesthesiol*. 2009;22(4):502-8.

Safety of Non-Operating Room Anesthesia

A Closed Claims Update

Zachary G. Woodward, MD^a,

Richard D. Urman, MD, MBA, FASA^{a,b,*}, Karen B. Domino, MD, MPH^c



Sources of Complexity in NORA

- Space and equipment
- Staff
- Patients
- Procedures
- Quality and safety
- **Efficiency**
- Finances

Anesthesia Services Staffing

- Anesthesiologist only
 - Similar to other assignments
- Anesthesia Care Team
 - Geographic proximity of sites
 - Requirement to “remain immediately available”
- Teaching Physicians
 - CMS billing rules versus accreditation standards

Solutions for Large Vs. Small Centers

- Large centers may have enough demand to run NORA as mini procedures suites to allow efficient staffing
- Small centers can plan for renovations/new construction aiming for multi-purpose suites and/or within the main OR pavilion for better efficiency

Scheduling of Anesthesia Services

- Block time versus fitting into gaps
 - If sufficient volume, block time may improve utilization
 - Scheduling full days rather than partial days of coverage should improve efficiency
 - for lower volume services a long day every other week rather than shorter blocks every week
- economic goal is to reduce overutilized time
 - more expensive than underutilized time

Adopted with permission from Dr. Alan Marco

Staffing and Schedule Optimization

- System-based triage of patients to anesthesiology services vs. procedural sedation
- Similar principles of capacity coordination and data analytics to drive optimization of perioperative services delivery
- Cases should be scheduled as in the main OR to facilitate integration into the electronic anesthesia record system



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Staffing and Schedule Optimization

- Case scheduling should be done in a manner to enable personnel assignments, improve efficiency, and provide the means to track clinicians' clinical activities
- Constant awareness of locations of all anesthesia cases
- No interruptions imposed by procedural sedation cases
- Scheduling inpatient and outpatient complex procedures during standard resource hours to support safe care



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Sources of Complexity in NORA

- Space and equipment
- Staff
- Patients
- Procedures
- Quality and safety
- Efficiency
- **Finances**

Finances and Budget

- Planning for new or expanding NORA services should be supported by a business plan
- When anesthesiology professional revenue does not support the costs to deliver care, maintenance of operations may require institutional financial support



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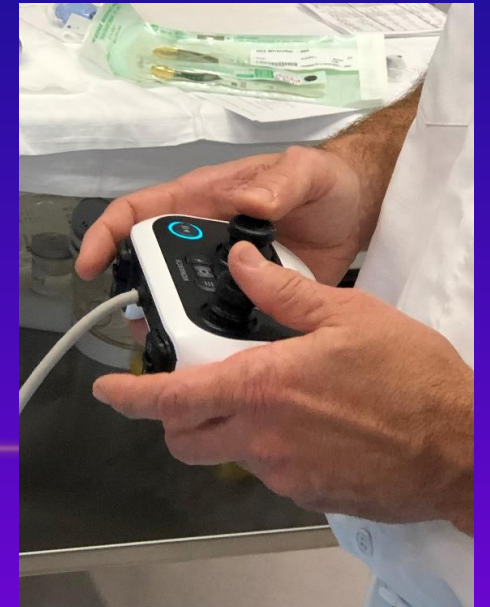
Statement on Nonoperating Room Anesthesia Services

Developed By: Committee on Practice Parameters

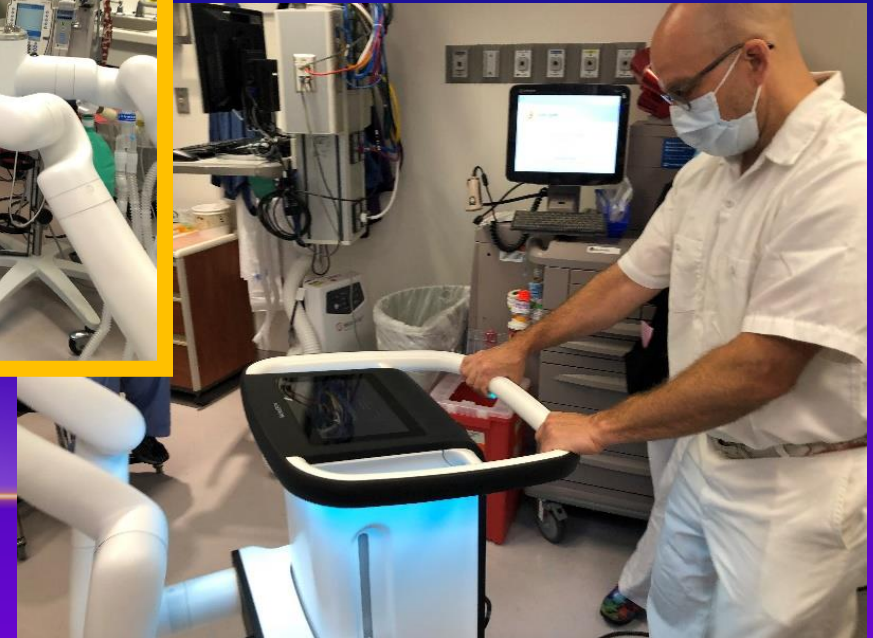
Committee of Oversight: Surgical and Procedural Anesthesia

Last Amended: October 18, 2023 (original approval: October 19, 1994)

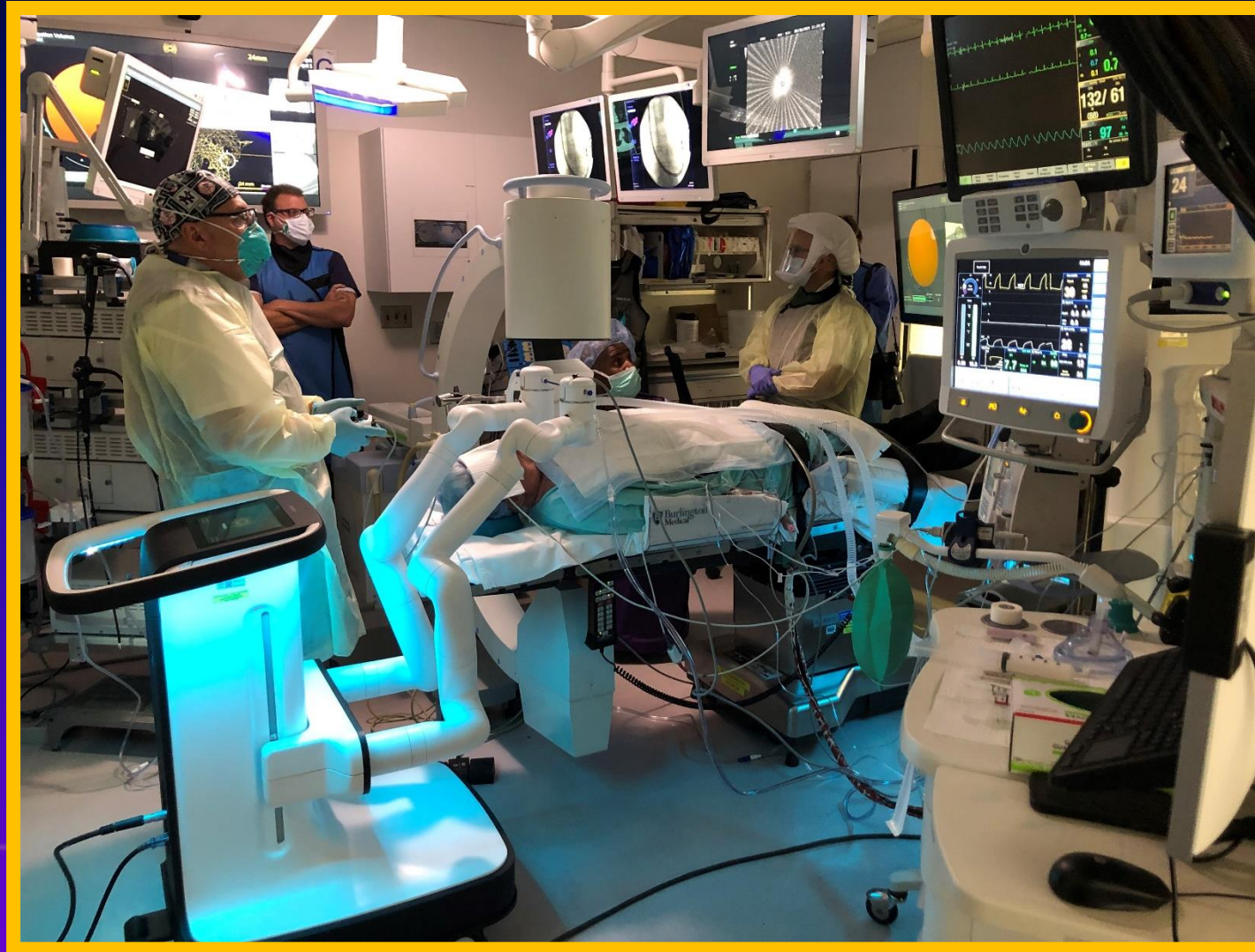
Change and Progress e.g. Robotic Bronchoscopy



Anticipate Emergencies



Safe Execution



Summary

- NORA is growing fast, and its future is bright
- Some complexities can be addressed by pre-planning such as the space, equipment and personnel challenges
- We have to be familiar with, prepared for, and ready to manage patients' comorbidities
- Successful safe delivery of NORA would require well thought out plan and organization (ASA NORA Statement)

Summary Contd.

- Patient safety in NORA areas is our #1 priority and focus
- Flexibility is needed to tailor and modify old anesthetic techniques and develop new ones to meet the new needs
- Effective communications and team work are essential for successful management of these challenging cases

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THANK YOU!

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Department of Anesthesiology



Cardiac Trauma

Caitlin Bradley, MD, FASA, FASE
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Emory University SOM



Disclosures

- Springer POCUS Book Project
 - Royalties once published



Goals

- Incidence
- Level 1 and Level 1 cardiac Requirements
- Types of Trauma: Penetrating vs. Blunt
- Aortic Injury
- When do we call for help?
- Trauma protocols
- Outcomes and survival
- Cardiopulmonary Bypass
- ECMO
- REBOA





Trauma Incidence

Trauma is an epidemic. In the United States, over 41 million ED visits and nearly 3 million non-fatal injuries annually (Frydrych LM 2019, AAST)

Trauma is one of the leading causes of death worldwide:

- 4.4 million fatalities annually
- 8% of deaths worldwide
- Leading cause of death for individuals under 45 years (AAST)
- Fourth Leading cause of death worldwide (AAST)
- ~75% are unintentional injuries, 25% violent injuries
- 33% MVC/MCC, 15% suicide, 10% homicide (WHO)
- Estimated cost: \$518 billion globally (AAST)



Cardiac Trauma Incidence

- Two types: **Penetrating** and **Blunt** Chest Trauma
- Rapidly Fatal: 90% of lethal cardiac trauma dies prior to hospital admission (Dokoupil, Marecová et al. 2019)
- Accounts for 20-25% of all trauma deaths (Majercik S 2017)
- Mortality remains high even in those who do survive, estimated at ~80% (B.J. Leavitt 1987)
- Cardiac and aortic injury are the main causes of hemorrhage related death in trauma patients: 10-25% (S. Saar 2017, R.M. Shorr 1987)
- Right ventricle injury most frequent site of injury>left ventricle>right atrium (S. Saar 2017)



Cardiac Trauma Incidence: Penetrating

Penetrating:

- Overall penetrating *Chest* injuries: 1-13% of trauma admissions
- Acute exploration needed in 5-15% of cases
 - In this population (non-ED thoracotomy), cardiac injuries found in 16-52% following stab wounds
 - Cardiac injuries found in 10-37% following gunshot wounds
- Great vessel injury present in 5.3% of gunshot wounds and 2% of chest stabbings (Demetriades 1997)
- Overall incidence of penetrating *cardiac injuries* estimated at 1 in 210 trauma admissions (Rhee PM 1998)



Cardiac Trauma Incidence: Blunt

Blunt:

- Thought to occur in less than 10% of trauma admissions but ~25% of traumatic deaths
- Injuries requiring operative intervention account for less than 0.01% of all trauma cases and up to 3% of all blunt chest trauma cases

Mechanism Of Injury:

- Forceful impact
- Rapid deceleration
- Crush
- 70-80% of patients have other injuries



Level 1 Trauma Center

Comprehensive Regional tertiary care facility capable of providing total care for every aspect of injury:

- 24-hour in-house coverage by general surgeons and prompt availability of specialties such as orthopedics, neurosurgery, anesthesiology emergency medicine, radiology, internal medicine, plastic surgery, oral and maxillofacial, pediatrics, and critical care.
- 24 hour labs services
- Adequate blood supply
- Medical social workers available 24hours a day
- Cardiothoracic surgery capabilities available 24hours per day, 365 days a year, with cardiopulmonary bypass equipment
- Provides leadership in prevention and education to surrounding communities
- Continuing Medical Education for trauma team members
- Robust incorporation of a comprehensive quality assessment program
- Participates in organized teaching and research efforts to innovate trauma care (20 peer-reviewed articles), substance abuse screening and patient intervention programs available
- (Tertiary care needs like CT surgery, HD, and microvascular surgery may be referred from level II facility)
- Must meet minimum requirement for annual volume of severely injured patients (1200 trauma patients or 240 patients with Injury Severity Score (ISS) >15

*(Society), (America)



Level 1a Cardiac Care Center

Established in Georgia in 2017

Title 31 - Health

Chapter 11 - Emergency Medical Services

Article 7 - Emergency Cardiac Care Centers

§ 31-11-132. Office of Cardiac Care; level designations and requirements

Universal Citation: [GA Code § 31-11-132 \(2017\)](#)

(a) There shall be established the Office of Cardiac Care within the Department of Public Health. The office shall administer the designation process provided for in this article, including, but not limited to, data collection, analysis and reporting, and site visits.

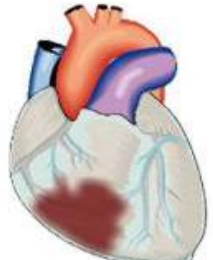
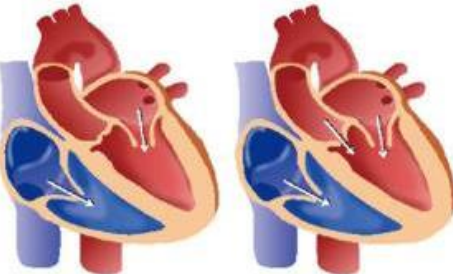
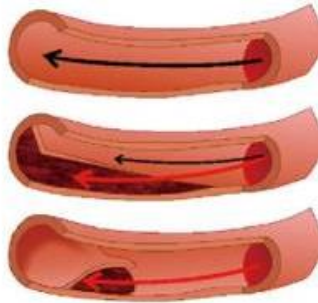
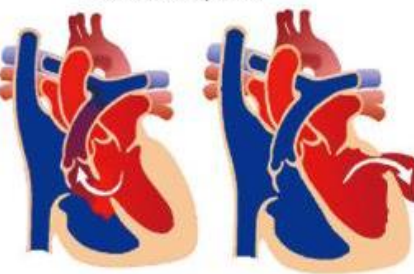
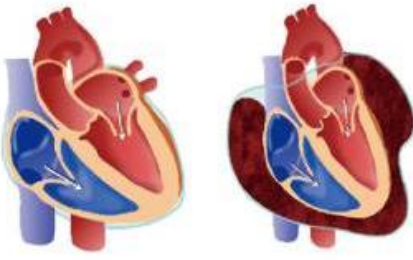
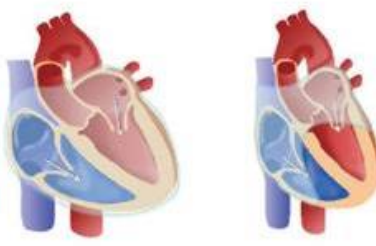
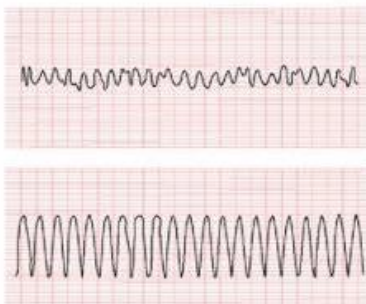
(b) The office shall designate hospitals that meet the criteria set forth in this article as emergency cardiac care centers. Each emergency cardiac care center shall be further designated as Level I, Level II, or Level III by the office. The criteria for each level designation shall be established by the office and shall include, at a minimum, the following:

(1) Level I shall have:

- (A) Cardiac catheterization and angioplasty facilities available 24 hours, seven days per week, 365 days per year;
- (B) On-site cardiothoracic surgery capability available 24 hours, seven days per week, 365 days per year;
- (C) Established protocols for therapeutic hypothermia for out-of-hospital cardiac arrest patients;
- (D) The ability to implant percutaneous left ventricular assist devices for support of hemodynamically unstable patients experiencing out-of-hospital cardiac arrest or heart attack;
- (E) Neurologic protocols to measure functional status at hospital discharge; and
- (F) The ability to implant automatic implantable cardioverter defibrillators;



Common Injuries from Blunt Cardiac Trauma

A Cardiac contusion  - Cardiac contusion is a bruise or lesion - Often diagnosed on autopsy - May result in RBBB or other arrhythmias - ECG is an essential in the workup - Treatment is often supportive	B Valvular injury  - AV is most commonly injured - Signs and symptoms include wide pulse pressure, dyspnea, angina, and diastolic murmur - Echocardiography is used for diagnosis - Management is often surgical	C Coronary artery dissection  - LAD and LMCA are at highest risk for dissection - Signs and symptoms include MI, hypotension, dyspnea, and arrhythmia - Coronary angiography is the gold standard for diagnosis - PCI or CABG are often required	D Aortic dissection  - Signs and symptoms include dyspnea, chest pain, paralysis, syncope, tachycardia, and hypotension - CT or echocardiography are used for diagnosis - Treatment includes BP management, endovascular, or surgical repair
E Septal defect and free wall rupture  - Signs and symptoms include chest pain, hypotension, cardiac tamponade, tachycardia, reduced heart sounds, and JVD - CT or echocardiography for diagnosis - Often needs urgent surgical repair	F Hemopericardium  - Hemopericardium occurs when blood fills the pericardial sac - Beck's triad includes hypotension, JVD, and muffled heart sounds - Pericardiocentesis or chest tube drainage is required to treat tamponade	G Pericardial rupture with cardiac subluxation  - Pericardial rupture may result in cardiac subluxation - Signs include sudden hypotension and resolution following change in position, intermittent loss of pulse, and maximum heart sounds in abnormal locations - Surgical repair often required	H Arrhythmias  - RBBB is the most common post-trauma arrhythmia - Vfib and Vtach are among the most dangerous - ECG used for diagnosis - Management includes cardioversion and medications to control arrhythmia



Blunt Cardiac Trauma

- Identified in 3-20% of sternal fractures
- Thought to be a factor in up to 20% of MVC deaths
- Head injury increases risk 3.5x and spine injury increases risk 4.7x
- Deceleration more likely to lead to avulsion injuries or to valves, coronary arteries
- Cardiac arrest due to chest strike is thought to coincide with ventricular repolarization. It is uncommon and atypical and not associated with other obvious thoracic injuries
- Pediatric blunt chest trauma is less common but harder to diagnose because of increased chest wall compliance



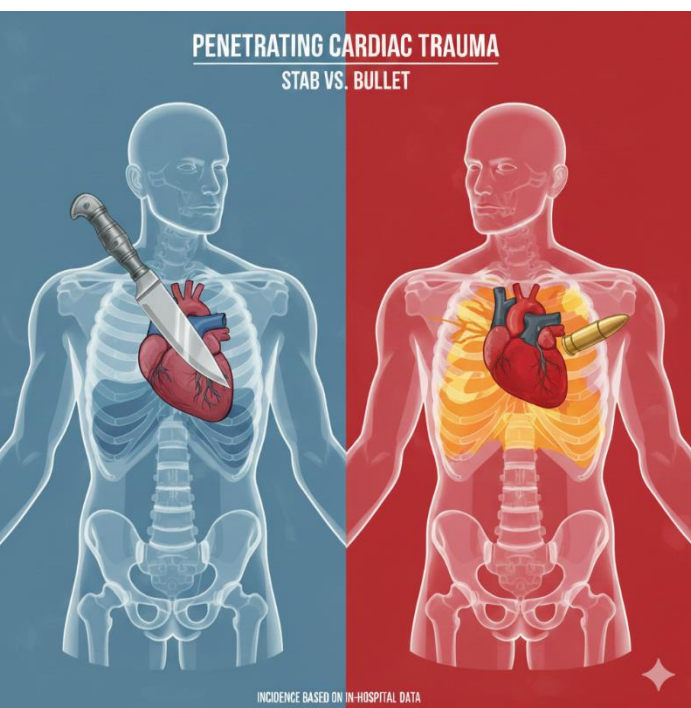
Treatment of Blunt Cardiac Injury (grading=AAST)

Grade	Injury/Signs	Treatment
Grade I	Minor EKG abnormality (nonspecific ST or T wave changes, PAC or PVCs or persistent sinus tachycardia)	Most commonly, only monitoring
	Blunt pericardial wound without cardiac injury, tamponade, or cardiac herniation	
Grade II	Heart block or ischemic changes without failure	May need pacing, appropriate volume and inotropic management
Grade III	Sustained or multifocal ventricular contractions	+/- hemodynamic support, monitoring
	Septal rupture, pulmonary or tricuspid incompetence, papillary muscle dysfunction, or distal coronary artery occlusion without cardiac failure	Options: operative/interventional, hemodynamic support, as relevant
	Blunt cardiac laceration with cardiac herniation	Operative
	Blunt cardiac injury with cardiac failure	Medical management, possible IABP
Grade IV	Septal rupture, pulmonary or tricuspid incompetence, papillary muscle dysfunction, or distal coronary artery occlusion producing cardiac failure	Operative/interventional, hemodynamic support
	Aortic or mitral valve incompetence	
	Injury of the right ventricle, right or left atrium	
Grade V	Proximal coronary artery occlusion	Intervention/operative, often fatal
	Left ventricular perforation	
	Stellate injuries, <50% tissue loss of the right ventricle, right or left atrium	
Grade VI	Blunt avulsion of the heart	Operative, likely fatal

Blunt cardiac injury grading extracted from the AAST Heart Injury grading scale.



Common Injuries from Penetrating Trauma



Incidence of Specific Injuries

Injury Type	Estimated Incidence	Clinical Context
Ventricular Injury	70% – 80%	The Right Ventricle (RV) is most common (~40%) due to its anterior position.
Atrial Injury	20% – 25%	Often associated with high-velocity projectiles or complex trajectories.
Cardiac Tamponade	60% – 80%	More common in stab wounds (80%+) than gunshot wounds (20%).
Active Bleeding	~100%	Nearly all penetrating wounds involve hemopericardium or hemothorax.
Coronary Artery	3% – 9%	The LAD is the most frequently injured vessel.
Valvular Injury	0.1% – 1%	Rarely seen in the acute phase; often diagnosed post-operatively.
Septal Injury	1% – 5%	Usually VSDs; frequently missed during the initial emergency thoracotomy.
Heart Failure	Low (Acute)	Usually a secondary result of valvular or septal defects found in survivors.

(Wall, Mattox et al. 1997)



Aortic Injury

- Rare pathology: less than 1% of all traumas
 - Chest Trauma: 0.25% (Sheehan) to 0.32% (Wu)
- Direct penetrating or complete transection of the aorta may cause exsanguination with pre-hospital death in 90% of patients and 44% mortality in patients who make it to the ED or OR
- Blunt injuries are more common than penetrating
- Blunt thoracic aortic injury accounts for ~1/3 of MVC fatalities (Teixeira PG 2011)
- Penetrating aortic injury more likely to be abdominal not thoracic but still carries a high mortality rate (80%)
- Blunt injury most likely to cause dissection at the ligamentum arteriosum where the arch is fixed
- 85-90% of aortic injury is distal to left subclavian artery
- ~10% of aortic injury is in the ascending aorta
 - These patients need cardiopulmonary bypass!



But!

ARISE III Trial: acute type A dissection

- FDA approved prospective, multicenter, non-randomized pivotal study to assess the safety and effectiveness of the investigational GORE Ascending Stent Graft in patients with acute Type A dissections who are considered high risk for conventional surgery
- Need 112 patients, follow-up for 5 years to evaluate safety and effectiveness outcomes
- ***These trials are for spontaneous dissections, not trauma!***



**Is a Cardiothoracic Surgeon required to be
in house for call at a level one trauma
center?**



No!



When do we call for Cardiothoracic Surgeons?

AmSECT

- Guideline 15.2: An on-call Perfusionist should be present and clinically ready for unscheduled and emergency procedures within 60 minutes of being called.

There are no specific criteria for minimum time required to build a cardiopulmonary bypass circuit. Pumps are typically kept built to not be the rate limiting step in an emergency. Wet down vs dry is institution specific. Annual competencies include pump building and oxygenator changeouts. International consensus suggests 72 hours storage time for a primed circuit and 30 days for a dry circuit (Wahba, Kunst et al. 2025).

Cardiothoracic surgeons needed for type A aortic injury, repair of ventricular septal injury, & coronary artery injury necessitating CABG. (Ball, Lee et al. 2022; Feliciano 2016)



Complications of Cardiac Repair

- Delayed cardiac rupture has been described up to two weeks after the initial insult. Thought to be due to either aneurysm formation or contained atrial rupture
- Non-operative valvular and septal injuries must be monitored with serial echocardiograms to rule out any worsening (Adams R, Guillaumondegui O.)
- Abnormal EKG
- Heart block
- Pericardial effusion
- Wall motion abnormalities
- Reduced left ventricular systolic function
- Hemorrhage
- Transected graft
- Post-traumatic acute myocardial infarction
- Valvular injury
- Sternal infection

(Ball, Lee et al. 2022; Tang, Inaba et al. 2011; Castano, Morales et al. 2012; Jhunjhunwala, Dente et al. 2016; Reser, Caliskan et al. 2015)



Iatrogenic Complications

Surgery:

- Coronary artery ligation or kinking
- Valvular dysfunction
- Conduction system injury
- Myocardial overstretch
- Phrenic nerve palsy



Surgical Technique

- Exposure technique depends on suspected injuries, patient clinical status, and surgeon's experience
 - Ex: unstable patient with tamponade on US and left chest stab wound – ED thoracotomy
 - Ex: stable patient without tamponade on US and left chest stab wound – OR median sternotomy
 - Sternotomy has better exposure of all heart chambers and the great vessels and ability to enter R and L pleural cavities (Conner J 2016)
 - Median sternotomy associated with improved postoperative pain and shorter length of hospitalization (Asaph JW 2000)
 - ***Sternotomy vs bilateral thoracotomy (“clamshell”) (Ball, Lee et al. 2022)***



Survival

- Survival rates for traumatic cardiac arrest remain very low: 3.3-9.2%(Alremeithi, Tran et al. 2024)
- Survival rate of those who make it to the hospital is between 20-75%(Dokoupil, Marecová et al. 2019)





Survival after Sternotomy

- Trauma Quality Improvement Program (2013-2016) Database
- 584 patients: 322 (55.1%) had sternotomy for penetrating trauma and 69 (11.8%) had sternotomy for blunt trauma
- Injury Severity Score (ISS) higher in blunt trauma
- Hemorrhage control longer in blunt trauma
- Additional injuries:
 - Blunt: rib fractures, sternal fractures, SVC injury, aortic injury
 - Penetrating: open cardiac injury, open lung injury, hemothorax
- **Mortality** rate Higher in **BLUNT TRAUMA** (29% vs 12.7%, $P < 0.001$) but when adjusting for covariates there was **no difference** in risk of mortality between groups (Duong W 2020)

Table 1. Demographics of adult trauma patients undergoing SHC.

Characteristic	All, (n=584)	Penetrating, (n=322)	Blunt, (n=69)	P value
Closed cardiac	11 (1.9)	4 (1.2)	7 (10.1)	<0.001
Cardiac laceration	69 (11.8)	50 (15.5)	19 (27.5)	0.02
Open cardiac	154 (26.4)	148 (46.0)	4 (5.8)	<0.001
Thoracic aorta	20 (3.4)	10 (3.1)	9 (13.0)	<0.001
Subclavian vessels	31 (5.3)	26 (8.1)	4 (5.8)	0.52
Superior vena cava	8 (1.4)	3 (0.9)	5 (7.2)	0.001



Concomitant Injuries

Table 1. Demographics of adult trauma patients undergoing SHC.

Characteristic	All, (n=584)	Penetrating, (n=322)	Blunt, (n=69)	P value
AIS (grade > 3), n (%)				
Head	29 (5.0)	8 (2.5)	16 (23.2)	<0.001
Thorax	424 (72.6)	226 (70.2)	43 (62.3)	0.20
Abdomen	36 (6.2)	9 (2.8)	8 (11.6)	0.001
ACS Level-I, n (%)	302 (51.7)	169 (52.5)	40 (58.0)	0.41



Mortality All Comers

Table 2. Multivariable logistic regression analysis for risk of mortality in adult trauma patients undergoing SHC.

Risk factor	OR (95% CI)	P-value
Blunt <i>versus</i> penetrating	2.33 (0.98-5.60)	0.06
Age	1.01 (0.98-1.03)	0.69
ISS	1.03 (1.01-1.06)	0.001
Hypotensive within 24h	2.11 (0.80-5.55)	0.13
PRBC transfusion units within 24h	1.05 (1.01-1.09)	0.013
Minutes to hemorrhage control	1.00 (0.89-1.11)	0.94
AIS—head (grade > 3)	4.15 (1.33-12.95)	0.014

Hosmer–Lemeshow chi-square statistic=5.011; *P* value=0.76.

AIS=abbreviated injury scale; PRBC=packed red blood cells.



Mortality Blunt Trauma

Table 3. Multivariable logistic regression analysis for risk of mortality in adult trauma patients undergoing SHC after blunt trauma.

Risk factor	OR (95% CI)	P value
Age	1.01 (0.97-1.05)	0.70
ISS	1.01 (0.97-1.06)	0.59
Hypotensive within 24h	6.95 (0.62-78.34)	0.12
PRBC transfusion units within 24h	0.995 (0.93-1.06)	0.87
Minutes to hemorrhage control	0.93 (0.75-1.16)	0.54
AIS—head (grade > 3)	4.69 (0.80-27.35)	0.09

Hosmer–Lemeshow chi-square statistic=8.103; *P* value=0.32.

AIS=abbreviated injury scale; PRBC=packed red blood cells.



Mortality Penetrating Trauma

Table 4. Multivariable logistic regression analysis for risk of mortality in adult trauma patients undergoing SHC after penetrating trauma.

Risk factor	OR (95% CI)	P-value
Age	1.003 (0.97-1.04)	0.87
ISS	1.04 (1.02-1.07)	0.001
Hypotensive within 24h	1.78 (0.57-5.56)	0.32
PRBC transfusion units within 24h	1.07 (1.02-1.12)	0.003
Minutes to hemorrhage control	1.00 (0.88-1.14)	0.98
AIS—head (grade > 3)	5.88 (1.23-27.98)	0.03

Hosmer–Lemeshow chi-square statistic=7.395, P-value=0.50.

AIS=abbreviated injury scale; PRBC=packed red blood cells.



Clinical Outcomes

Table 5. Clinical outcomes in adult trauma patients undergoing SHC.

Outcome	All, (n=584)	Penetrating, (n=322)	Blunt (n=69)	P value
LOS, d, median (IQR)	8.0 (5-13)	7.0 (5-12)	10.0 (5-19)	0.06
ICU, d, median (IQR)	4.0 (3-9)	4.0 (3-7)	7.0 (3-13)	0.009
Ventilator days, median (IQR)	2.0 (1-6)	2.0 (1-3)	5.0 (2-10)	<0.001
Procedure, n (%)				
Lung repair	92 (15.8)	78 (24.2)	13 (18.8)	0.34
Cardiac repair	261 (44.7)	222 (68.9)	34 (49.3)	0.002
Great vessel repair	43 (7.4)	31 (9.6)	11 (15.9)	0.12
Minutes to hemorrhage control, median (IQR)	52.8 (22-88)	49.8 (20-80)	84.6 (24-140)	<0.001
Lung repair	92 (15.8)	78 (24.2)	13 (18.8)	0.34
Cardiac repair	261 (44.7)	222 (68.9)	34 (49.3)	0.002
Great vessel repair	43 (7.4)	31 (9.6)	11 (15.9)	0.12



Survival After Thoracotomy

Retrospective multicenter study (5 trauma hospitals) over 3 years, 157 patients

- Overall mortality for thoracic injury requiring thoracotomy for hemorrhage control at 29%(Karmy-Jones R 2001). The risk of death increases linearly with total chest hemorrhage after thoracic injury.
- Penetrating: 17.4% mortality
- Blunt: 66.7% mortality
- Urgent thoracotomy (excluding ED thoracotomy) occurred almost 3hrs later for blunt trauma compared to penetrating trauma (Karmy-Jones R 2001)

Table 2. Thoracic Injuries*

Injury	Chest Wall	Internal Mammary Artery	Aorta/Great Vessel	Cardiac	Lung
Blunt (n = 36)	24 (67)	0	4 (11)	3 (8)	16 (44)
Penetrating (n = 121)	36 (30)	7 (6)	5 (4)	15 (12)	91 (75)
GSW (n = 72)	16 (22)	1 (1)	4 (6)	7 (10)	62 (86)
SW (n = 49)	20 (41)	6 (12)	1 (2)	8 (16)	29 (59)

*Data are given as number (percentage) of patients. GSW indicates gunshot wound; SW, stab wound.

(Karmy-Jones R 2001)



Survival after Emergency Department Thoracotomy: Review of Published Data from the Past 25 Years

Peter M Rhee, MD, MPH, FACS, Jose Acosta, MD, FACS, Amy Bridgeman, RN, BSN,
Dennis Wang, MD, FACS, Marion Jordan, MD, FACS, Norman Rich, MD, FACS

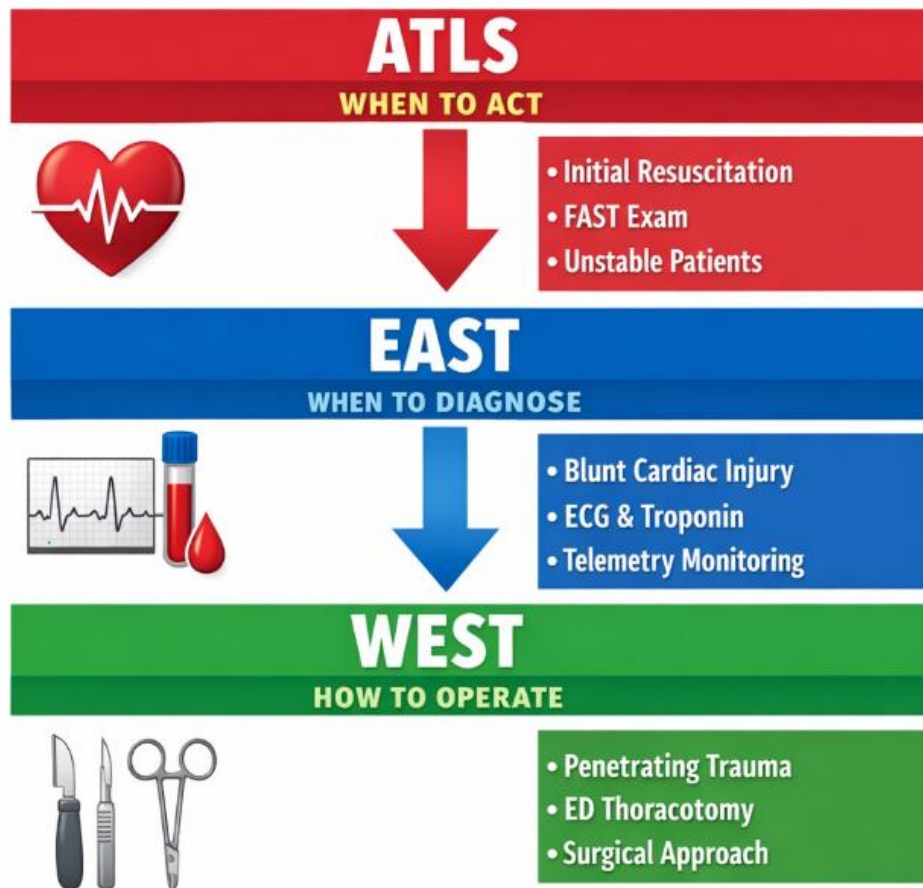
- Survival after Resuscitative thoracotomy is very low: 7-13% Penetrating Trauma higher survival: 8-15% with stab wounds having higher survival than GSW
- Blunt Trauma very low survival: 1-2%
- Location with highest survival: Heart (19.4%)
- Signs of life: survival 11.5% if present, 2.5% if not
- Take home: best survival results seen in patient who undergo RT for thoracic stab injuries who arrive to trauma bay with signs of life

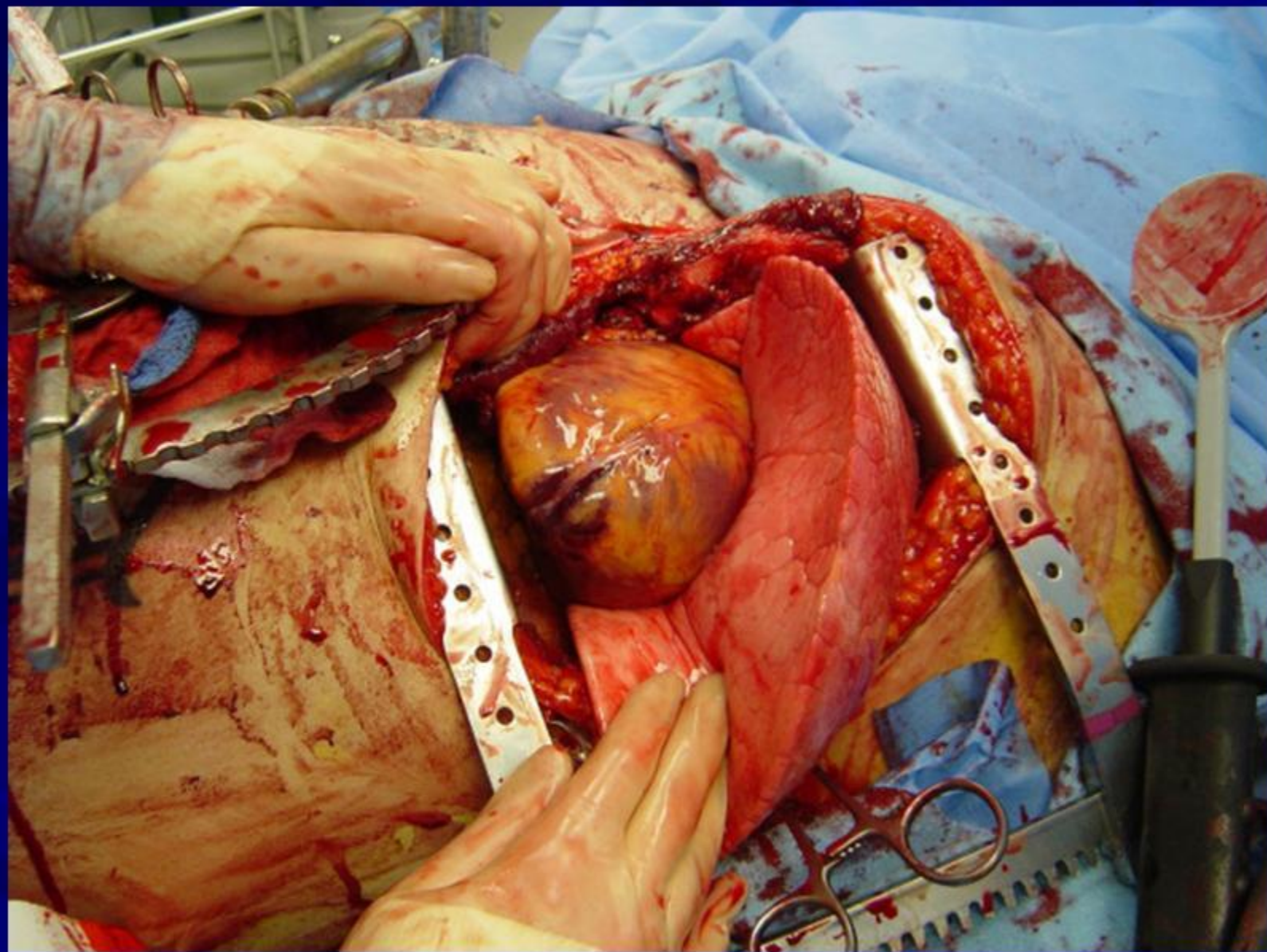
Cardiac injury			Thoracic injury		
Survivors	EDT performed	Survival rate (%)	Survivors	EDT performed	Survival rate (%)
3	18	16.7	3	25	12.0
205	1,058	19.4	158	1,493	10.7

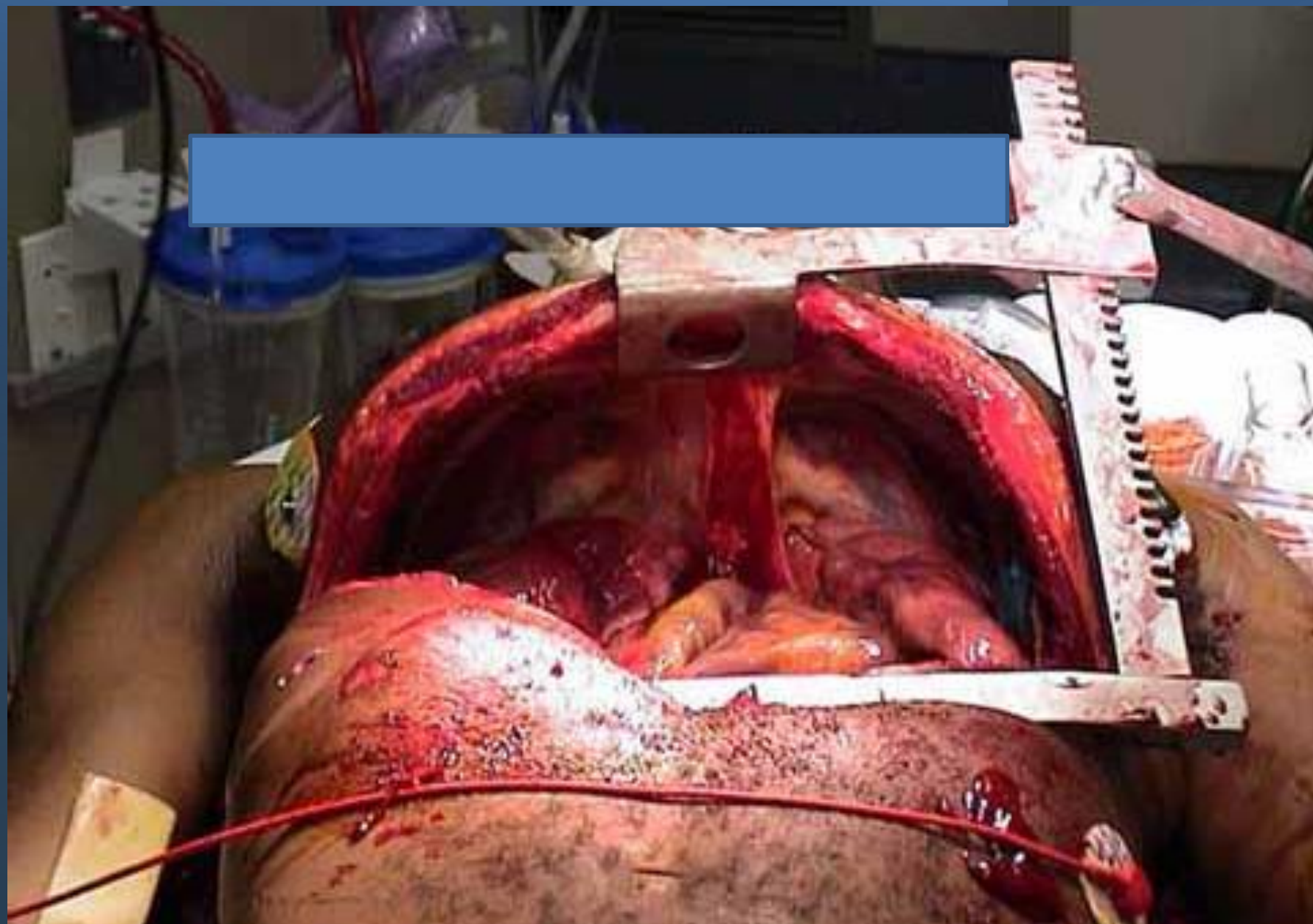
(Rhee PM 2000)



Cardiac Trauma Evaluation Guidelines

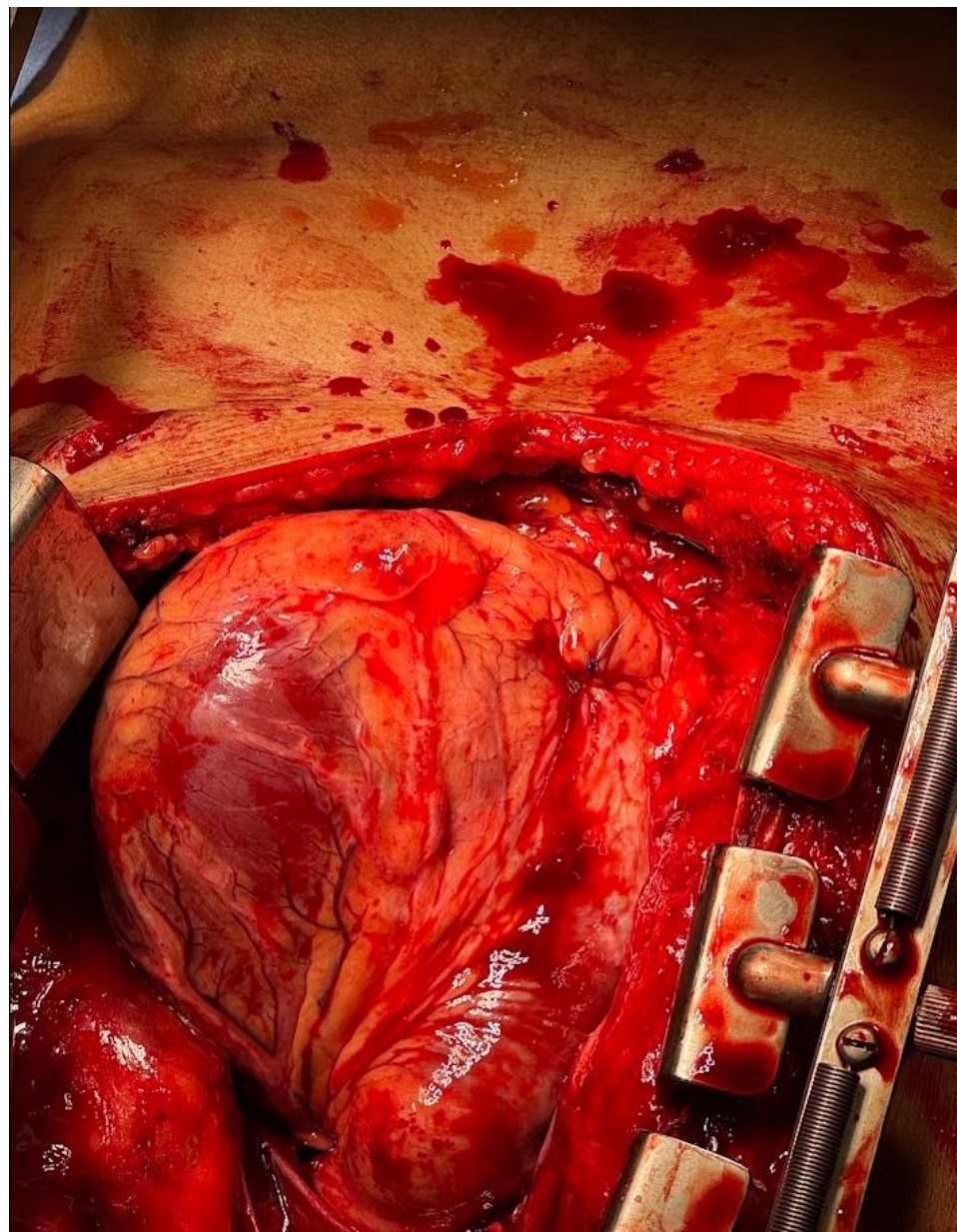
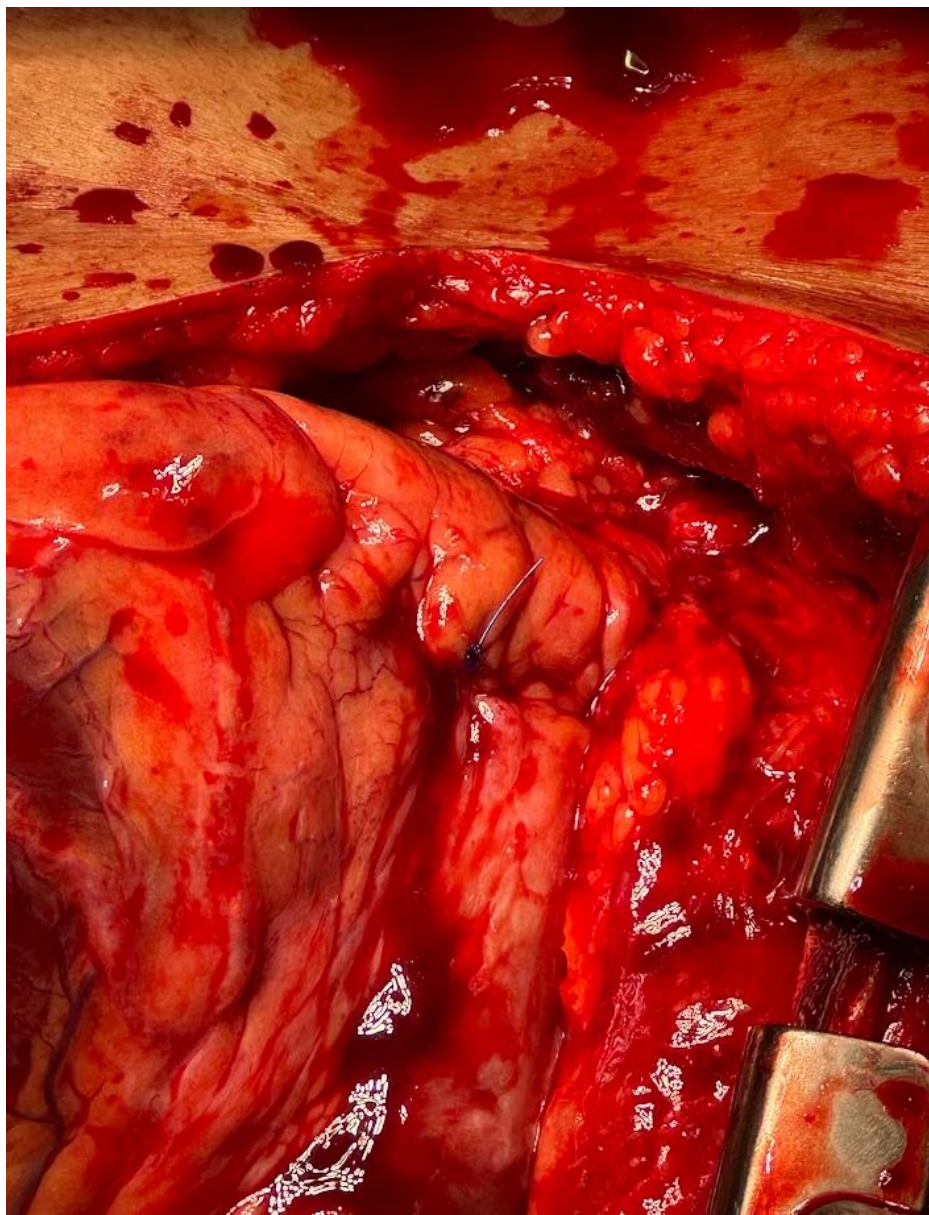


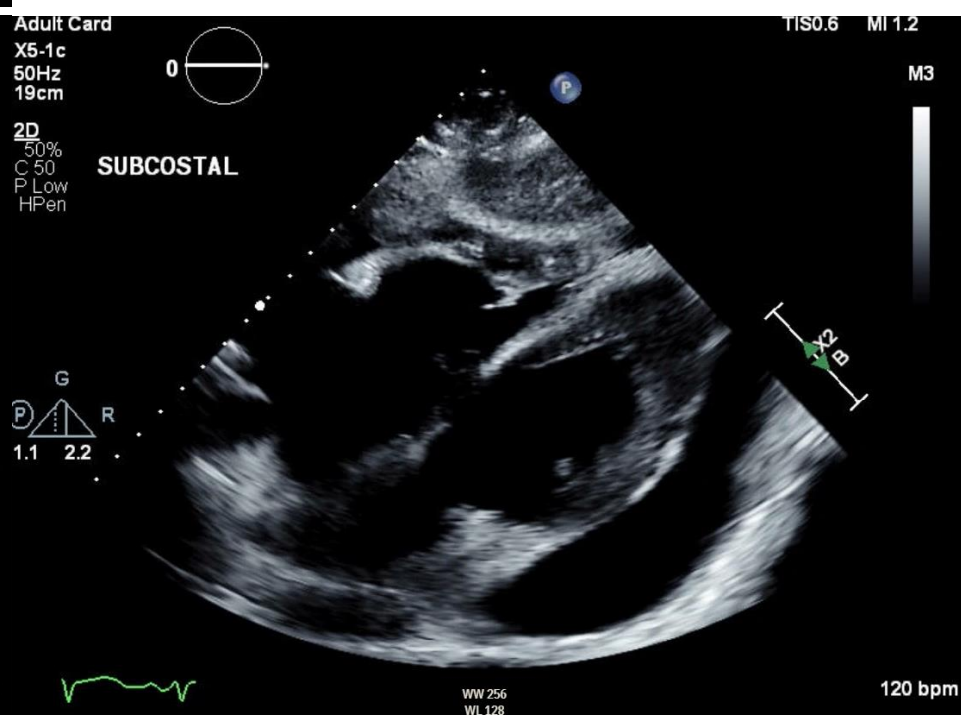
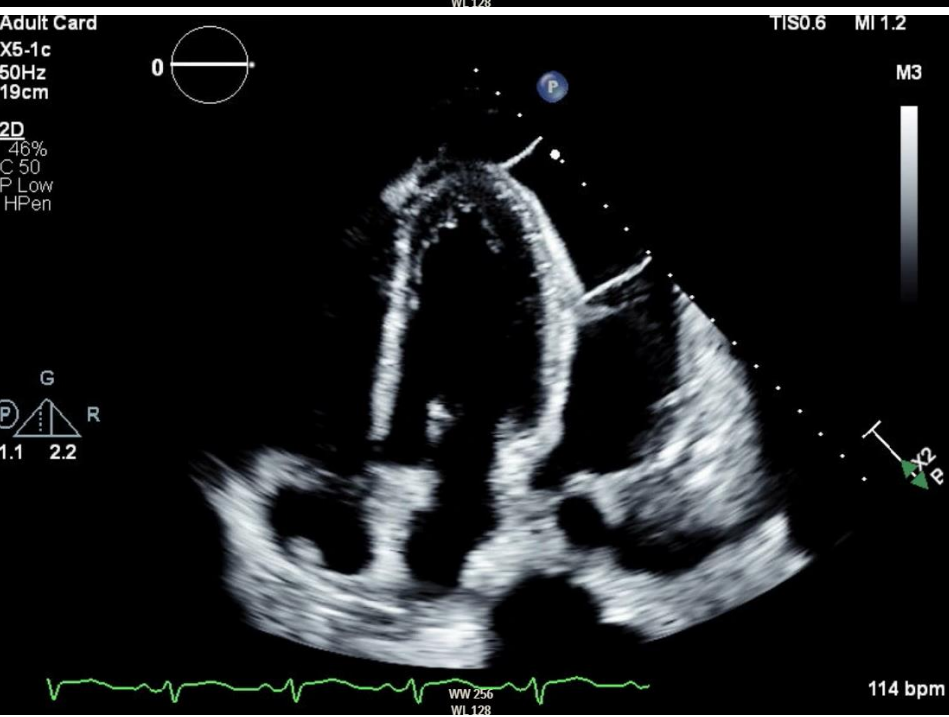
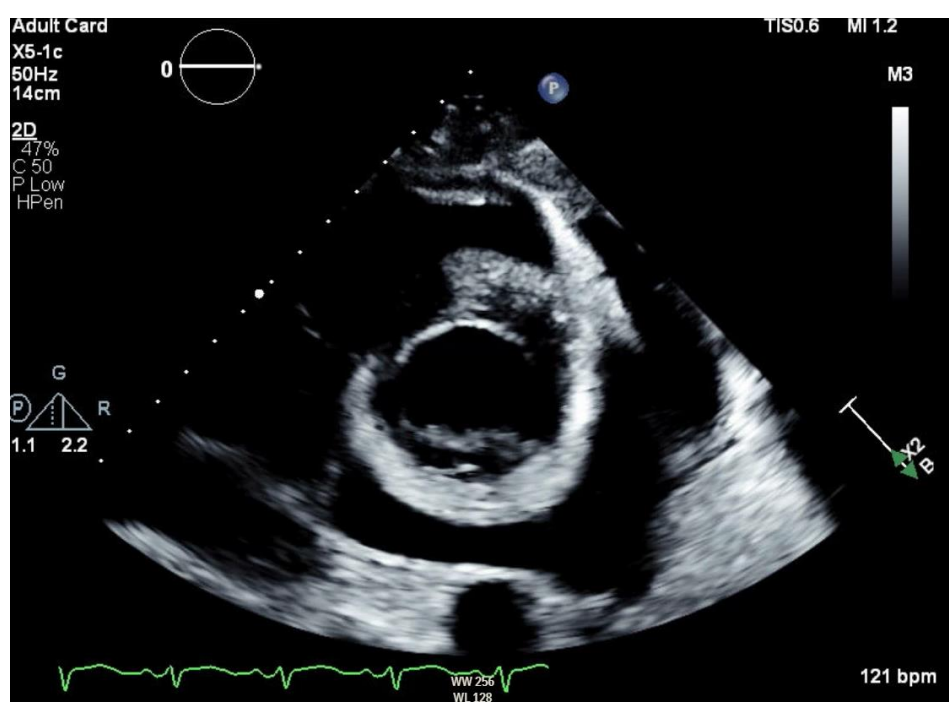
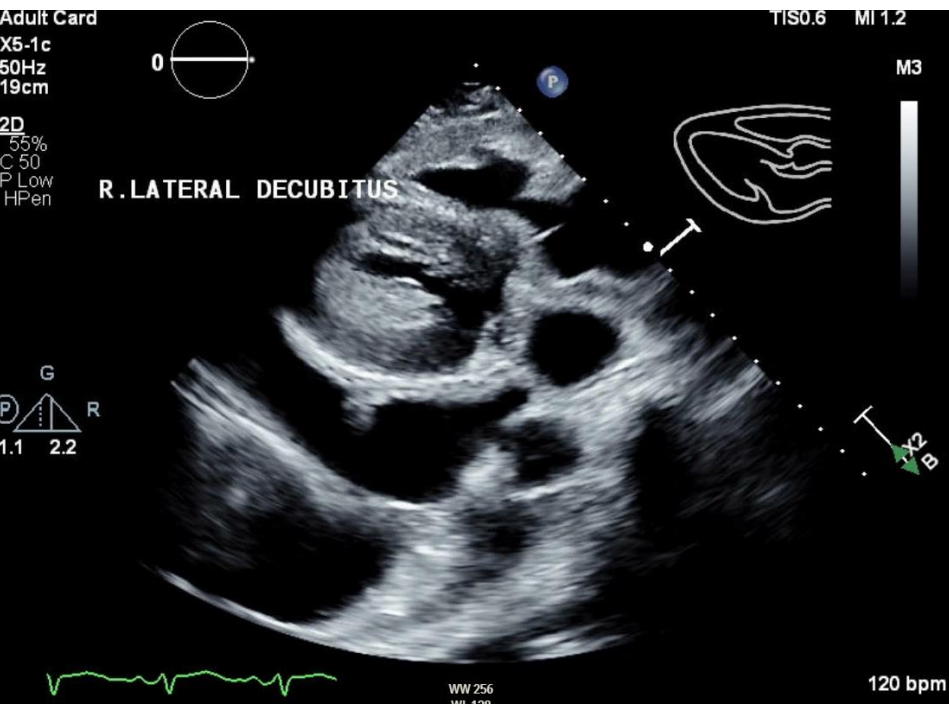










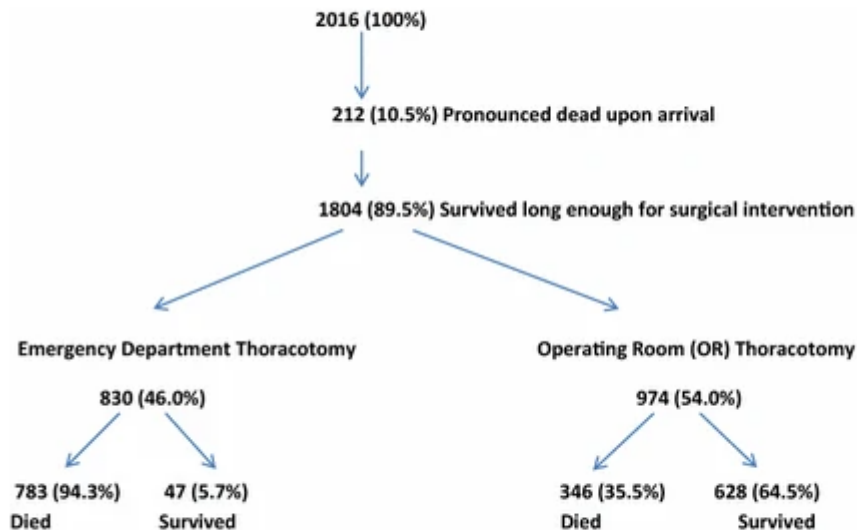




Predicting Penetrating Prognosis

National Trauma Data Bank (NTDB) queried 2016 for cardiac injuries with survival as main outcome. 2016 incidences of cardiac trauma from 1,310,720 patients. Incidence of penetrating traumas estimated at 0.16%*

Fig. 1



Outcomes stratified to emergency department versus operating room thoracotomy

(Asensio, Ogun et al. 2018)



Table 3 Outcomes

From: Penetrating cardiac injuries: predictive model for outcomes based on 2016 patients from the National Trauma Data Bank

Overall survival	685/2016 (34.0%)	
Overall mortality	1331/2016 (66.0%)	
Mortality among patients with RTS = 0	938/998 (93.9%)	★
Mortality among patients with RTS ≥1	393/1018 (38.6%)	
Mortality among patients with GCS <8	951/1026 (92.6%)	
Mortality among patients with GCS >8	86/303 (28.3%)	
Mortality among patients with gunshot wounds	1146/1264 (90.6%)	★
Mortality with stab wounds	171/717 (23.8%)	
Mortality with impalement injuries	13/19 (68.4%)	
Mortality with shotgun injuries	11/16 (68.7%)	
Mortality among patients who underwent ED thoracotomy	783/830 (94.3%)	★
Mortality among patients who underwent OR thoracotomy	347/974 (35.6%)	
Mortality with aortic cross-clamping	958/1156 (82.8%)	★
Mortality among patients who did not undergo aortic cross-clamping	373/860 (43.3%)	



Table 6 Predictors of outcome for mortality

From: Penetrating cardiac injuries: predictive model for outcomes based on 2016 patients from the National Trauma Data Bank

Stepwise logistic regression analysis	p value	AOR	95% CI
Cardiac gunshot wounds	<0.001	26.85	17.21–41.89
Field CPR	0.003	3.65	1.53–8.69
Absent spontaneous ventilation	0.008	1.08	1.02–1.14
Presence of associated abdominal gunshot wound	0.009	2.58	1.26–5.26
Need for ED airway	0.0003	1386.3	126.0–15251.71
Aortic cross-clamping	0.0003	0.18	0.11–0.28



Predicting Blunt Prognosis

American College of Surgeon Trauma Quality Improvement Program (2017) queried. 125,696 patients with blunt thoracic injury, 2368(1.9%) had blunt cardiac injury.

- Blunt Cardiac injuries (myocardial injuries, pericardial injuries (hemopericardium with/without tamponade), coronary artery laceration/thrombosis, and valve/septum/chordae tendinae laceration/rupture) identified by AIS codes
- Primary outcomes: independent predictors of concomitant cardiac contusions and predictors of mortality
- Secondary outcomes: in-hospital complications, difference in injury patterns, and injury severity between survivors and non-survivors



Results

- Overall mortality 7.4%
- Multivariate regression analysis showed blunt cardiac injury was independently associated with higher odds of mortality aOR 2.6, $p < 0.001$ over solely blunt thoracic injury

Table 2. Type of cardiac injury and associated mortality rate.

Variable	Overall, (n=2368)	Mortality rate, n (%)
Myocardial injuries, n (%)		
Contusion only	1359 (43)	280 (20)
Laceration	414 (18)	359 (87)
Other	196 (8.3)	82 (42)
Pericardial, n (%)		
Hemopericardium	461 (20)	260 (56)
Hemopericardium with tamponade	33 (1.4)	12 (36)
Coronary artery laceration/thrombosis, n (%)	13 (0.5)	8 (62)
Valve/Septum/Chordae tendineae laceration/rupture, n (%)	31 (1.3)	21 (68)
Multiple injuries, n (%)	170 (7.2)	131 (77)



Results

Table3. Results of multivariate regression for predictors of concomitant cardiac contusion among patients with blunt thoracic injury.

Variable	aOR	95% CI	P value	Variable	aOR	95% CI	P value
Age categories				Concomitant thoracic injuries			
18-44y	Ref	-	-	Flail chest	2.05	1.65-2.54	<0.001*
45-64y	1.13	0.99-1.30	0.077	Lung contusion	1.54	1.36-1.74	<0.001*
≥65y	1.40	1.18-1.64	<0.001*	Sternal fracture	2.13	1.88-2.41	<0.001*
ED HR≥ 100 bpm	1.36	1.21-1.53	<0.001*	Diaphragmatic injury	1.96	1.45-2.67	<0.001*
ED SBP ≤90mm Hg	1.41	1.19-1.68	<0.001*	Esophageal injury	5.45	2.21-13.4	<0.001*
PRBC requirements within 4 h of admission				Hemothorax	1.93	1.61-2.31	<0.001*
0 Units	Ref	-	-	Hemopneumothorax	1.38	1.14-1.67	<0.001*
<4 Units	1.57	1.28-1.94	<0.001*	Hemopneumomediastinum	1.41	1.14-1.73	0.001*
≥4 Units	1.70	1.41-2.05	<0.001*	Thoracic aortic injury	1.78	1.30-2.44	<0.001*
MVC mechanism of injury	2.82	2.42-3.29	<0.001*	Nonaortic thoracic vascular injury	1.59	1.02-2.50	0.043*

(El-Qawaqzeh, Anand et al. 2023)

Table6. Results of multivariate regression for predictors of mortality among BCI patients.



Variable	aOR	95% CI	P value
Age categories			
18-44y	Ref	-	-
45-64y	1.638	1.172-2.289	0.004* 
≥65y	5.869	3.917-8.795	<0.001 
Gender			
Male	Ref	-	-
Female	1.09	0.811-1.464	0.567
Thoracic aortic injury	1.794	1.072-3.002	0.026*
Nonaortic thoracic vascular injury	1.332	0.690-2.574	0.393
Lung injury	0.939	0.700-1.260	0.674
Diaphragmatic injury	3.069	1.747-5.392	<0.001 
Sternal fracture	0.851	0.625-1.160	0.307
≥3 rib fractures	0.90	0.60-1.30	0.45
Hemothorax	3.08	2.19-4.32	<0.001 
Hemopneumothorax	1.017	0.682-1.516	0.934
Comorbidities			
History of CHF	2.779	1.315-5.876	0.007 
History of anticoagulant use	1.45	0.739-2.846	0.280
Cirrhosis	3.021	1.005-9.083	0.049*



Intracardiac Epinephrine

Previously part of ATLS/ACLS and less likely to be performed when chest is already open. Last ditch effort, has largely fallen out of favor for IV or IO routes.

Carries risk of intramyocardial hematoma, coronary artery laceration, or intractable arrhythmias when administered

Arrest most commonly due to exsanguination in trauma so giving epinephrine to an "empty" heart is ineffective

Administration of epinephrine (not route specific) in traumatic cardiac arrest is independently associated with a decrease in survival to discharge and 7-day survival (Jiang, 2025).

IV Survival

Penetrating <5%

Blunt <1%



Intracardiac Epinephrine

Positive outcomes limited to case reports (Nicholson, Abd-El-Hafez et al. 2025)

Removed from ACC/AHA guidelines after 2000:

"Intracardiac administration should be used only during open cardiac massage or when other routes of administration are unavailable. Intracardiac injections increase the risk of coronary artery laceration, cardiac tamponade, and pneumothorax. Intracardiac injections also cause interruption of external chest compression and ventilation." (Part 6: Advanced Cardiovascular Life Support, 2000)

(Jiang, Wei et al. 2025)(Yamamoto, Suzuki et al. 2019)



Polytrauma: Cardiac Injury Plus ???

- TBI occurs in up to 35% of patients with blunt cardiac injury - Caution with anticoagulants and antiplatelets (Adams R, Guillamondegui O.)

Nationwide Utilization of Cardiopulmonary Bypass in Cardiothoracic Trauma: A Retrospective Analysis of the National Trauma Data Bank

[Benjamin P Johnson](#)¹, [Horacio M Hojman](#)¹, [Eric J Mahoney](#)¹, [Danielle Detelich](#)², [Manish Karamchandani](#)²,
[Caroline Ricard](#)², [Janis L Breeze](#)³, [Nikolay Bugaev](#)¹



	Before Matching			After Matching		
	No bypass N=27,062	Bypass N=303	Absolute Standardized Difference	No bypass N=895	Bypass N=303	Absolute Standardized Difference
Mechanism of injury			0.31			0.00
Blunt	12,819 (47.4)	190 (62.7)		562 (62.8)	190 (62.7)	
Penetrating	14,243 (52.6)	113 (37.3)		333 (37.2)	113 (37.3)	
Head injury >2	6,273 (23.2)	47 (15.5)	0.19	156 (17.4)	47 (15.5)	0.05
Abdominal injury >2	8,329 (30.8)	57 (18.8)	0.28	190 (21.2)	57 (18.8)	0.06
Spine injury >2	2,605 (9.6)	22 (7.3)	0.09	75 (8.4)	22 (7.3)	0.04
Other injury >2	17 (0.1)	0 (0.0)	0.04	1 (0.1)	0 (0.0)	0.05
Extremity injury >2	6,782 (25.1)	63 (20.8)	0.10	180 (20.1)	63 (20.8)	0.02
Lung injury	12,211 (45.1)	130 (42.9)	0.04	377 (42.1)	130 (42.9)	0.02
Heart injury	4,064 (15.0)	118 (38.9)	0.56	379 (42.3)	118 (38.9)	0.07
Vessels injury	4,475 (16.5)	179 (59.1)	0.98	529 (59.1)	179 (59.1)	0.00
Thoracic aorta injury	1,378 (5.1)	132 (43.6)	1.00	383 (42.8)	132 (43.6)	0.02
Pulmonary artery injury	396 (1.5)	11 (3.6)	0.14	28 (3.1)	11 (3.6)	0.03
Pulmonary vein injury	178 (0.7)	6 (2.0)	0.12	20 (2.2)	6 (2.0)	0.02
Myocardial+pericardial injury	4,021 (14.9)	113 (37.3)	0.53	366 (40.9)	113 (37.3)	0.07
Intracardiac injury	42 (0.2)	11 (3.6)	0.26	16 (1.8)	11 (3.6)	0.11
Coronary artery injury	77 (0.3)	11 (3.6)	0.24	25 (2.8)	11 (3.6)	0.05



Results

Table 2:

Surgical Procedures (in first 24 hours)

	No bypass N=895	Bypass N=303
Lung procedure	132 (14.7)	37 (12.2)
Cardiovascular system procedure	5 (0.6)	22 (7.3)
Papillary muscle procedure	0 (0.0)	3 (1.0)
Septal repair procedure	12 (1.3)	9 (3.0)
Revascularization procedure	40 (4.5)	17 (5.6)
Heart repair procedure	322 (36.0)	108 (35.6)
Vessel repair procedure	470 (52.5)	197 (65.0)
ECMO	3 (0.3)	3 (1.0)
Percutaneous bypass	2 (0.2)	0 (0.0)
Exploratory thoracotomy	272 (30.4)	49 (16.2)
Sternotomy	60 (6.7)	33 (10.9)

Clinical Complications

	No bypass N=895	Bypass N=289
Any complication	314 (35.1)	131 (45.3)
Cardiac arrest	70 (7.8)	18 (6.2)
Myocardial infarction	1 (0.1)	2 (0.7)
CVA	4 (0.4)	11 (3.8)
AKI	8 (0.9)	3 (1.0)
ARDS	16 (1.8)	10 (3.5)
Deep SSI	1 (0.1)	0 (0.0)
DVT	16 (1.8)	10 (3.5)
Organ/space SSI	5 (0.6)	0 (0.0)
Pneumonia	61 (6.8)	22 (7.6)
Pulmonary embolism	21 (2.3)	3 (1.0)
Superficial SSI	6 (0.7)	2 (0.7)
Unplanned intubation	13 (1.5)	6 (2.1)
Osteomyelitis	1 (0.1)	0 (0.0)
Unplanned return to OR	12 (1.7)	8 (3.6)
Unplanned return to ICU	7 (1.0)	1 (0.4)
Severe sepsis	14 (2.0)	5 (2.2)

- The use of cardiopulmonary bypass (CPB) in initial management of select patients is associated with survival benefit. Further studies needed to better delineate which injuries have the most benefit from using CPB



Additional Studies

- Dauphine: 25% mortality rate (16 trauma patients, 12 penetrating, 9 blunt, treated with CPB in LA between 1993-2002)
- Chughtai: mortality 44.4% (1992-1998, nine case reports)

Table 1

Summary of Nine Patients Treated for Trauma With the Use of Cardiopulmonary Bypass (CPB)

Case no.	Injury	Bypass type	Early CPB	Outcome	Role or benefit of CPB
1	Ventricle, OMA	RA-aorta	No	Reoperation, MI, death	Would have allowed bypass of injured coronary artery.
2	Ascending aorta	RA-aorta	Yes	DIC, death	Necessary for repair secondary to site
3	Descending aorta, pulmonary contusion	Femoral artery-aorta	Yes	Alive	Overcame inability to ventilate and maintained spinal perfusion.
4	Intrapericardial IVC, right auricle	SVC-aorta	Yes	Alive	Overcame persistent bleeding and permitted intracardiac inspection.
5	Right innominate vessels	RA-aorta	No	Exsanguination, death	Would have allowed controlled repair of complex injuries.
6	Retrohepatic IVC, liver	RA-aorta, circulatory arrest	Yes	Alive	Allowed rapid repair (12 min) in a bloodless field.
7	Retrohepatic IVC, liver	RA-aorta, circulatory arrest	No	Alive	Overcame persistent bleeding and permitted rapid repair (8 min).
8	Hypothermia (26°C)	Femoral-femoral	No	Cardiac arrest, death	Would have allowed rapid rewarming and resuscitation.
9	Hypothermia (28°C)	Femoral-femoral	Yes	Alive	Allowed rapid rewarming and successful defibrillation.

OMA = obtuse marginal artery, IVC = inferior vena cava, RA = right atrium, SVC = superior vena cava, MI = myocardial infarction, DIC = disseminated intravascular coagulation.

(Dauphine, McKay et al. 2005)(Chughtai, Gilardino et al. 2002)



Additional Studies

- Wall: 47% mortality (1977-1997: 711 cardiac injuries, 96% stab or gun shot)
- Baker: 45% mortality (106 patients with penetrating injuries, 1989-1995)
- Pate: 10% mortality*(88 patients with traumatic rupture of the aorta)



ECMO

- Historically, trauma patients make up less than 1% of total adult ECMO population with thoracic injury being most common reason to cannulate.
- Nationwide Inpatient Sample (NIS) Database: 66 fold increase in cannulation from 2002-2012 (Hu, Griswold et al. 2019).
- Survival: 70% at decannulation and 61% at hospital discharge (Swol J 2018)
- ARDS most common reason to cannulate in trauma (Willers, Mariani et al. 2023)
- Bleeding most common concern
- Heparin bonded circuits (Ball, Lee et al. 2022; Arlt, Philipp et al. 2010)



(Swol J 2018)



HD Support with Increased Bleeding Risk Traumas

- Systematic review: 96 patients with bleeding trauma of 183 total patients*
- Trauma survival in 84 patients (87%), overall survival 82.3%

Table 1. - Summary of Extracorporeal Life Support (ECLS) Treatment and Outcomes in Six Subgroups

Subgroups	N Articles/Patients/Survivors (%)	ECLS Mode VA; VV, N (%)	Mean ECLS, Duration (hours)	Bleeding Sources	Bleeding Control Interventions: Surgery, Radiological, Compression Devices, Drugs	Supportive Management, Drugs, Anticoagulation Reveal	Preventive Mmanagement	Complications During ECLS, Device- Related, Clotting, Bleeding, Lethal, (N, %)
Trauma patients 5173-96	25/96/84 (87)	VA 22(23), VV 32(33), VV→VA 1(1), VVA 2(2), Unknown 39(41)	178	Penetrating injuries, traumatic liver, spleen laceration, hemopneumothorax, subdural hematoma, rib fractures, lung parenchymal bleeding, rupture of thoracic aorta, bronchial bleeding, pericardial effusion, subdural hematoma, crush injury lower extremities, trachea rupture	Chest drain, laparotomy, thoracotomy, pericardiostomy, wedge resection, other surgery, packing, aortic stenting, repair of ventricular wall and coronary vessels lungisolation, packing, pulmonary artery locking, nitric oxygen	Epsilon-aminocaproic acid, aprotinin, temperature correction	Decreased heparin, heparin-free run	DVT after decannulation (2; 2) Limb ischemia (1; 1) Clotting in ECLS circuit (2; 2) Thrombosis vena cava inferior (1; 1) Air embolism (1; 1) Accidental removal of drainage cannula (2; 2)† Leak out at cannula site (2; 2)† Surgical site bleeding (7; 7) Disseminated intravascular coagulopathy, Gastrointestinal bleeding (2; 2) No further defined bleeding (5; 5) Diffuse bleeding (8; 8) Pericardial effusion (1; 1) Exsanguination (3; 3) Intracranial hemorrhage (1; 1) Fat embolism (1; 1) Pulmonary hypertension (1; 1) Multiorgan failure, sepsis (3; 3)

(Willers, Swol et al. 2021)



ECMO

Chest Trauma and Parenchymal Injury:

ECLS can be used to minimize ventilatory settings when standard and advance strategies are failing (Mulder, Keelan et al. 2018).

Cannulation strategy may need to be altered because of concomitant injuries.

VV is most common while VA is reserved for need for circulatory support; temporary RV support may be needed as well (Ramin, Charbit et al. 2019). Guirand et al showed higher survival in VV-ECMO in trauma than conventional mechanical ventilation (Guirand, Okoye et al. 2014)

Cardiac Trauma and Traumatic arrest

Cardiac arrest from trauma is associated with a very low survival rate with high incidence of permanent neurologic disability in survivors. VA-ECLS has been described in both penetrating and blunt cardiac injuries (Yoann, Erwan et al. 2013; Misselbrook, Hameed et al. 2021; Restrepo-Córdoba, Hernández-Pérez et al. 2017)).



Iatrogenic Complications

ECMO:

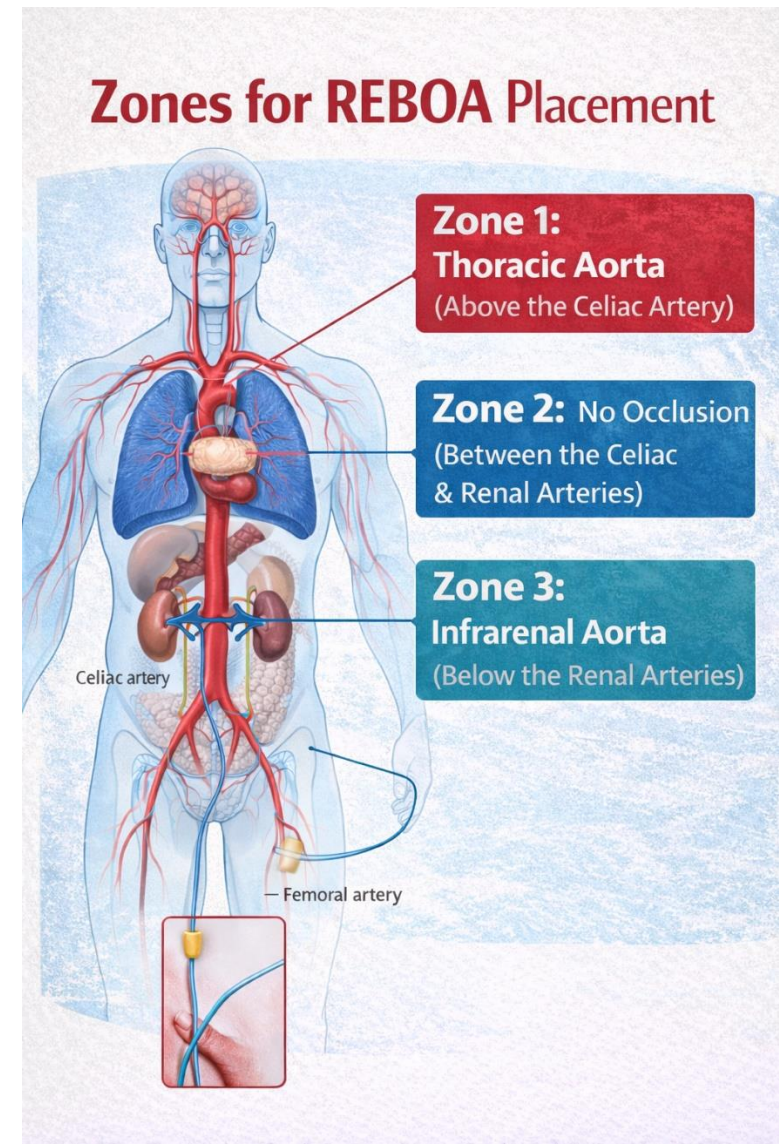
- Vessel perforation or dissection
- Retrograde aortic dissection
- Limb ischemia



Resuscitative Endovascular Balloon Occlusion of the Aorta

REBOA

- Zone 1: Descending Thoracic Aorta (left subclavian artery to celiac trunk, for Abdominal/Retroperitoneal Hemorrhage)
- Zone 2: Visceral Aorta (celiac artery to renal artery – avoid!)
- Zone 3: Infrarenal Aorta (renal artery to aortic bifurcation)





Conclusions

- Cardiac Trauma is an infrequent trauma with high morbidity and mortality
- Survival after sternotomy for hemorrhage control roughly the same between injury types
- Survival after thoracotomy for hemorrhage control (excluding resuscitative) greater for penetrating injury, likely due to faster OR times
- Type A aortic dissection needs CPB
- Overall survival after resuscitative thoracotomy very low; higher for penetrating than blunt injury and surgery happens faster for penetrating injuries
- May be a role for CPB for cardiac repair, even with polytraumas, and ECMO in select patients
- Future studies for endovascular repair of aorta and REBOA
- Keep a high index of suspicion for obstructive shock



Questions?

Thank you!





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Images created with chat GPT

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ENT Anesthesia: Airway Management and Beyond

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Conflict Of Interest Disclosure

- Speaker – Medtronic Inc. and Mindray North America
- Royalties from textbooks:
 - Anesthesia for Otolaryngology
 - Clinical Airway Management: an Illustrated Case Based Approach
- Co-author: ASA Difficult Airway Guidelines

Objectives

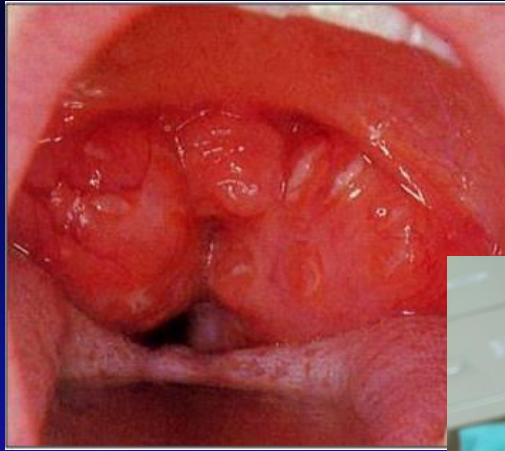
At the end of this presentation , the participant will be able to discuss:

- Pre-op eval
- The ENT airway
- Awake intubation
- Jet ventilation
- High Flow NC oxygenation
- Beyond the airway management
 - Anesthetic management
 - Muscle relaxants/nerve monitoring
 - Steroid use
 - Smooth extubation and beyond

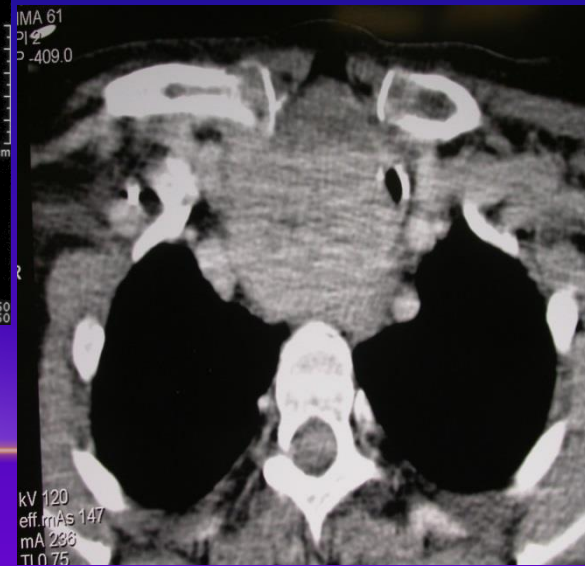
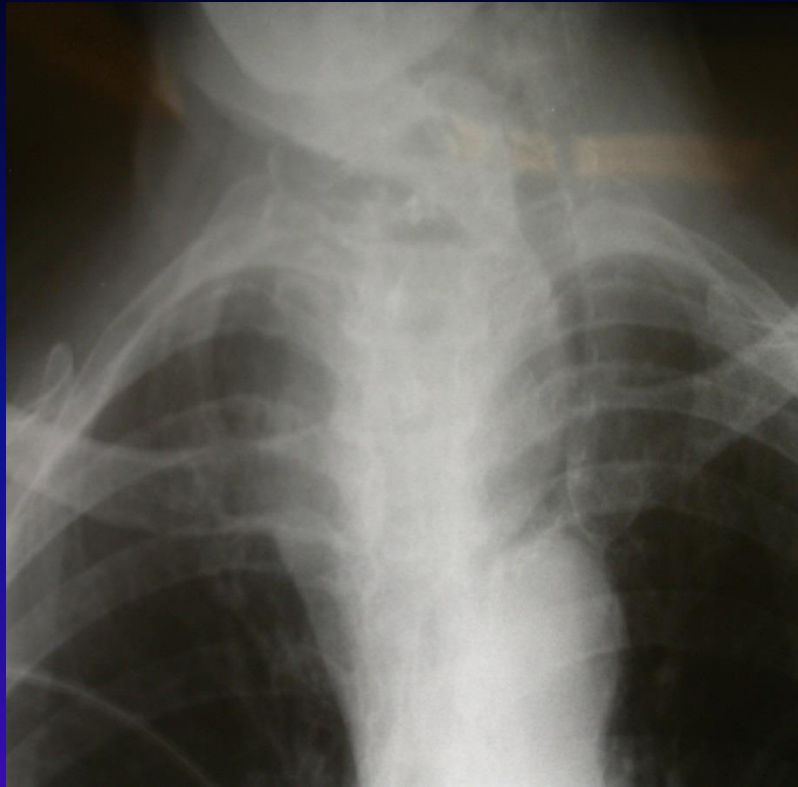
Pre-operative Evaluation

- Airway evaluation, symptoms of compromise
- Size of the lesion or tumor, its location and extent
- Common co-morbidities:
 - CAD
 - Chronic obstructive/restrictive pulmonary disease,
 - Malnutrition
 - Aspiration pneumonitis

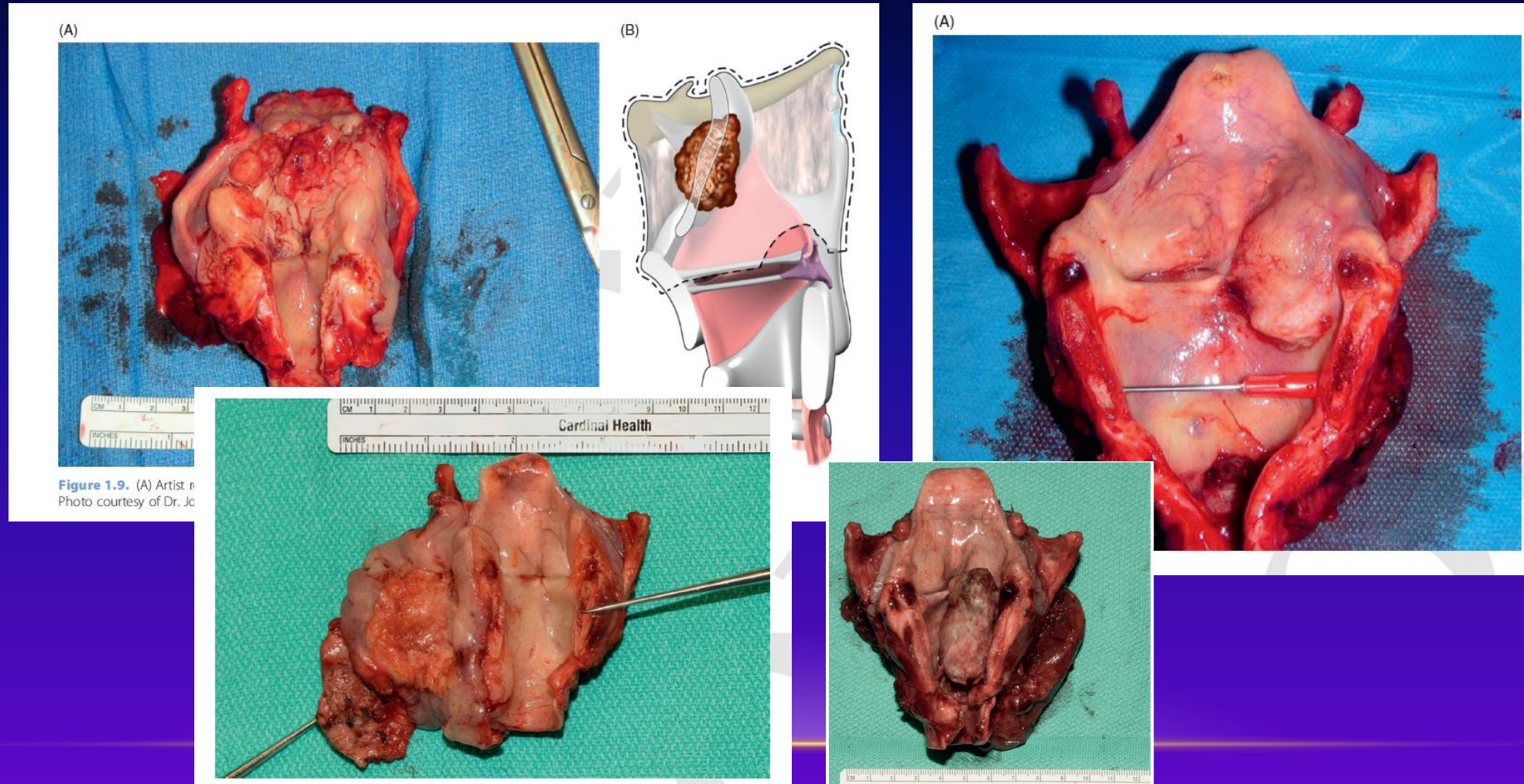
Airway Exam



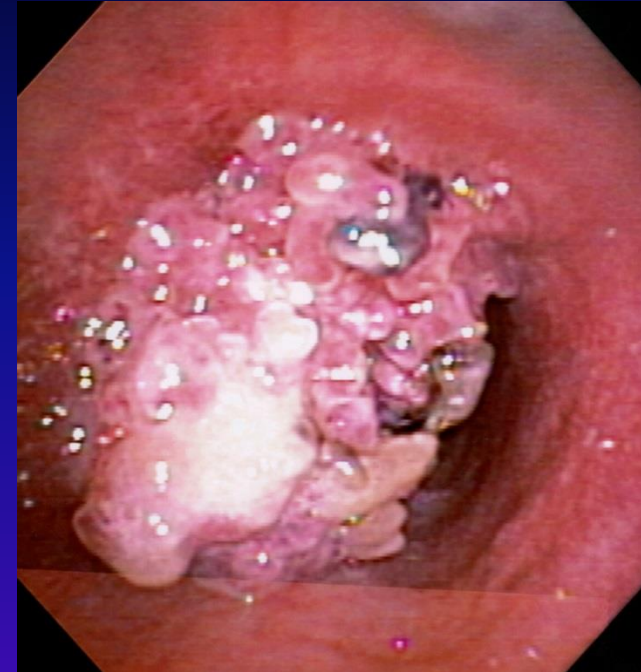
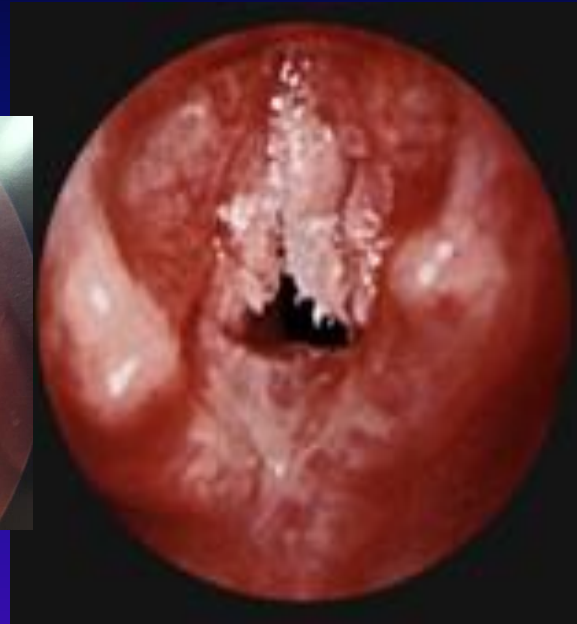
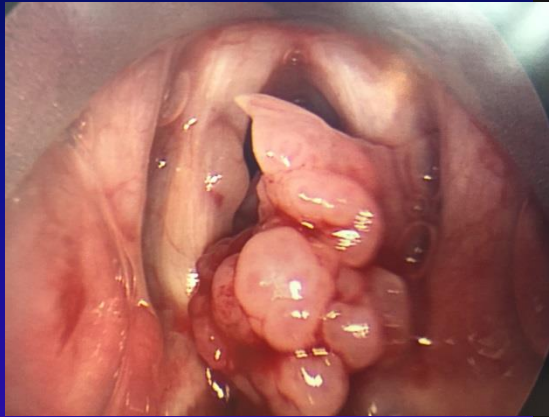
Distorted Deviated Trachea



Glottic Tumors



Laryngeal Cases



- Usually done as intubated, apnea or suspension laryngoscopy with jet ventilation

NAP 4 Project

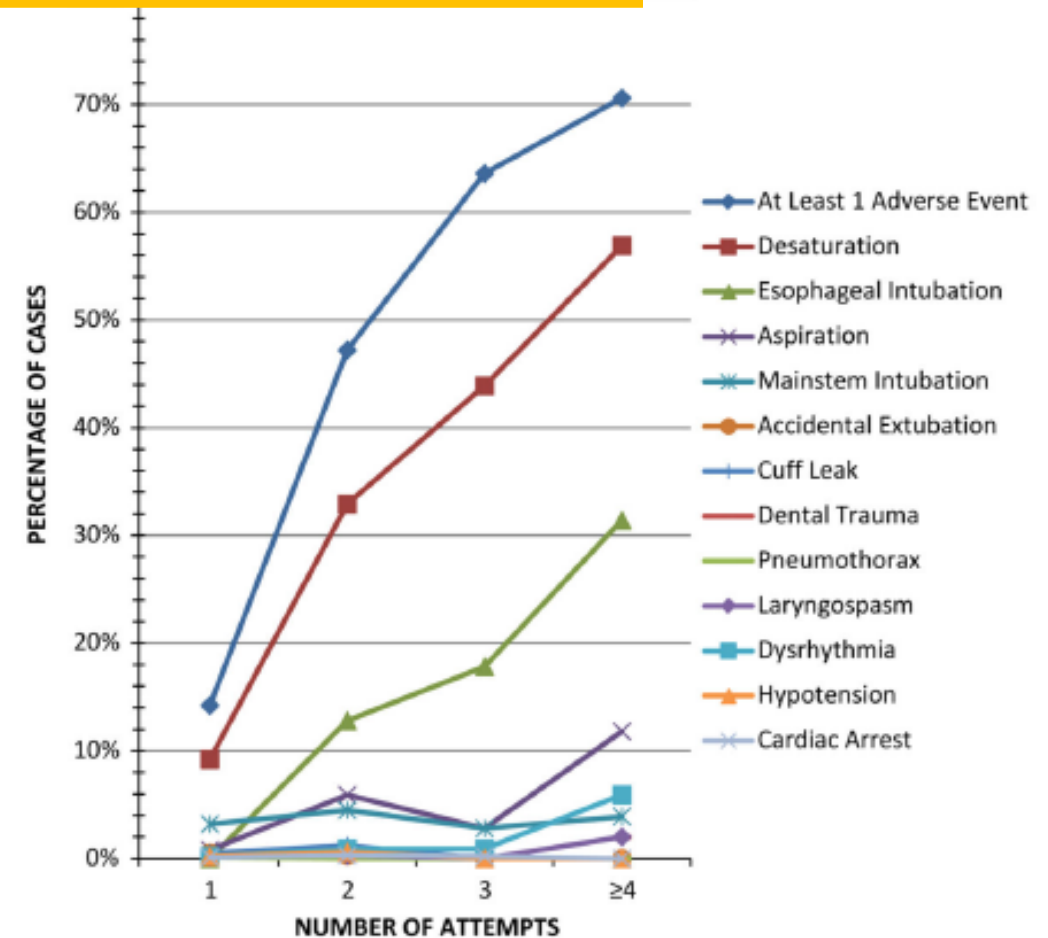
- Nearly 50% of the events followed head & neck surgery.
- Approximately 70% of these reports were associated with obstructive lesions within the airway
- Evidence of poor anticipation and planning for management of airway instrumentation & extubation.



The Importance of First Pass Success When Performing Orotracheal Intubation in the Emergency Department

John C. Sakles, MD, Stephen Chiu, MD, Jarrod Mosier, MD, Corrine Walker, MD, and Uwe Stolz, PhD, MPH

- 2K patients over 4 years
- Emergency intubations in the ED
- 72% 1st pass success rate
- 11% aspiration rate with 4 attempts



Video Laryngoscopes



Respiration and the Airway

Videolaryngoscopy *versus* direct laryngoscopy for adults undergoing tracheal intubation: a Cochrane systematic review and meta-analysis update

Jan Hansel^{1 2}  , Andrew M. Rogers³, Sharon R. Lewis⁴, Tim M. Cook^{3 5},
Andrew F. Smith^{1 6}

We found that videolaryngoscopes of any design likely reduce rates of failed intubation (Macintosh-style: risk ratio [RR]=0.41; 95% confidence interval [CI], 0.26–0.65; hyperangulated: RR=0.51; 95% CI, 0.34–0.76; channelled: RR=0.43, 95% CI, 0.30–0.61; moderate-certainty evidence) with increased rates of successful intubation on first attempt and better glottic views across patient groups and settings. Hyperangulated

Does VL Ever Fail?

- Reports of being able to see the larynx, but cannot intubate¹
 - Poor mandibular advancement²
 - Other predictors of failure:³
 - Neck radiation
 - Masses
 - Surgical alterations (Flaps)
- Intubator's experience??

1. Platts-Mills et al, comparison of glidescope videolaryngoscopy vs direct laryngoscopy intubation in the ED . Acad emerg med 2009; 16:866-71

2. Trmblay MH, Williams S et al. Poor visualization during DL and high upper lip bite score ... Anesth Analg. 2008;106(5):1495-1500

3. Aziz , Healy, et al Routine Clinical Practice Effectiveness of the GlideScope... Anesthesiology 2011;114(1):34-41

Success of Intubation Rescue Techniques after Failed Direct Laryngoscopy in Adults

A Retrospective Comparative Analysis from the Multicenter Perioperative Outcomes Group

Michael F. Aziz, M.D., Ansgar M. Brambrink, M.D., Ph.D., David W. Healy, M.D., M.R.C.P., F.R.C.A., Amy Wen Willett, M.D., Amy Shanks, Ph.D., Tyler Tremper, B.S., Leslie Jameson, M.D.,

(**ANESTHESIOLOGY 2016; 125:656-66**)

- 1.5K cases/ 347K had failed DL
- 28 % of failed DL had ≥ 2 predictors of DI
- Pharyngeal injury was reported in 12/1122 rescue, all associated with VL
- Dental injury was reported in 4 cases

Success of Intubation Rescue Techniques after Failed Direct Laryngoscopy in Adults

A Retrospective Comparative Analysis from the Multicenter Perioperative Outcomes Group

Michael F. Aziz, M.D., Ansgar M. Brambrink, M.D., Ph.D., David W. Healy, M.D., M.R.C.P., F.R.C.A., Amy Wen Willett, M.D., Amy Shanks, Ph.D., Tyler Tremper, B.S., Leslie Jameson, M.D.,

(ANESTHESIOLOGY 2016; 125:656-66)

Table 1. Airway Rescue Techniques and Comparative Success Rates of the Common Rescue Strategies

Rescue Technique (Total n = 1,511)	Success, n (%) (95% CI)	Failure, n (%) (95% CI)	P Values
Video laryngoscopy (n = 1,122)	1,032 (92) (90–93)	90 (8) (7–10)	Reference group
SGA conduit (n = 82)	64 (78) (68–86)	18 (22) (14–32)	0.0001
Flexible fiberoptic (n = 170)	132 (78) (71–83)	38 (22) (17–29)	0.0001
Lighted stylet (n = 128)	98 (77) (69–83)	30 (23) (17–31)	0.0001
Optical stylet (n = 9)	6 (67) (35–88)	3 (33)	0.031

SGA = supraglottic airway.

2022 American Society of Anesthesiologists Practice Guidelines for Management of the Difficult Airway*

Jeffrey L. Apfelbaum, M.D., Carin A. Hagberg, M.D.,
Richard T. Connis, Ph.D., Basem B. Abdelmalak, M.D.,
Madhulika Agarkar, M.P.H., Richard P. Dutton, M.D.,
John E. Fiadjoe, M.D., Robert Greif, M.D.,
P. Allan Klock, Jr., M.D., David Mercier, M.D.,
Sheila N. Myatra, M.D., Ellen P. O'Sullivan, M.D.,
William H. Rosenblatt, M.D.,
Massimiliano Sorbello, M.D.,
Avery Tung, M.D.

ANESTHESIOLOGY 2022; 136:31–81

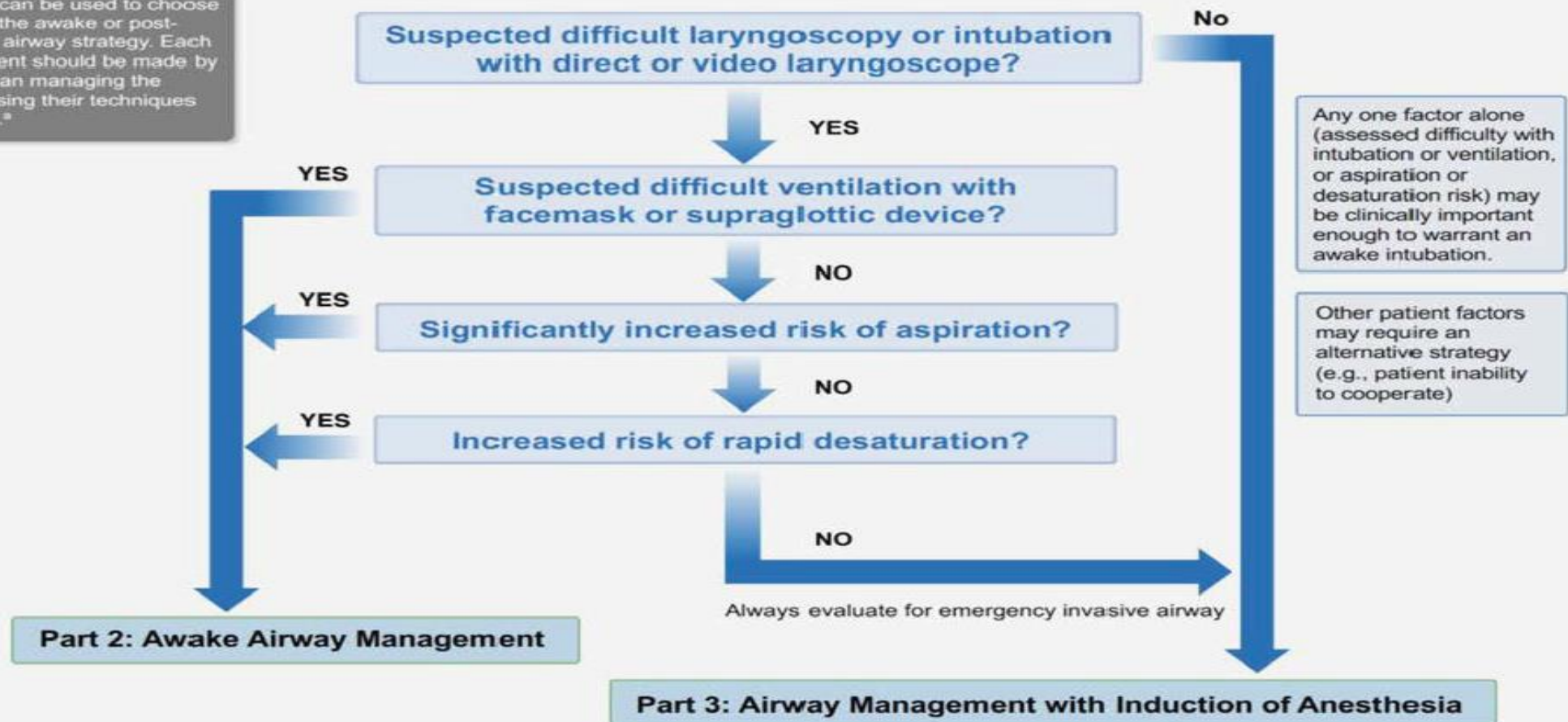


2022 ASA Guidelines Part 1: Decision Tool

DIFFICULT AIRWAY INFOGRAPHIC: ADULT PATIENTS

Part 1: Pre-Airway Management Decision Making Tool (planning)

This tool can be used to choose between the awake or post-induction airway strategy. Each assessment should be made by the clinician managing the airway, using their techniques of choice.⁸



The ENT Surgeon As Plan B ??

- Are your surgeons aware that they are plan B for some of you??
- Awake tracheostomy vs. asleep tracheostomy
- Elective vs. emergency

Awake Intubation:

Advantages

- Patient safety
- Spontaneous ventilation allows more time for intubation
- Muscle and tongue tone maintained
- Anatomy in a dynamic airway is easier to identify

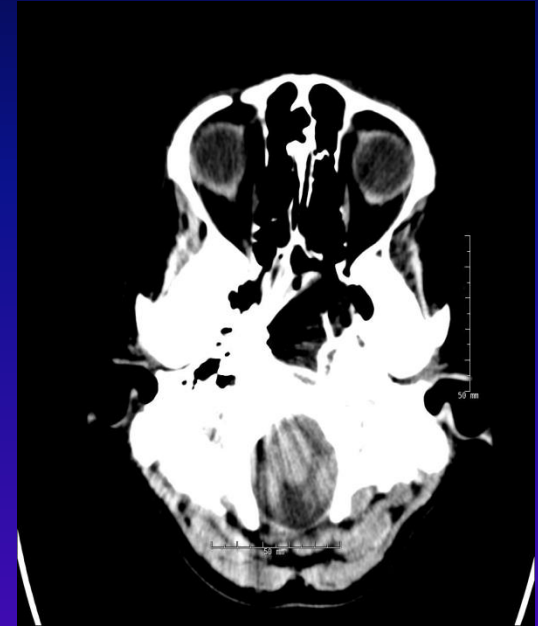
YOU WILL NOT REGRET AI , BUT YOU MAY
REGRET NOT DOING IT

Intubating Device

- Awake Intubation does not have to be via flexible fiberoptic
- Awake is the technique ; the device is your choice, what is available, what's is your personal preference based on you experience...

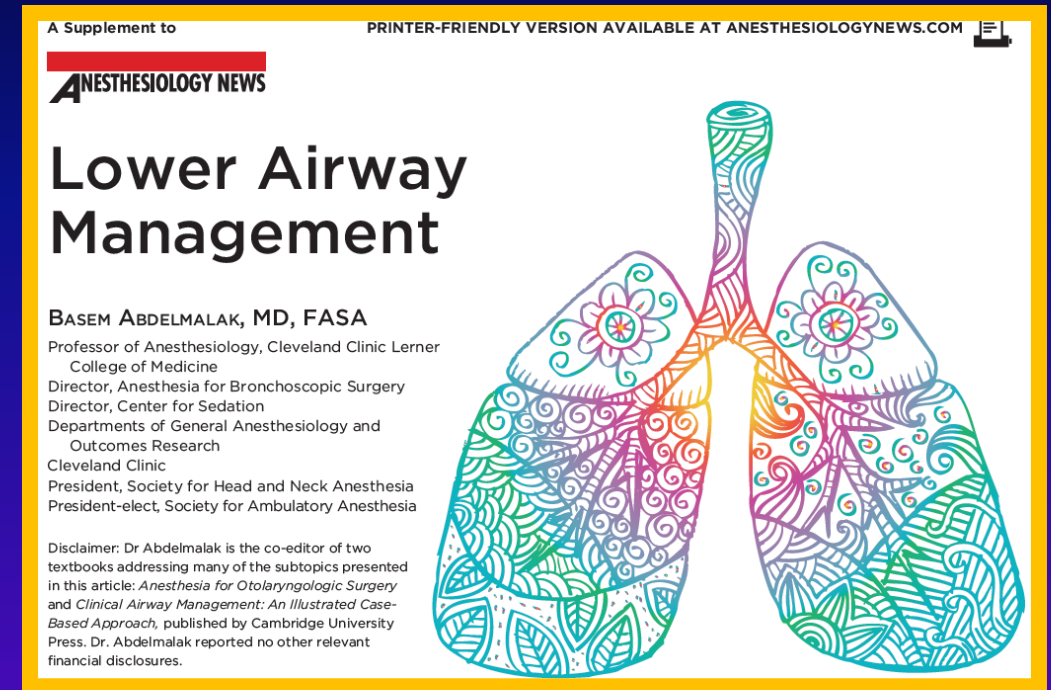
Fiberoptic Only Airway

- 33 Y/O S/P ATV accident
- Trismus and scheduled for Jaw surgery
- Base skull fracture resulting in nasal cavity connecting to the cranium



What is Not Covered in the ASA 2022 Guidelines?

- Lower airway management
 - Subglottic stenosis
 - Tracheal resection
 - Tracheal rupture

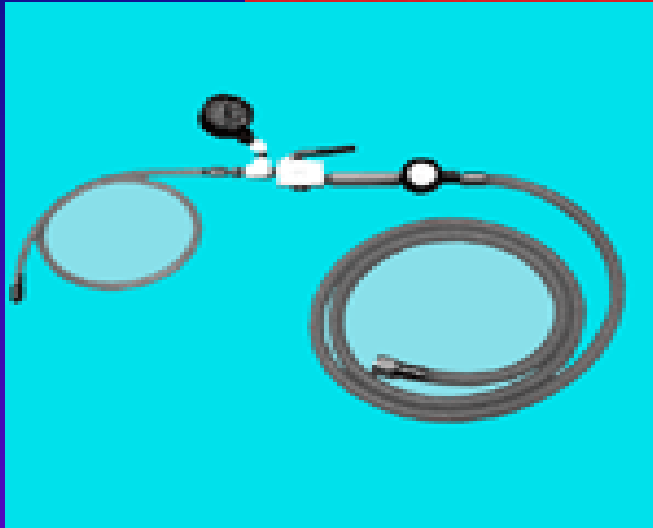


Heliox

Does it have a role in
ENT Anesthesia
practice?



Jet Ventilator Equipment



med-worldwide.com/jet-ventilator.html accessed 11-02-04

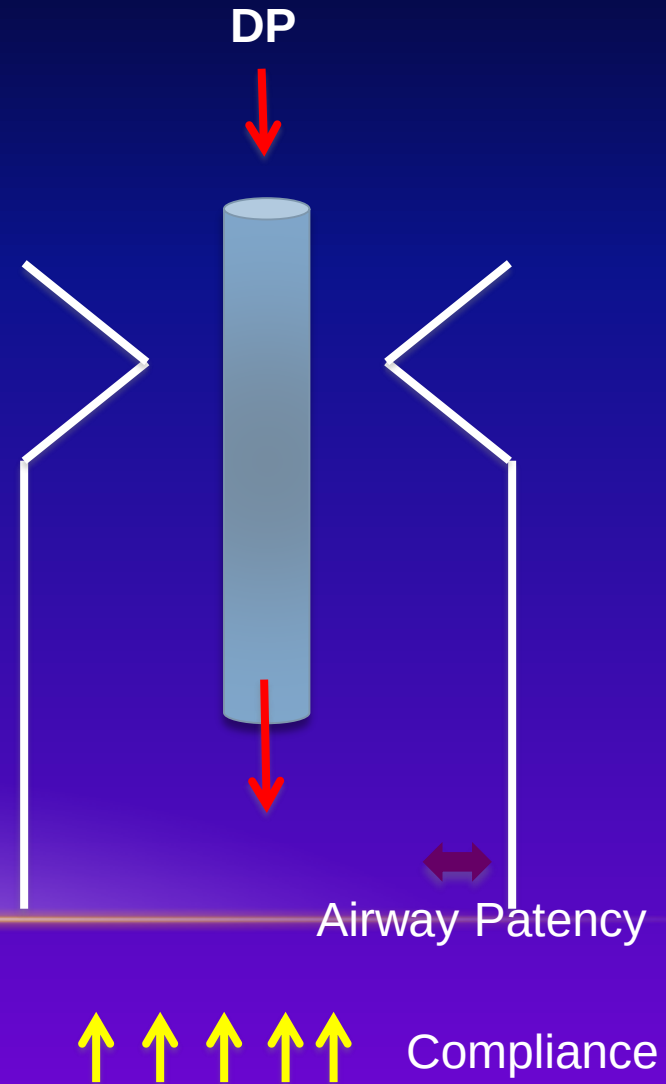
mainlinemedical.com/en-us/dept_1020.html

groups.msn.com/DrMAGBOULAIRWAYPAGE/jetventilator.msnw accessed 11-9-05

Tidal Volumes In Jv

- Tidal volumes depend on:

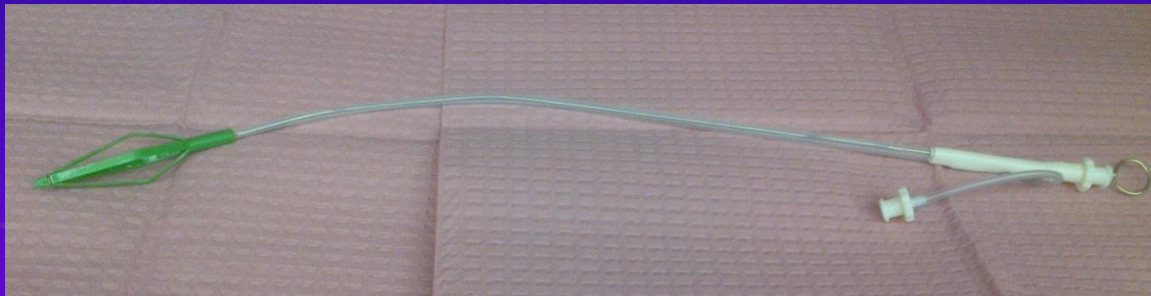
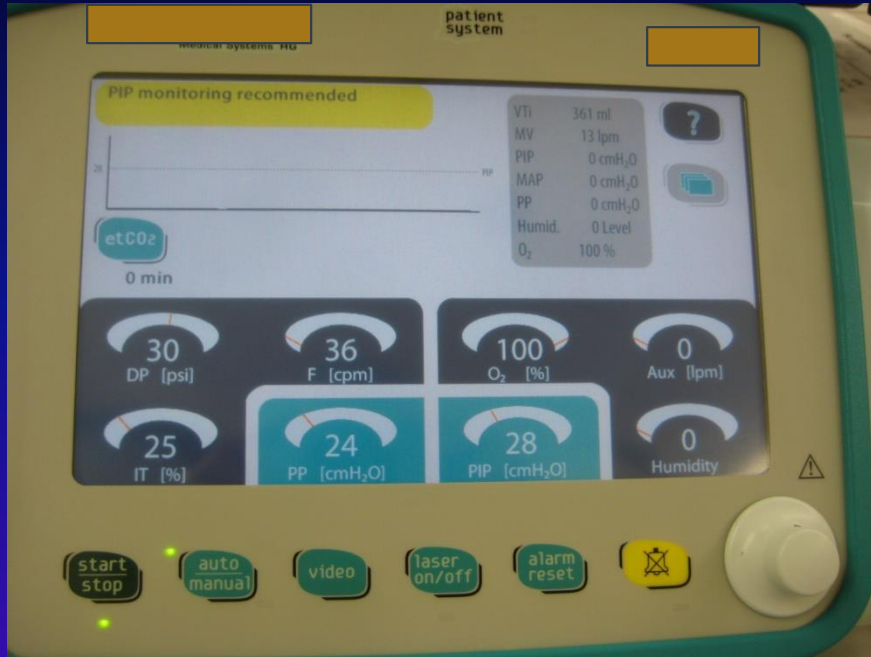
- Driving pressure
- Inspiratory time
- Airway patency
- Chest wall compliance



Supraglottic JV



Subglottic Jetting



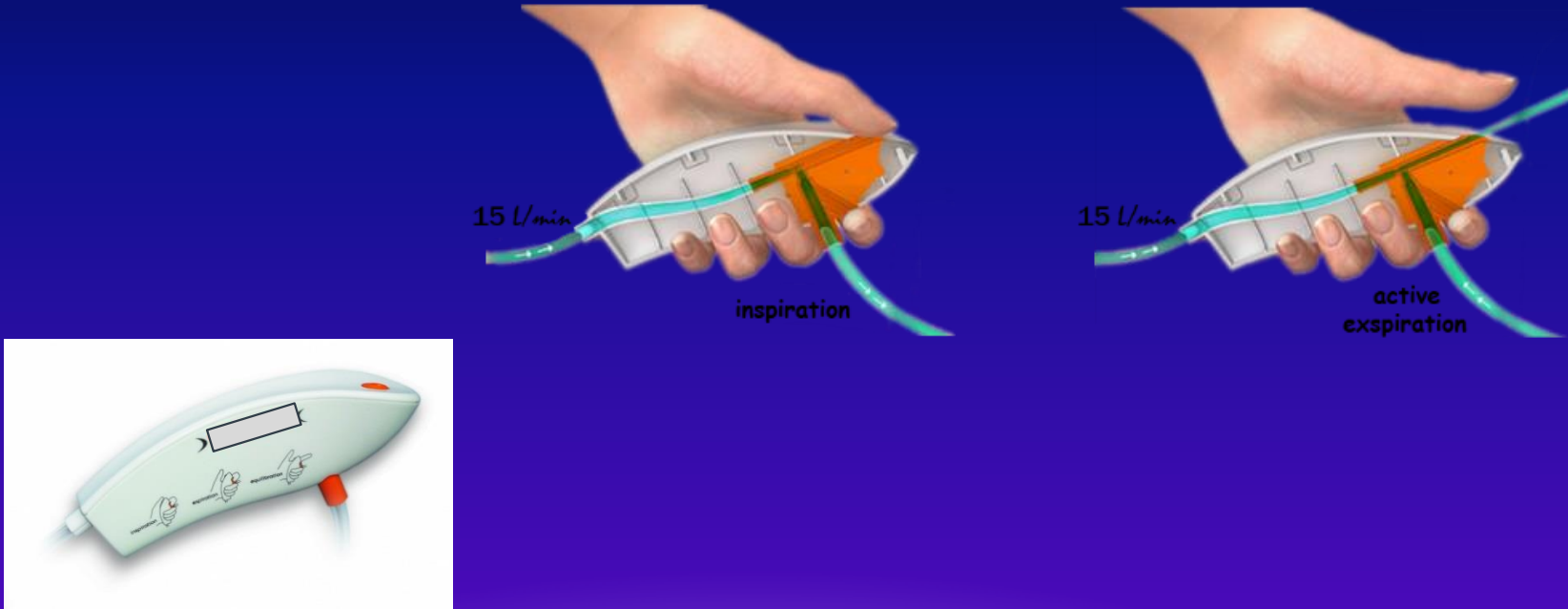
Transcutaneous CO₂ Monitoring



Jet Ventilation Golden Rule

**What Goes in
Must Come out!**

What's New In Jet Ventilation?



Tracheal Resection

- Staged intubation:
 - Oral
 - Transfield
 - Oral

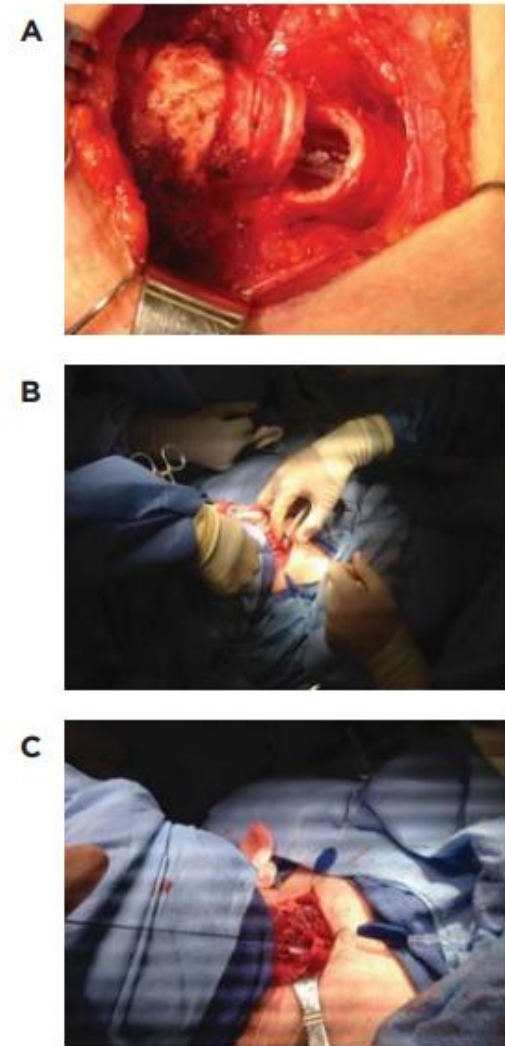


Figure 7.

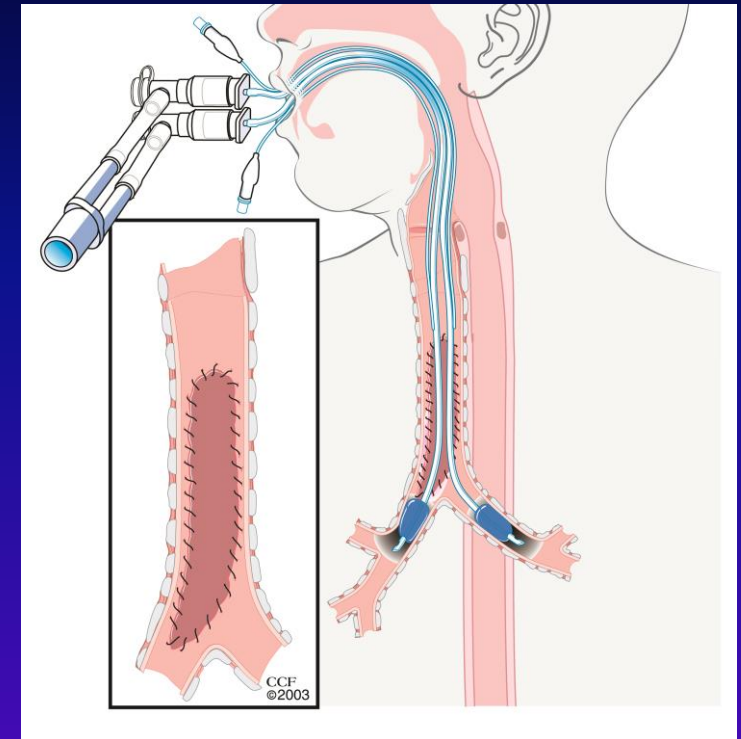
A. An MLT is positioned and **B,** a trans-field reinforced ETT is introduced into the distal trachea. **C.** The oral MLT is reintroduced into the trachea under direct vision.

ETT, endotracheal tube; **MLT,** microlaryngeal tube

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Tracheal Rupture

- Initial management
- Conservative management
- Surgical repair



Flap Management

- Usually awake intubation
- Invasive monitoring
- Intravascular volume colloids vs. crystalloids
- Narcotic infusion
- Temperature management
- Transfusion triggers
- Vasopressors use
- post-op disposition

Optimal Perioperative Care in Major Head and Neck Cancer
Surgery With Free Flap Reconstruction
A Consensus Review and Recommendations
From the Enhanced Recovery After Surgery Society

- Mostly common sense interventions
- No evidence for outcomes improvement, or cost analysis
- Weak evidence for the majority of the recommendations
- A lot of the evidence from non-ENT surgeries

Expert Consensus Statement on the Perioperative Management of Adult Patients Undergoing Head and Neck Surgery and Free Tissue Reconstruction From the Society for Head and Neck Anesthesia

David W. Healy, MD, MRCP, FRCA, FASA,* Benjamin H. Cloyd, MD, MIPH,†
Tracey Straker, MD, MS, MPH, CBA, FASA,‡ Michael J. Brenner, MD,§ Edward J. Damrose, MD, FACS,||
Matthew E. Spector, MD,§ Amit Saxena, MD,¶ Joshua H. Atkins, MD, PhD, CPE,#
Radhamangalam J. Ramamurthi, MD, FRCA,** Arpan Mehta, BM, FRCA,†† Michael F. Aziz, MD,‡‡
Davide Cattano, MD, PhD, FASA, CMQ,§§ Adam I. Levine, MD,|||| Samuel A. Schechtman, MD,†
Laura F. Cavallone, MD, MSc,¶¶ and Basem B. Abdelmalak, MD, FASA, SAMBA-F##

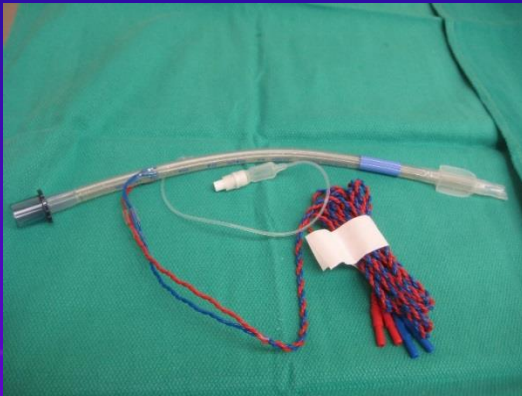
Healy, D. W., Cavallone, L. F., Schechtman, S. A., Levine, A. I., Cattano, D., Aziz, M. F., Mehta, A., Ramamurthi, R. J., Atkins, J. H., Saxena, A., Spector, M. E., Damrose, E. J., Brenner, M. J., Straker, T., Cloyd, B. H., & Abdelmalak, B. B. (2021). Expert Consensus Statement on the Perioperative Management of Adult Patients Undergoing Head and Neck Surgery and Free Tissue Reconstruction From the Society for Head and Neck Anesthesia. *Anesthesia & Analgesia*, 133(1), 274–283.
<https://doi.org/10.1213/ANE.0000000000005564>

Laryngoplasty



Use And Avoidance Of Muscle Relaxants

- Yes, in DL, tracheostomy and/or maxillofacial
- Avoid post induction in parotidectomy, neck dissection, thyroidectomy, etc...
- Narcotic infusion helps keep patients still during long cases
- Recommend: fentanyl, or sufentanil



The Use of Remifentanyl infusion In ENT Surgeries

- Helpful in short very stimulating cases, like DL
- Less preferred in long cases such as flaps, neck dissection and parotidectomy , due to:
 - Hypotension
 - Bradycardia
 - Hyperalgesia
 - Cost

The Use of Steroids In ENT Surgeries

- Airway edema
 - evidence of its real advantage is controversial at best
- PONV prophylaxis
- Helps with postoperative pain management
- Decreases post-op fatigue phenomenon
- Better recovery profile

Airway Safety In ENT Anesthesia

Recovery Factors. a higher incidence of coughing, laryngospasm and desaturation following tracheal extubation.

Re-intubation plan in PACU



Smooth Extubation

- Deep extubation
- Lidocaine IV Vs. intratracheal vs. intraETT cuff
- Bridging to LMA
- Remifentanyl
- Other narcotic infusions

Extubation of the Difficult airway

- Short-term use of an AEC? and/or SGA ?
- Evaluate the R/B of elective surgical tracheostomy
- Evaluate the R/B of awake Vs. “deep” extubation
- When feasible, use supplemental O₂ throughout the extubation process
- Assess the clinical factors that may produce an adverse impact on ventilation after extubation

**2022 American Society
of Anesthesiologists
Practice Guidelines for
Management of the
Difficult Airway***

What Could Go Wrong With AECs?

- Tracheo-laryngeal trauma
- Kinking/esophageal migration on re-intubation
- Aspiration
- Accidental extubation of the AEC
- Barotrauma with jetting through the AEC
- Stomach rupture

Extubation Following Placement of a Reintubation Catheter



Dosemeci L, Yilmaz M, Yegin A, Cengiz M, Ramazanoglu A - Crit Care (2004) , **The routine use of pediatric airway exchange catheter after extubation of adult patients who have undergone maxillofacial or major neck surgery: a clinical observational study.**
https://openi.nlm.nih.gov/detailedresult.php?img=PMC1065057_cc2956-1&req=4

Unforeseen Esophageal Misplacement of Airway Exchange Catheter Leading to Gastric Perforation

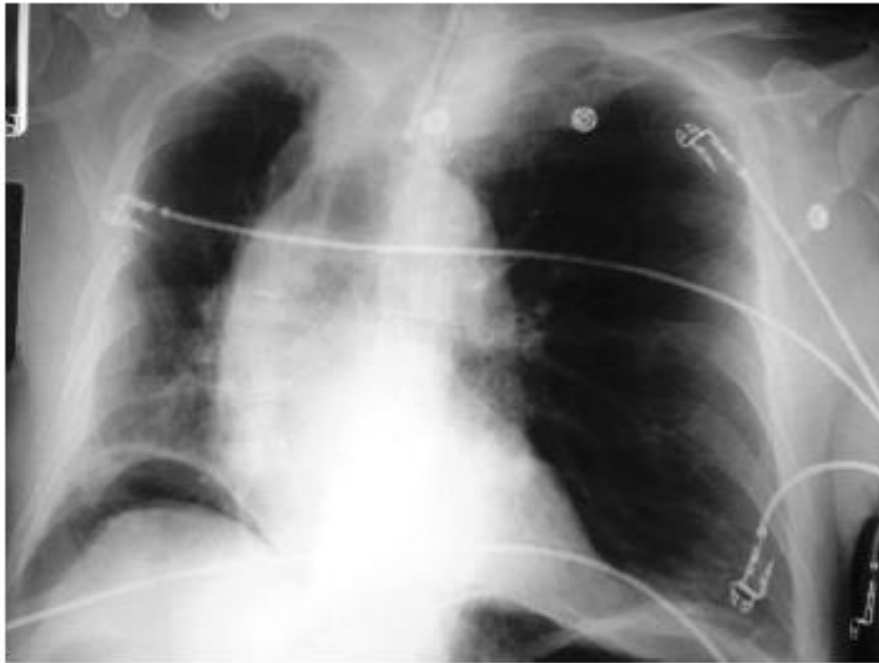
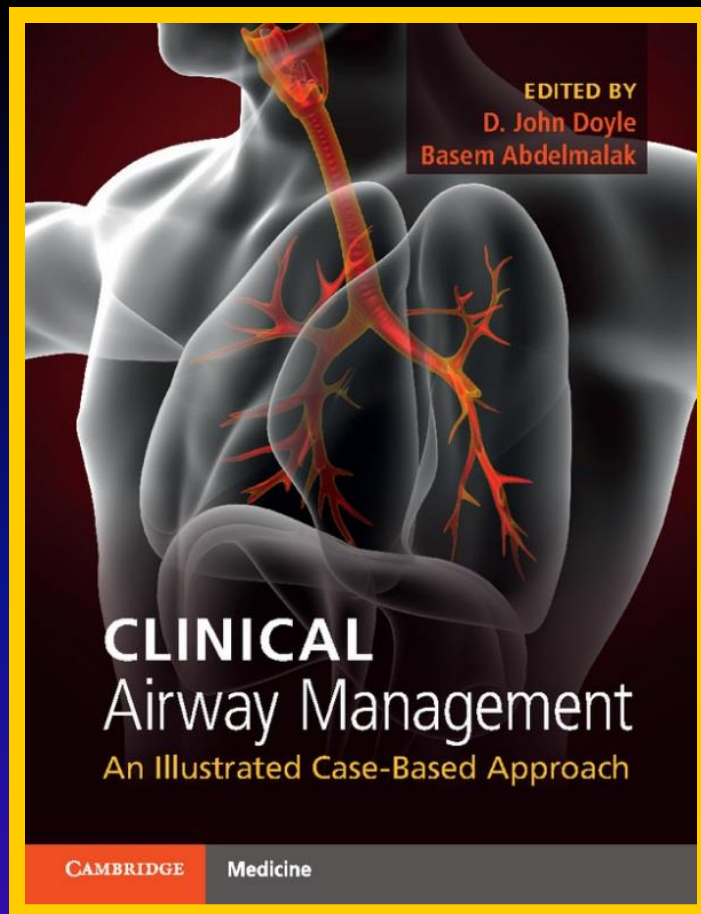


Fig. 1. Chest radiograph demonstrating gas under the diaphragm. Note the Cook catheter within the insufflated esophagus which appears to lie within the trachea.



Fig. 2. Abdominal radiograph demonstrating gastric distension from oxygen insufflation.



Section 7

When the Airway Goes Bad

Chapter

62

Extubation of the Difficult Airway

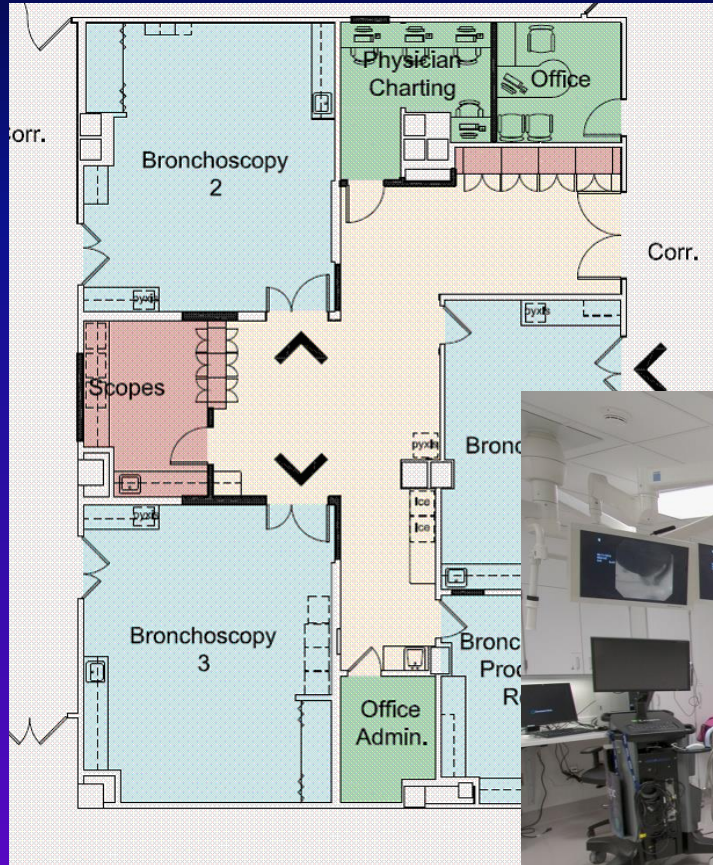
Jennifer Sainsbury and Richard M. Cooper



Figure 62.1 An appropriately sized airway exchange catheter inserted to a depth wherein the markings on the catheter align with those on the tracheal tube.

ANESTHESIA FOR BRONCHOSCOPY

Modern Fully Equipped Bronchoscopy Suite



Anesthetic Considerations And Techniques For Advanced Diagnostic And Therapeutic Bronchoscopy

Advances in Anesthesia 32 (2014) 71–87

ADVANCES IN ANES

Anesthesia and Upper and Lower Airway Management for Advanced Diagnostic and Therapeutic Bronchoscopy

Basem Abdelmalak, MD^{a,b,c,*}, Sonali Sethi, MD^d,
Thomas R. Gildea, MD, MS^e

6314

Anesthesia for Bronchoscopy

Basem B. Abdelmalak^{*}, Thomas R. Gildea[‡] and D. John Doyle[†]

Current Pharmaceutical Design, 2012, 18, 6314-6324

Anesthesia Technique for Endobronchial Ultrasound-Guided Fine Needle Aspiration of Mediastinal Lymph Node

Mona Sarkiss, MD, PhD,^{*} Marcus Kennedy, MD,[†] Bernhard Riedel, MD, PhD,^{*} Peter Norman, MD,^{*}
Rodolfo Morice, MD,[†] Carlos Jimenez, MD,[†] and George Eapen, MD[†]

Anesthesia: Intraoperative

- Topical anesthesia and sedation could be used for simple bronchoscopy

To Sleep or Not To Sleep
That Is the Question

Joseph Cicenia, MD, FCCP, and
Charanjit S. Bahniwal, MD†*

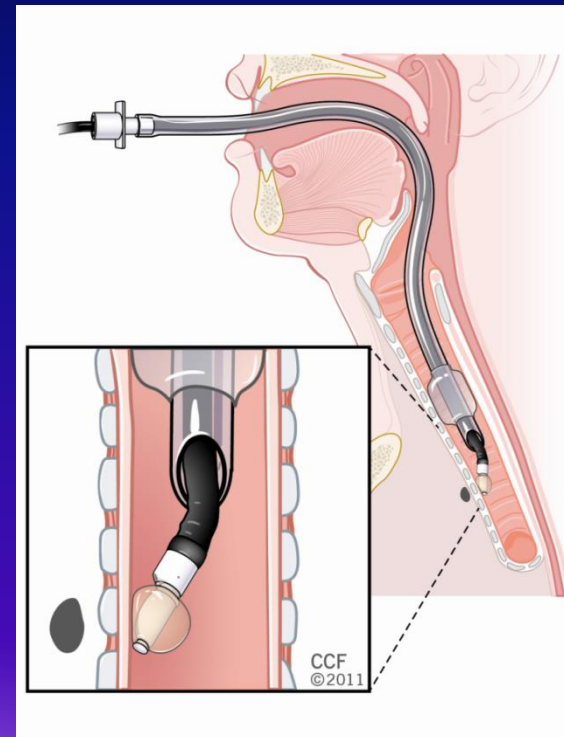
- GA is required for most of the advanced bronchoscopy

Total Intravenous Anesthesia (TIVA)

- Avoid polluting the room with inhaled anesthetic agents
- Ensures continuous delivery of anesthesia despite possible ventilation leaks
- Allows for utilization of intermittent apnea or jet ventilation techniques

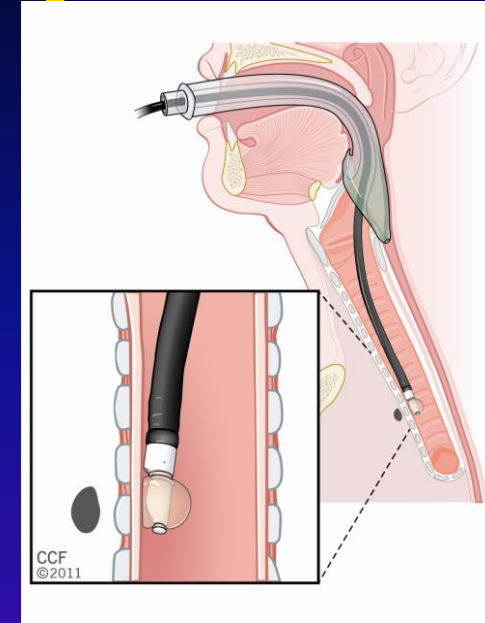
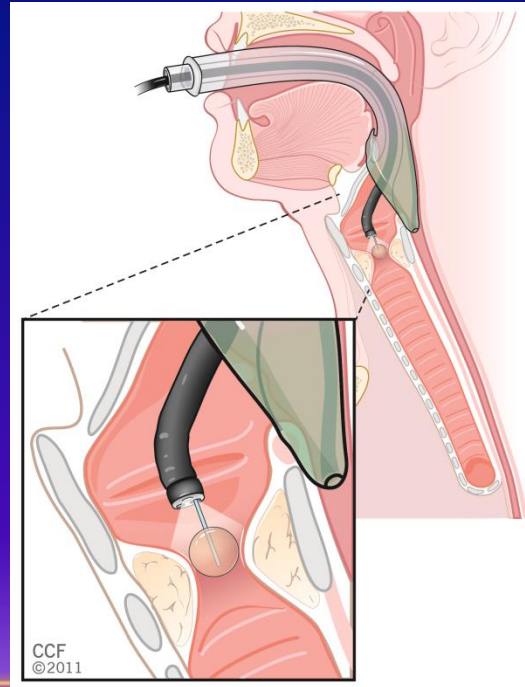
Choice of The Airway

- Lower tracheal and bronchial lesions and /or defects:
 - Use as large of a tube as possible to allow room for the bronchoscope and ventilation



Choice Of The Airway

- Sub-glottic and upper tracheal lesions: SGA



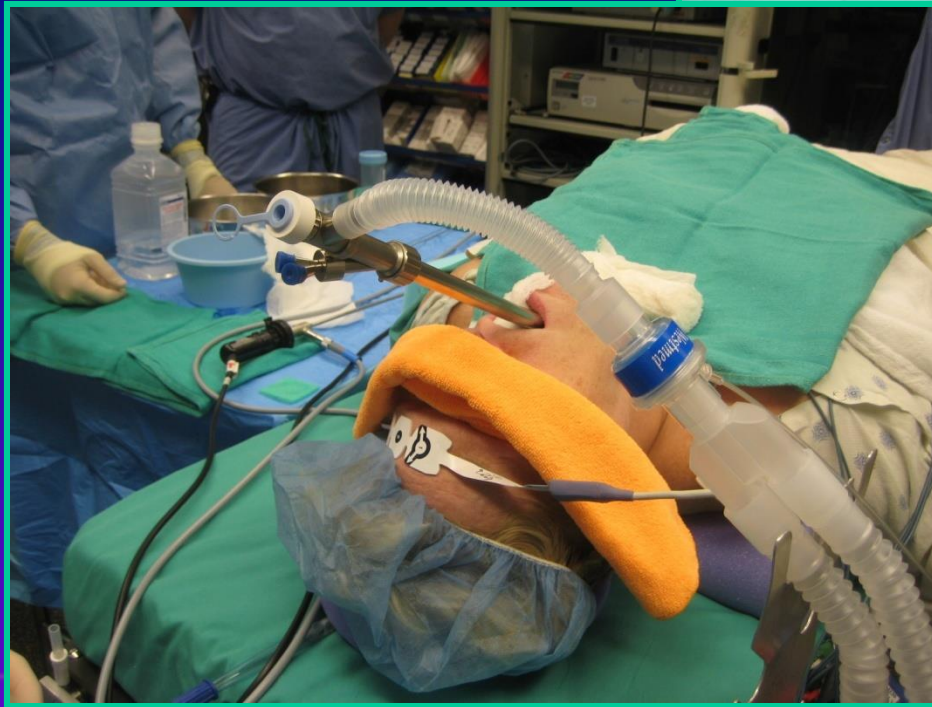
Simultaneous Ventilation

- Use a fiberoptic swivel connector to allow Continuous ventilation to avoid circuit disconnect during bronchoscopy



Abdelmalak B, Gildea T, Doyle J. Anesthesia For Bronchoscopy. Current Pharmaceutical Design, 2012, 18, 6314-6324

Ventilating Rigid Bronchoscope



Abdelmalak B, Sarkiss M: Anesthesia for Therapeutic Bronchoscopic Procedures. In: *Anesthesia for Otolaryngologic Surgery* edn. Edited by Abdelmalak B , Doyle DJ eds.. London, UK: Cambridge University Press,; 2013: In Press.

Intermittent Apnea



High Flow Apneic Oxygenation and No Ventilation

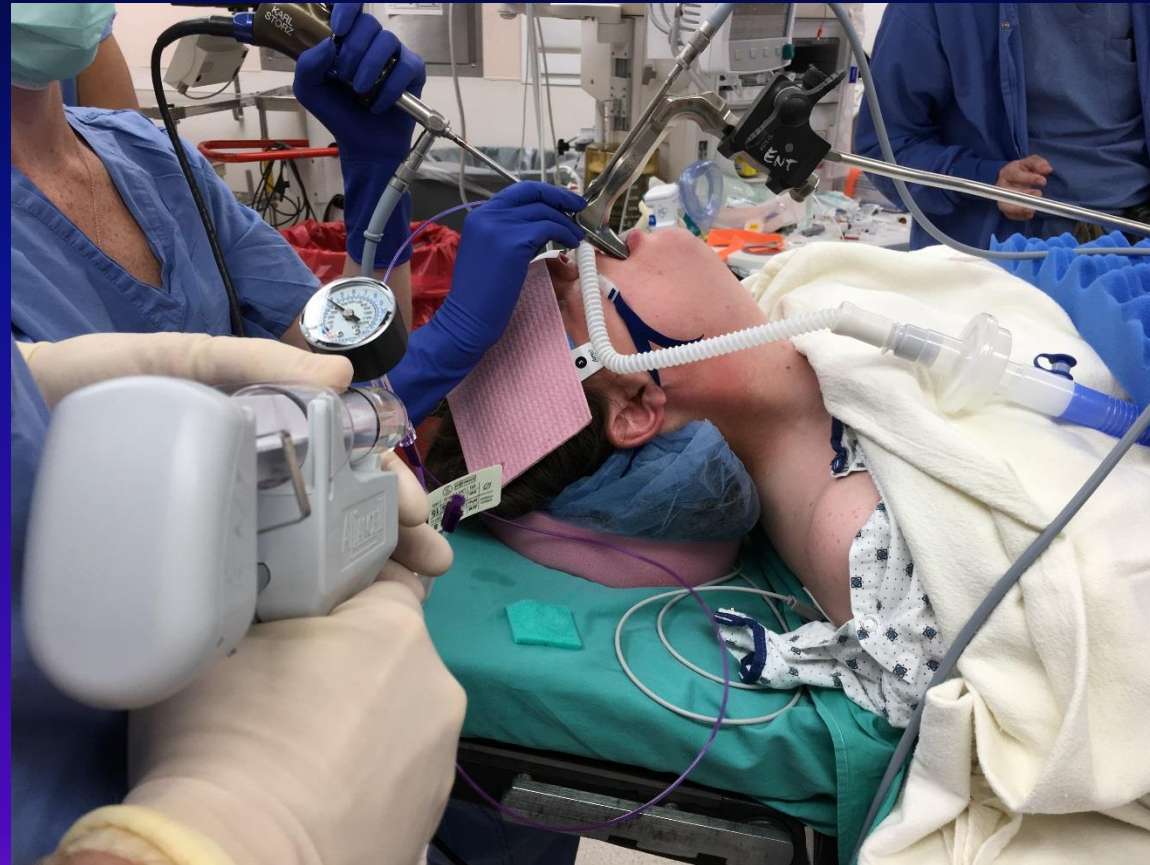
- It provides apneic oxygenation
- No VC, or airway protection



Renda T, Corrado A, Iskandar G, et al **Br J Anaesth.** 2018 Jan;120(1):18-27
Douglas N, Ng I, Nazeem F, et al · **Anaesthesia** 2018 Feb;73(2):169-176.



HFNO in Laryngo-tracheal Surgery



Utility of Transnasal Humidified Rapid Insufflation Ventilatory Exchange for Microlaryngeal Surgery

Michael S. Benninger, MD ; Emily S. Zhang, BS ; Bonnie Chen, BS; William S. Tierney, MD, MS, MS ;
Basem Abdelmalak, MD; Paul C. Bryson, MD

CONCLUSION

THRIVE is a safe and effective oxygenation and ventilation technique that addresses the disadvantages of other methods during microlaryngeal surgery. The failure rate of 11% seen in our cohort demonstrates the

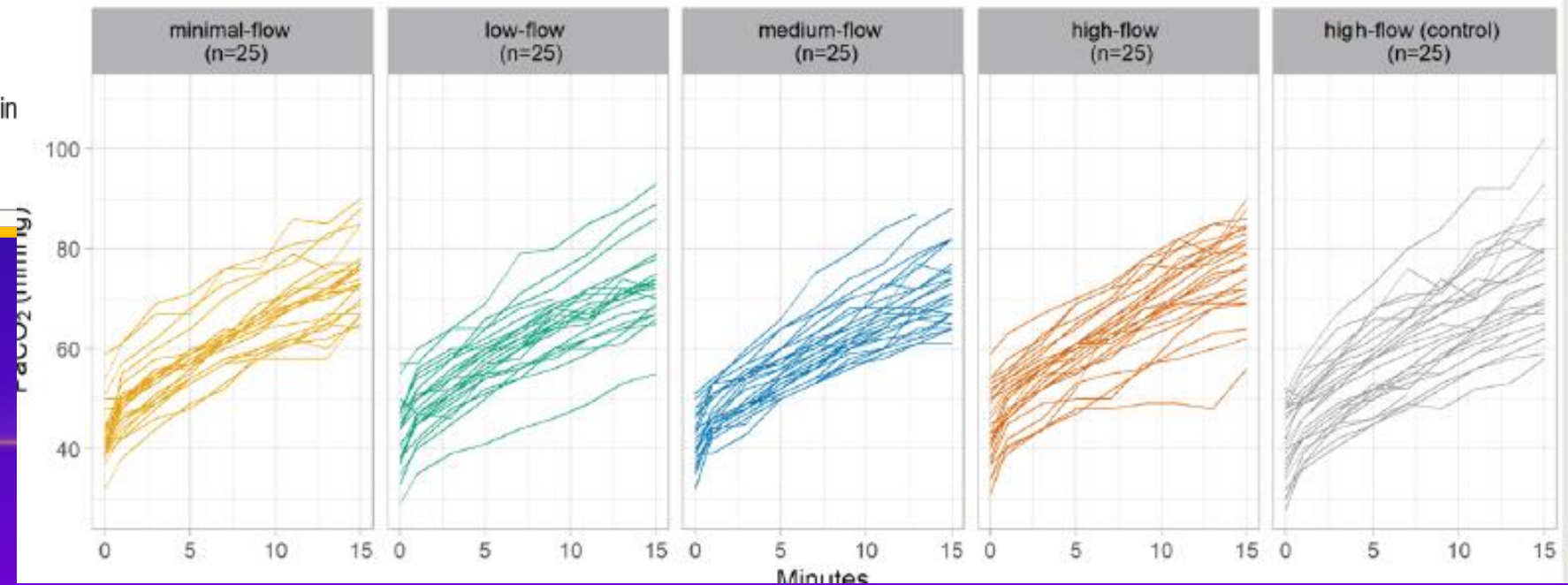
importance of careful patient selection for optimal outcomes. When possible, higher success is anticipated with patients with BMI <30. Back-up equipment and plans, such as jet ventilation and intermittent ventilation through an ETT should be readily available to supplement inadequate oxygenation and ventilation with THRIVE.

ANESTHESIOLOGY

Carbon Dioxide Changes during High-flow Nasal Oxygenation in Apneic Patients: A Single-center Randomized Controlled Noninferiority Trial

Thomas Riva, M.D., Robert Greif, M.D.,
Heiko Kaiser, M.D., Thomas Riedel, M.D.,
Markus Huber, Ph.D., Lorenz Theiler, M.D., Sabin
ANESTHESIOLOGY 2022; 136:82–92

Arterial partial pressure of carbon dioxide

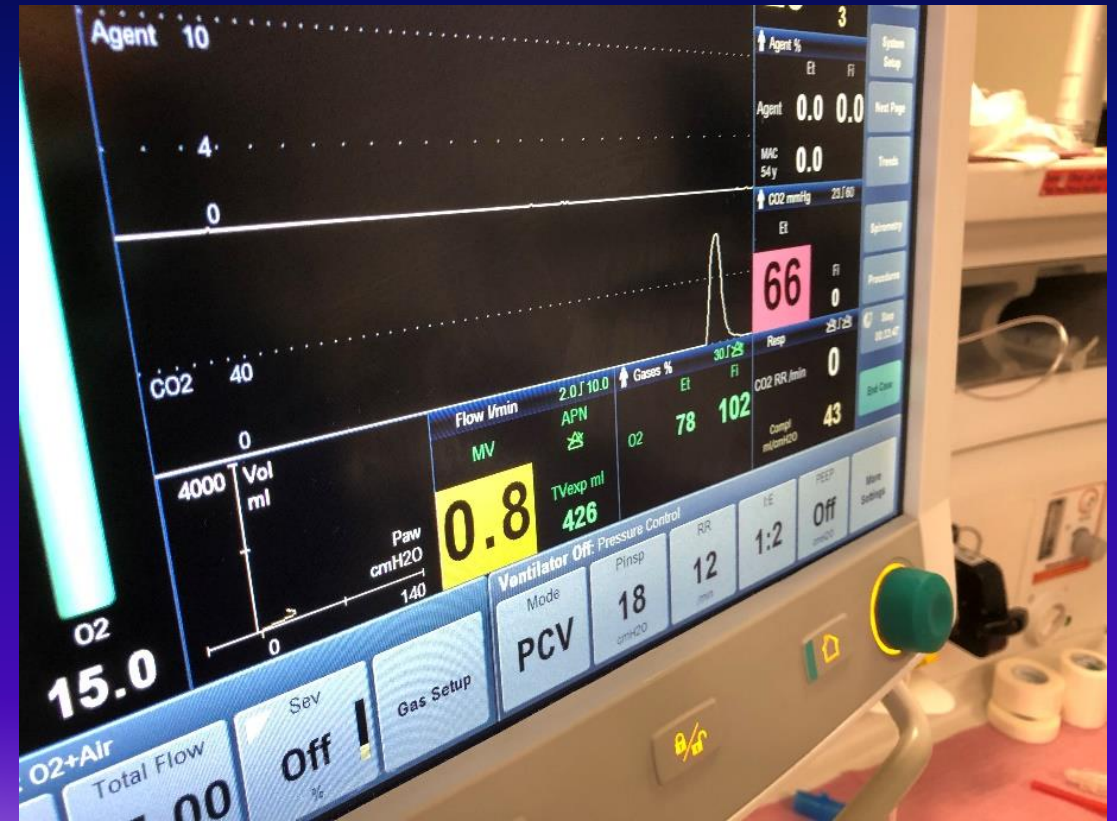


Can We Finally Take the “ $\dot{V}_E$ ” Out of THRIVE?

Allan F. Simpao, M.D., M.B.I., Martin J. London, M.D.

controversy. Their study and the studies of high-flow nasal oxygen in children suggest we can finally take the “ $\dot{V}_E$ ” (which is generally equated with carbon dioxide clearance)

Apneic Ventilation with HFNO



Advantages Over Jet Ventilation

- Easier to be trained on
- No risk of barotrauma
- Does not cause VC mobility or lung excursion
- Can be used pre, intra, and post op
- Warmed, humidified gas flow
- Very helpful when Jet ventilation is challenging
- Cheaper equipment

Intra-oral ignition of monopolar diathermy during transnasal humidified rapid-insufflation ventilatory exchange (THRIVE)

D. Onwode¹, K. El-Boghdady¹, R. Oakley² and I. Ahmad³

- Palate Surgery in a 65 Y/O using HFNO
- Noticed an Arc arising from the diathermy tip
- The Fire Triad:
 - Oxidizer
 - Fuel
 - Energy source



Cadaveric Study on the Safety of High-Flow Nasal Oxygen in Laser Microlaryngeal Surgery

Ellen L. Ferraro, MD ; Nicholas Zura, MS3; Basem B. Abdelmalak, MD, FASA, SAMBA-F;
Ursula Galway, MD; Michael S. Benninger, MD ; Paul C. Bryson, MD MBA 

Safety and Utility of Transnasal Humidified Rapid-Insufflation Ventilatory Exchange (THRIVE) for Laser Laryngeal Surgery

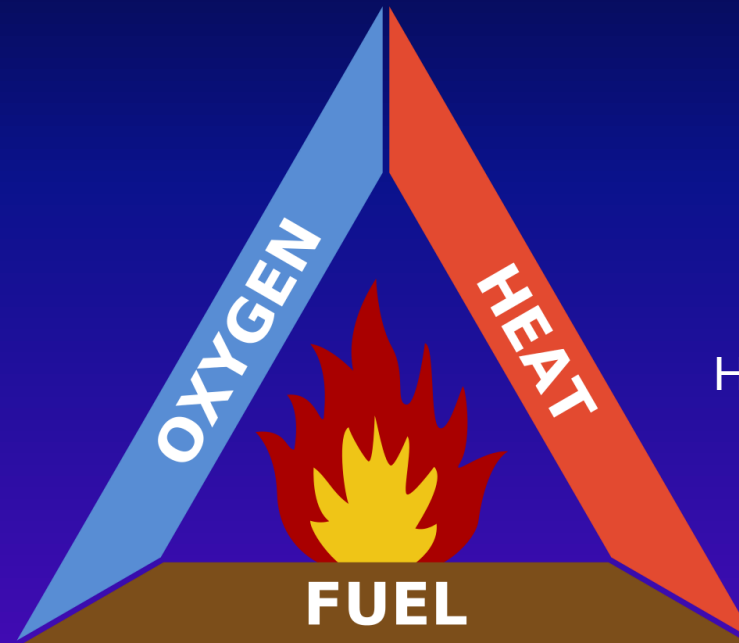
Nergis C. Khan, AB^{1*}, Neelaysh Vukkadala, MD^{1,2*} ,
Amit Saxena, MD³, Edward J. Damrose, MD¹,

Conclusion. By eliminating the fuel component of the fire triangle, THRIVE can be safely used for continuous delivery of high FiO₂ during LLS, provided adherence to institutional THRIVE-LLS protocols.

The Fire Triangle

Oxidizer:

Oxygen
Nitrous oxide



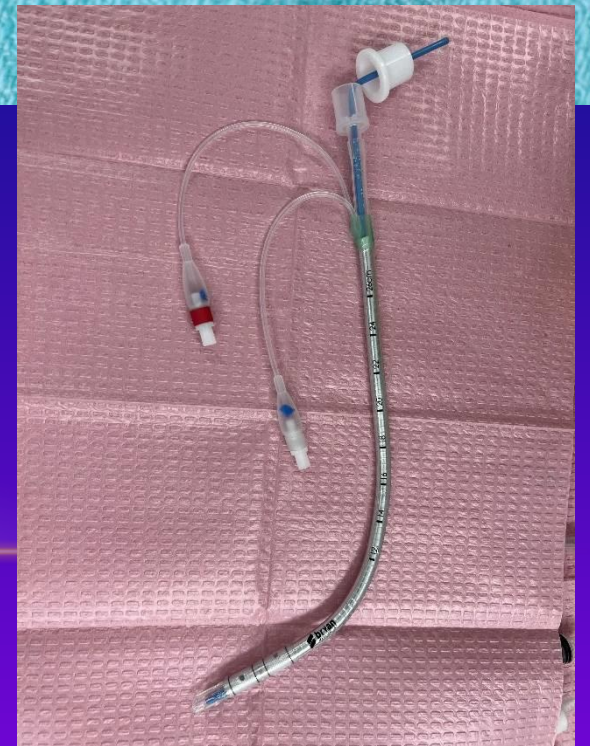
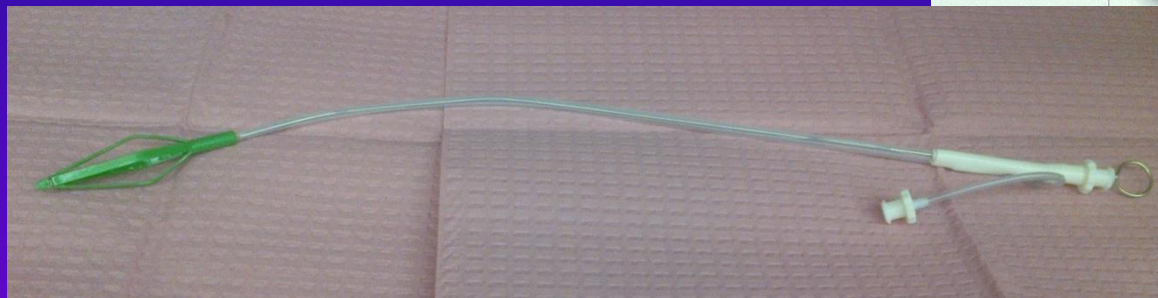
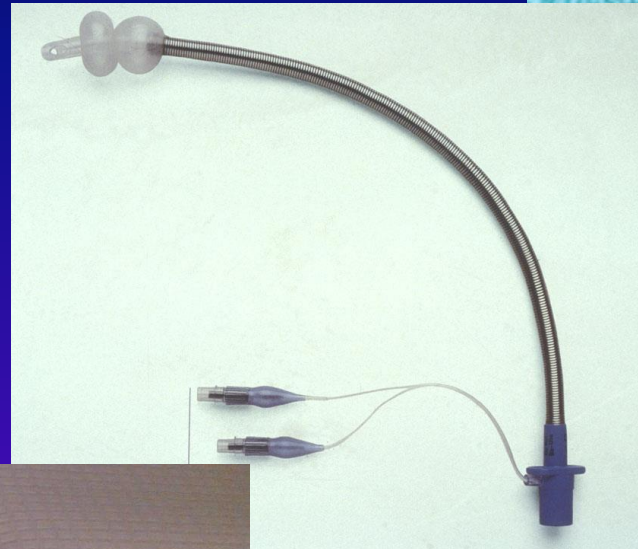
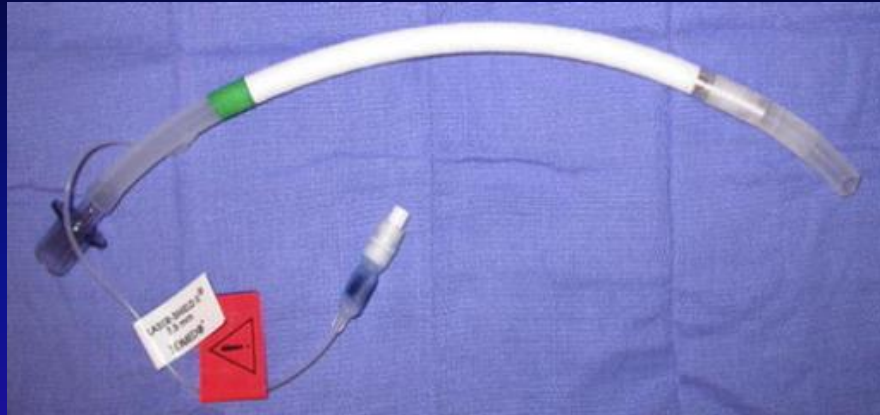
Igniting Energy:

LASER, Cautery
Thermoplasty catheter
Heat-generating light source/drill

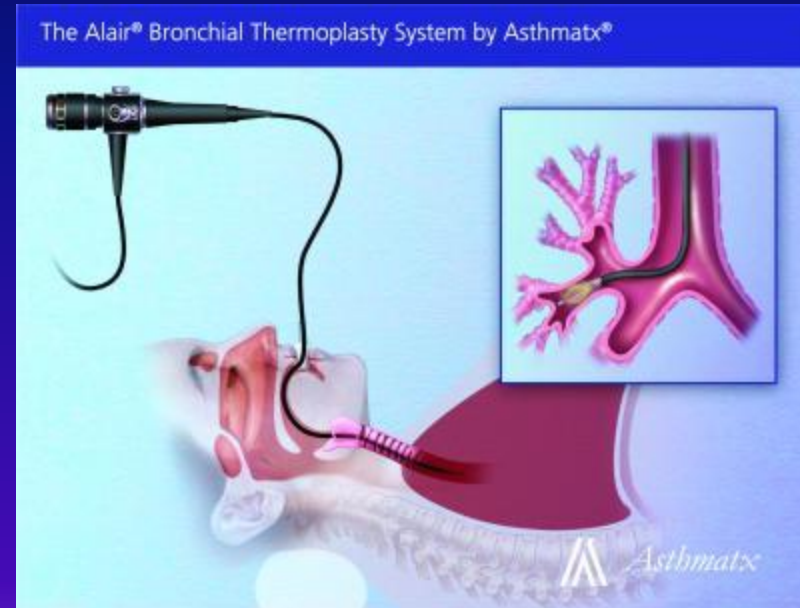
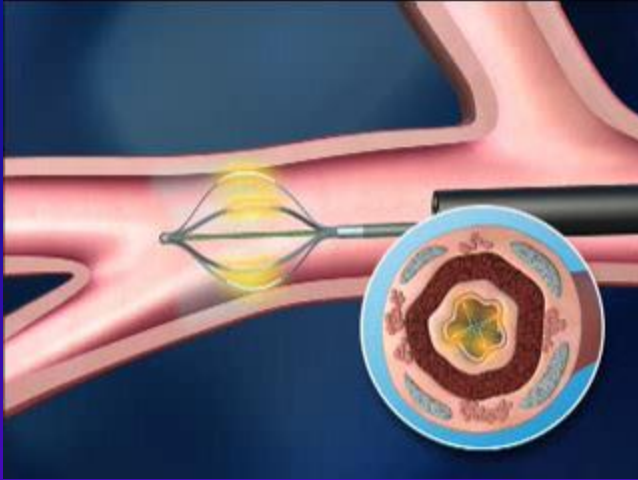
Fuel:

ETT, Drapes

Laser Resistant Tubes



Thermoplasty



Safety Measures: Limitation of Oxidizers

- The FiO_2 should be limited to the lowest concentration necessary to maintain acceptable O_2 sat.
- The balance of the FGF should be nitrogen (air) and/or helium
- Inhalation agents may be added as clinically indicated
- Nitrous oxide should not be used
- Communication

Practice Advisory for the Prevention and Management of Operating Room Fires

Anesthesiology 2013; 118:00-00

An Updated Report by the American Society of Anesthesiologists Task Force on Operating Room Fires

American Society of
Anesthesiologists®

OPERATING ROOM FIRES ALGORITHM

Avoid using ignition sources¹ in proximity to an oxidizer-enriched atmosphere²
Configure surgical drapes to minimize the accumulation of oxidizers
Allow sufficient drying time for flammable skin prepping solutions
Moisten sponges and gauze when used in proximity to ignition sources

Is this a High-Risk Procedure?

An ignition source will be used in proximity to an oxidizer-enriched atmosphere

Team plan and team roles for preventing and managing a fire
Recognition of the presence of, or an increase in, an oxidizer-enriched atmosphere

- Use cuffed tracheal tubes for surgery in the airway; appropriately prepare laser-resistant tracheal tubes
- Consider a tracheal tube or laryngeal mask for monitored anesthesia care (MAC) with moderate to deep sedation and/or oxygen-dependent patients who undergo surgery of the head, neck, or face.
- Before an ignition source is activated:
 - Announce the intent to use an ignition source
 - Reduce the oxygen concentration to the minimum required to avoid hypoxia³
 - Stop the use of nitrous oxide⁴

Fire Management:

Early Warning Signs of Fire⁵

Fire is not present;
Continue procedure

HALT PROCEDURE
Call for Evaluation

FIRE IS PRESENT

AIRWAY⁶ FIRE:

- IMMEDIATELY, without waiting
- Remove tracheal tube
- Stop the flow of all airway gases
- Remove sponges and any other flammable material from airway
- Pour saline into airway

NON-AIRWAY FIRE:

- IMMEDIATELY, without waiting
- Stop the flow of all airway gases
- Remove drapes and all burning and flammable materials
- Extinguish burning materials by pouring saline or other means

If Fire is Not Extinguished on First Attempt

Use a CO₂ fire extinguisher⁷
If FIRE PERSISTS: activate fire alarm, evacuate patient, close OR door, and turn off gas supply to room

Fire out

Fire out

- Re-establish ventilation
- Avoid oxidizer-enriched atmosphere if clinically appropriate
- Examine tracheal tube to see if fragments may be left behind in airway
- Consider bronchoscopy

- Maintain ventilation
- Assess for inhalation injury if the patient is not intubated

Assess patient status and devise plan for management

AIRWAY⁶ FIRE:

IMMEDIATELY, without waiting

- Remove tracheal tube
- Stop the flow of all airway gases
- Remove sponges and any other flammable material from airway
- Pour saline into airway

Fire out

If Fire is Not Extinguished on First Attempt

Use a CO₂ fire extinguisher⁷

If FIRE PERSISTS: activate fire alarm, close OR door, and turn off gas supply to room

- Re-establish ventilation
- Avoid oxidizer-enriched atmosphere if clinically appropriate
- Examine tracheal tube to see if fragments may be left behind in airway
- Consider bronchoscopy

Summary

- Respect and appreciate the ENT Airway!
- Use awake intubation when indicated
- There are many options for airway management, for these procedures depending on the patient comorbidities, and the planned procedure.
- ENT Anesthesia is more than airway management
- Effective communication and team work are essential to successful management of these challenging cases



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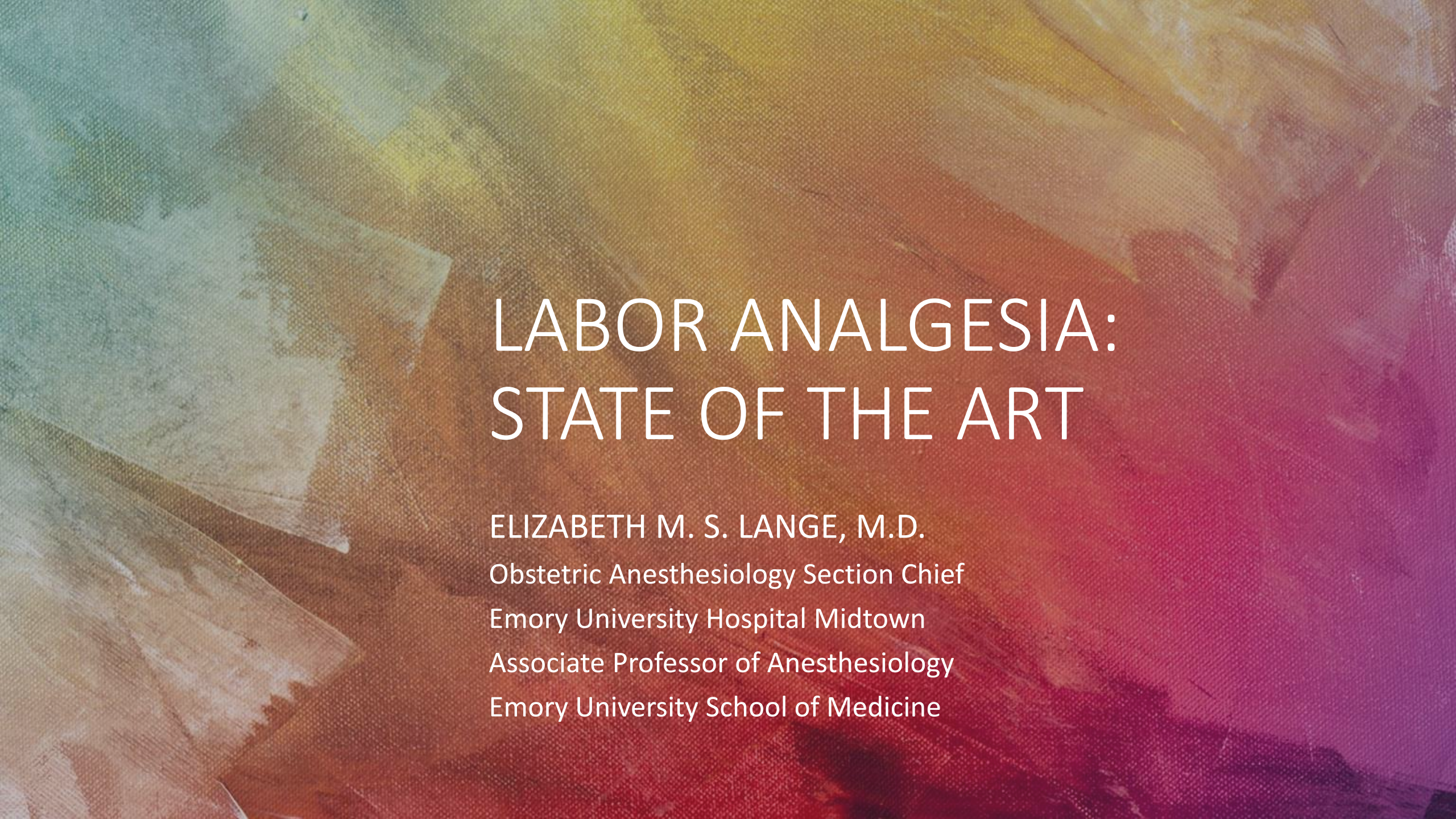
Cleveland Clinic

Every life deserves world class care.

Thank you for your attention
Basem Abdelmalak, MD
abdelmb@ccf.org



@basemcc



LABOR ANALGESIA: STATE OF THE ART

ELIZABETH M. S. LANGE, M.D.

Obstetric Anesthesiology Section Chief

Emory University Hospital Midtown

Associate Professor of Anesthesiology

Emory University School of Medicine

I have no financial disclosures.

Neuraxial Labor Analgesia

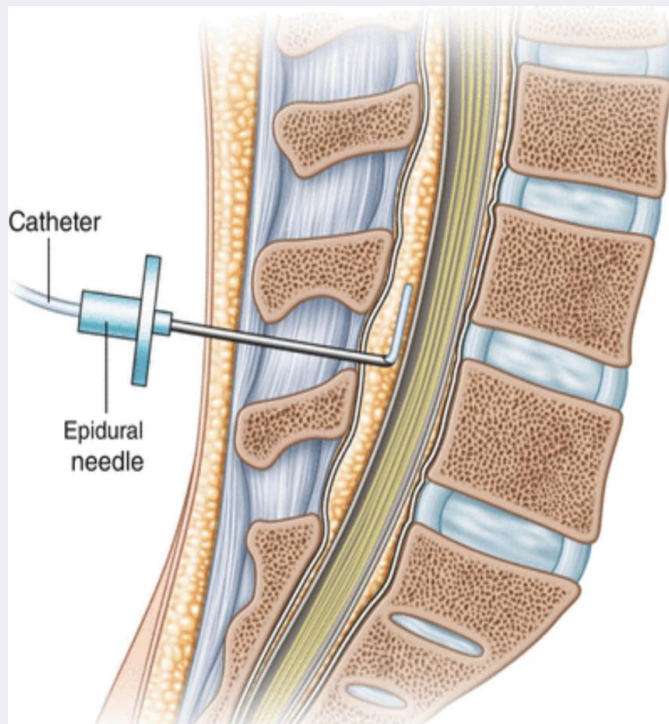
Initiation Techniques

Maintenance Analgesia

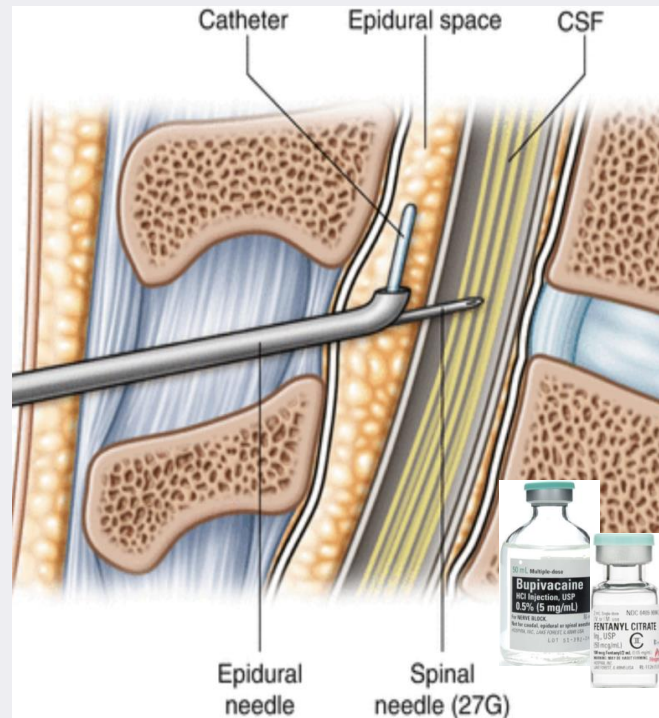
Neuraxial Adjuvants

Initiation of Neuraxial Analgesia

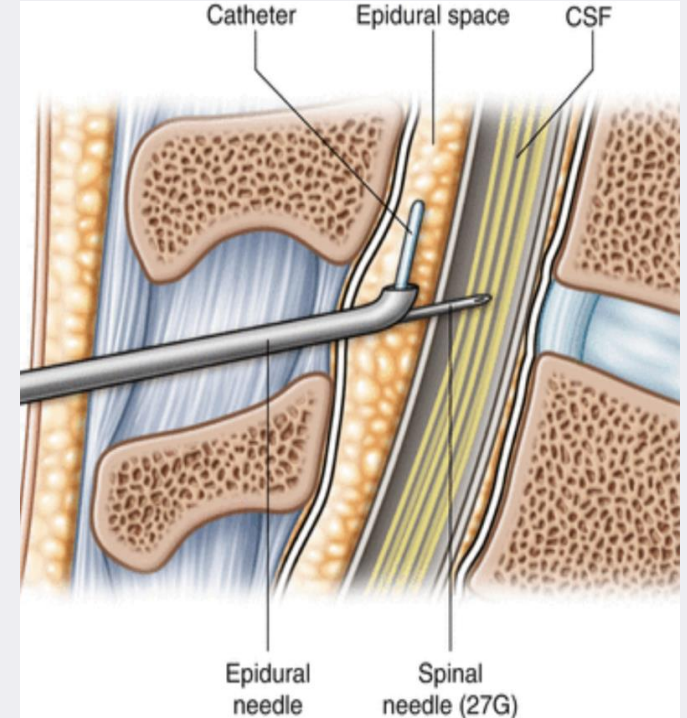
Traditional Epidural Technique



Combined Spinal-Epidural Technique



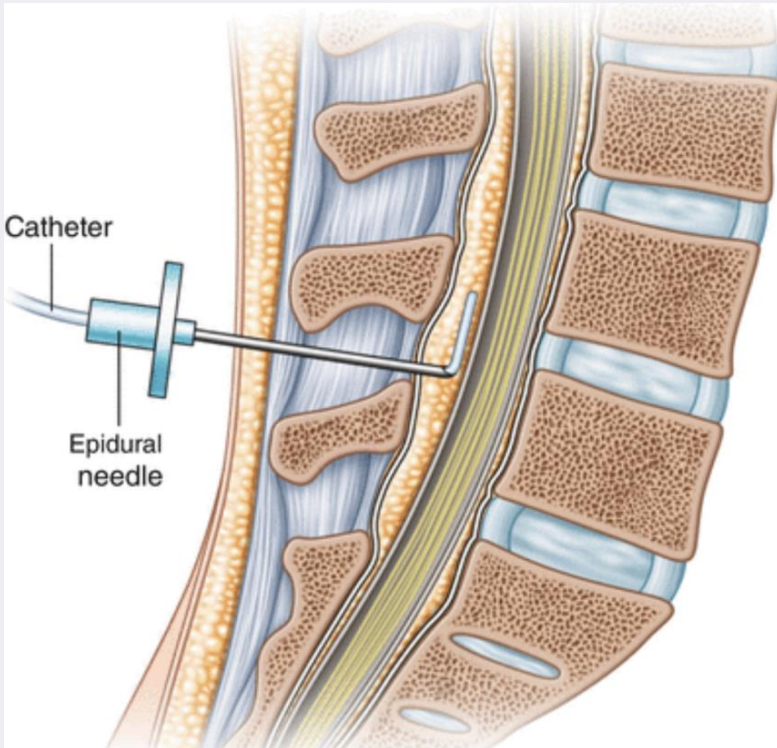
Dural Puncture Epidural Technique



Pictures: Turnbull J.H., Aleshi P. (2015) Spinal and Epidural Anesthesia.

Initiation of Neuraxial Analgesia

Traditional Epidural Technique



Advantages

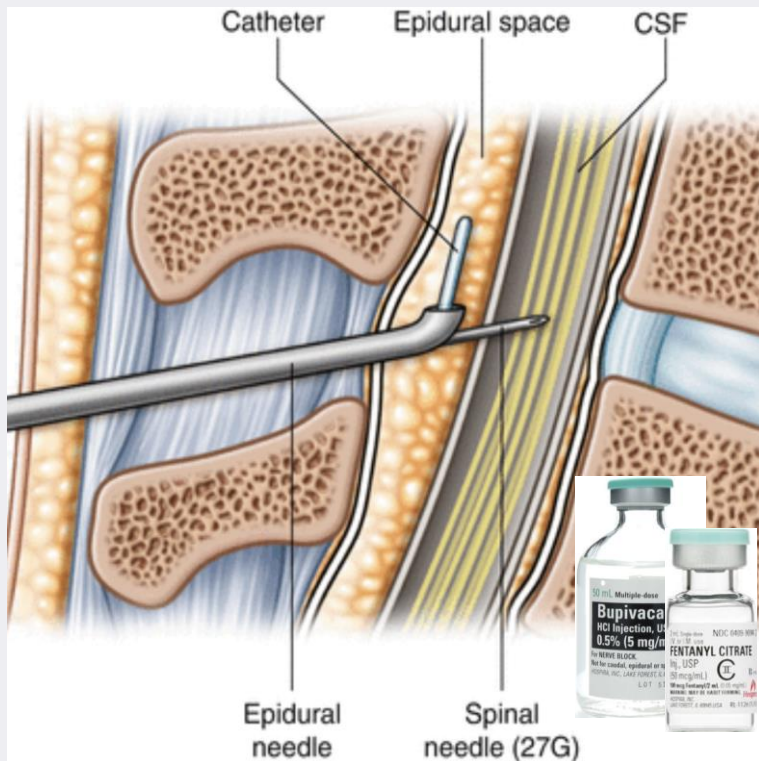
- Targeted titration of analgesia
- Confirmation of catheter function
- Hemodynamic stability

Disadvantages

- Variable blockade
- Inconsistent sacral coverage
- Higher failure rate

Initiation of Neuraxial Analgesia

Combined Spinal-Epidural Technique



Advantages

- Rapid onset
- Uniform sensory block, sacral block
- Decreased local anesthetic consumption
- Lower failure rates

Disadvantages

- Increased risk of hypotension
- FHR abnormalities
- Delayed assessment of epidural catheter

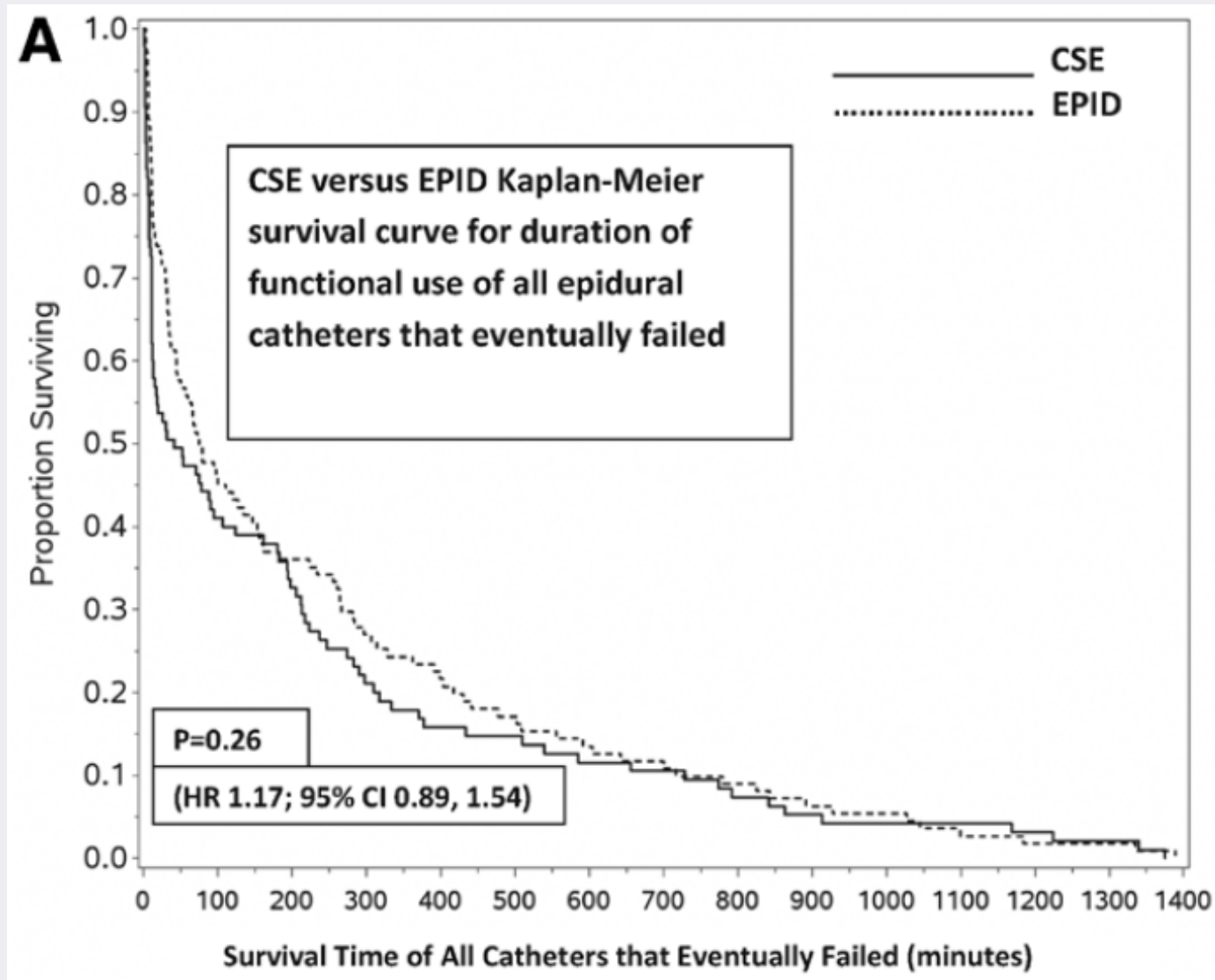
Initiation Neuraxial Analgesia

Types of failures	Epidural	CSE	Total	<i>P</i> value
Neuraxial labor analgesia (n)	7849	4741	12590	
Overall failure rate (%)	14	10	12	<0.000001

Variables	Success (n = 1008)	Failure (n = 17)	Odds ratio (95% CI)	<i>P</i> value
Epidural technique	113 (11)	7(41)	5.54 (2.07-14.85)	0.001
CSE technique	895 (89)	10 (59)		

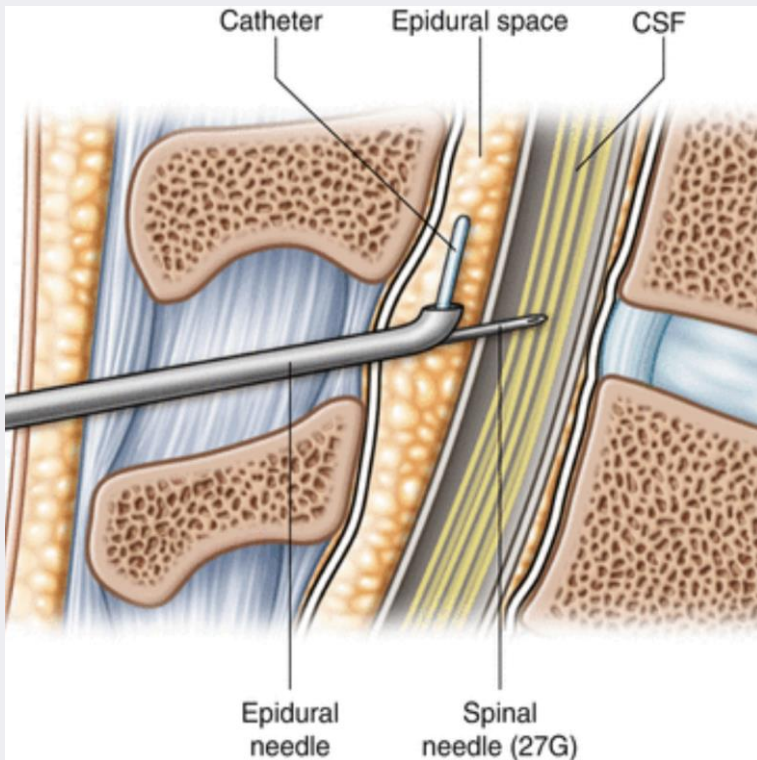
Pan P. Int J Obstet Anesth 2004; 13(4): 227-33.
Booth J. Anesthesiology 2016; 125 (3): 516-24.
Grondin L. Anesthesiology 2009; 111(1): 165-72.
Lee S. Anesth Analg 2009; 108; 252-4.
Gambling D. Anesth Analg 2013; 116(3): 636-43.

Initiation of Neuraxial Analgesia



Initiation of Neuraxial Analgesia

Dural Puncture Epidural Technique



Advantages

- Improved sacral coverage
- Confirmatory midline placement
- Earlier confirmation of functioning catheter
- Few maternal side effects

Disadvantages

- Onset time

Dural Puncture Epidural Technique Improves Labor Analgesia Quality With Fewer Side Effects Compared With Epidural and Combined Spinal Epidural Techniques: A Randomized Clinical Trial

Anthony Chau, Carolina Bibbo, Chuan-Chin Huang, Kelly G Elterman, Eric C Cappiello, Julia N Robinson, Lawrence C Tsen

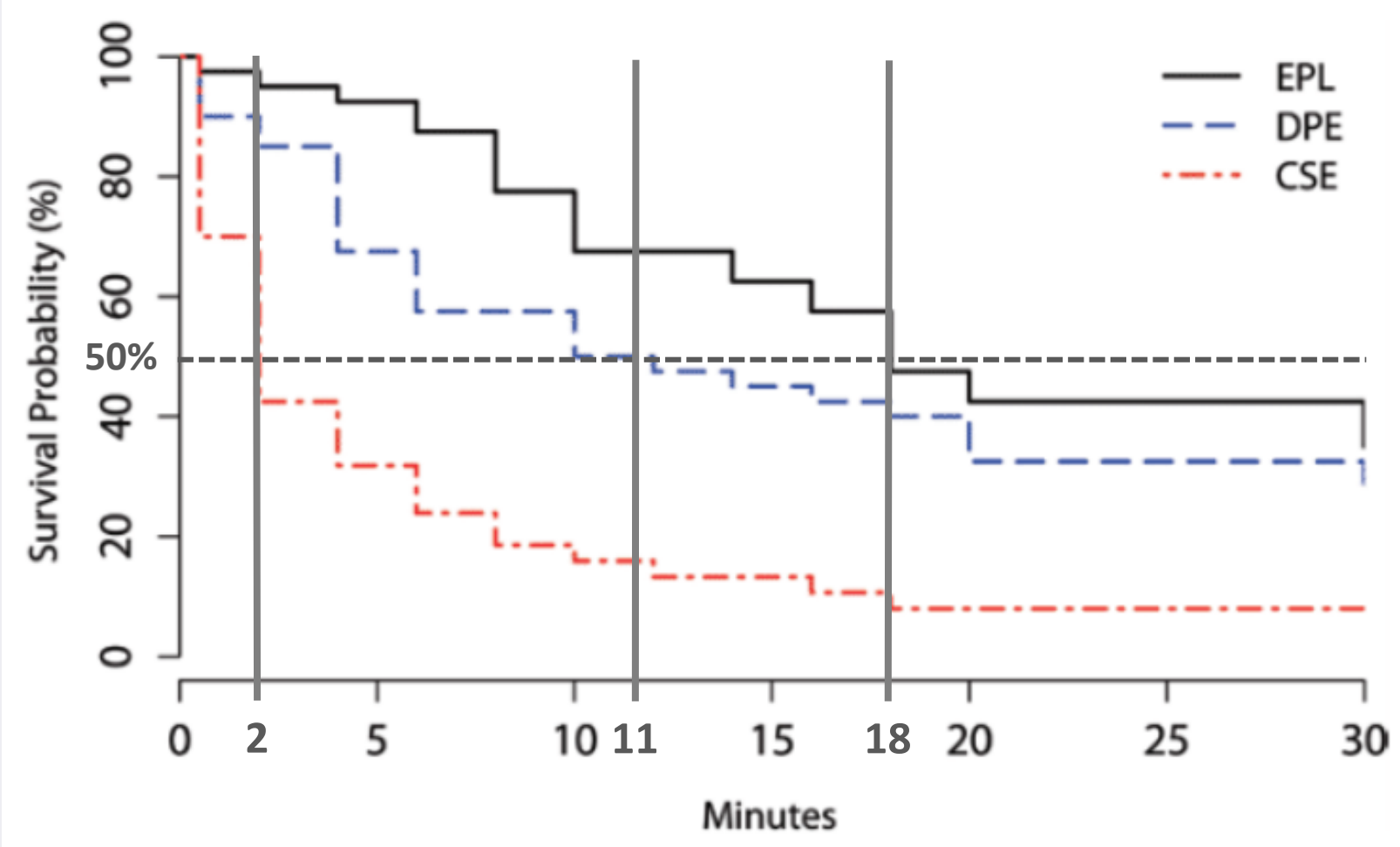
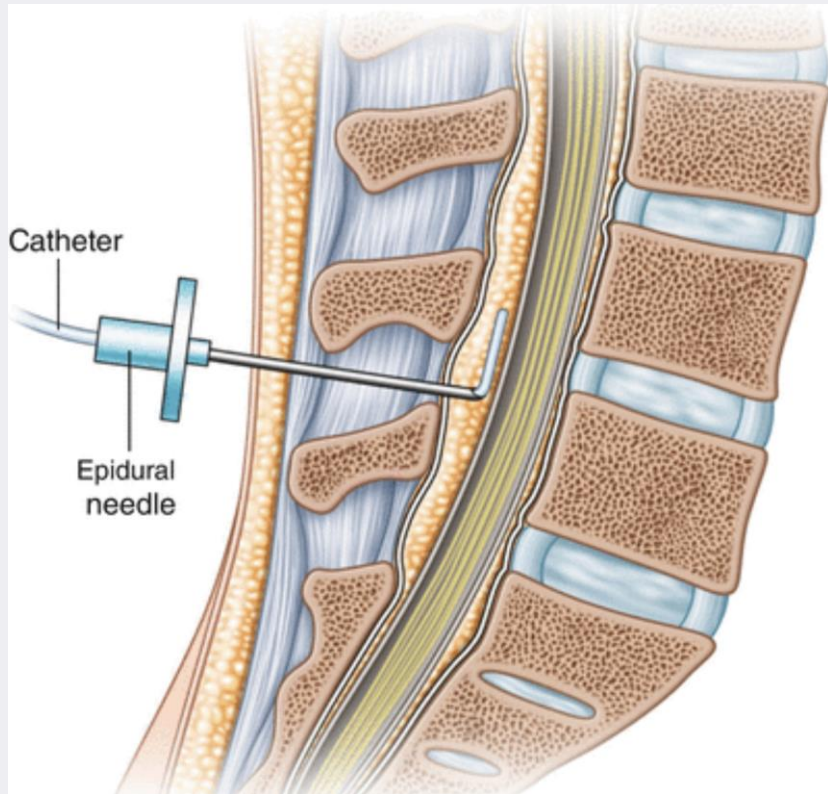


Table 6. Results for Secondary Outcomes and Respective Risk Ratios and 95% Confidence Intervals

	DPE			DPE			CSE		
	EPL as Reference			CSE as Reference			EPL as Reference		
	RR	95% CI	P ^c	RR	95% CI	P ^c	OR	95% CI	P ^c
Block quality									
Bilateral S2 blockade at 10 min	2.13	1.39–3.28	<.001	0.84	0.71–1.00	.043	2.53	1.69–3.80	<.001
Bilateral S2 blockade at 20 min	1.60	1.26–2.03	<.001	1.00	1.00–1.00	∞	1.60	1.26–2.03	<.001
Bilateral S2 blockade at 30 min	1.18	1.01–1.30	.034	1.00	1.00–1.00	∞	1.18	1.01–1.32	.034
Physician top-up intervention	0.45	0.23–0.86	.011	0.45	0.23–0.86	.011	1.00	0.65–1.55	>.999
Asymmetric block first 30 min	0.70	0.44–1.11	.12	2.00	0.97–4.14	.051	0.35	0.18–0.68	.001
Asymmetric block after 30 min	0.19	0.07–0.51	<.001	1.00	0.27–3.72	>.999	0.19	0.07–0.51	<.001
Maternal adverse effects									
Nausea	0.25	0.03–2.14	.17	1.00	0.06–15.44	>.999	0.25	0.03–2.14	.17
Pruritus	1.00	0.27–3.72	>.999	0.15	0.06–0.38	<.001	6.75	2.60–17.53	<.001
Hypotension	1.00	0.31–3.19	>.999	0.38	0.15–0.98	.032	2.60	1.02–6.61	.032
Presence of motor block ^a	0.40	0.15–1.03	.057	1.57	0.38–6.52	.53	0.25	0.07–0.88	.057
Uterine contractions									
Baseline combined UT and UH	1.00	0.42–2.40	>.999	1.33	0.51–3.49	.56	0.75	0.29–1.97	.56
Post-NA combined UT and UH	0.80	0.23–2.76	.72	0.22	0.08–0.60	<.001	3.60	1.48–8.75	.001

Laboratory Assessment Prior to Neuraxial Labor Analgesia



- Neuraxial labor analgesia is gold standard for labor analgesia
- Epidural hematoma devastating consequence

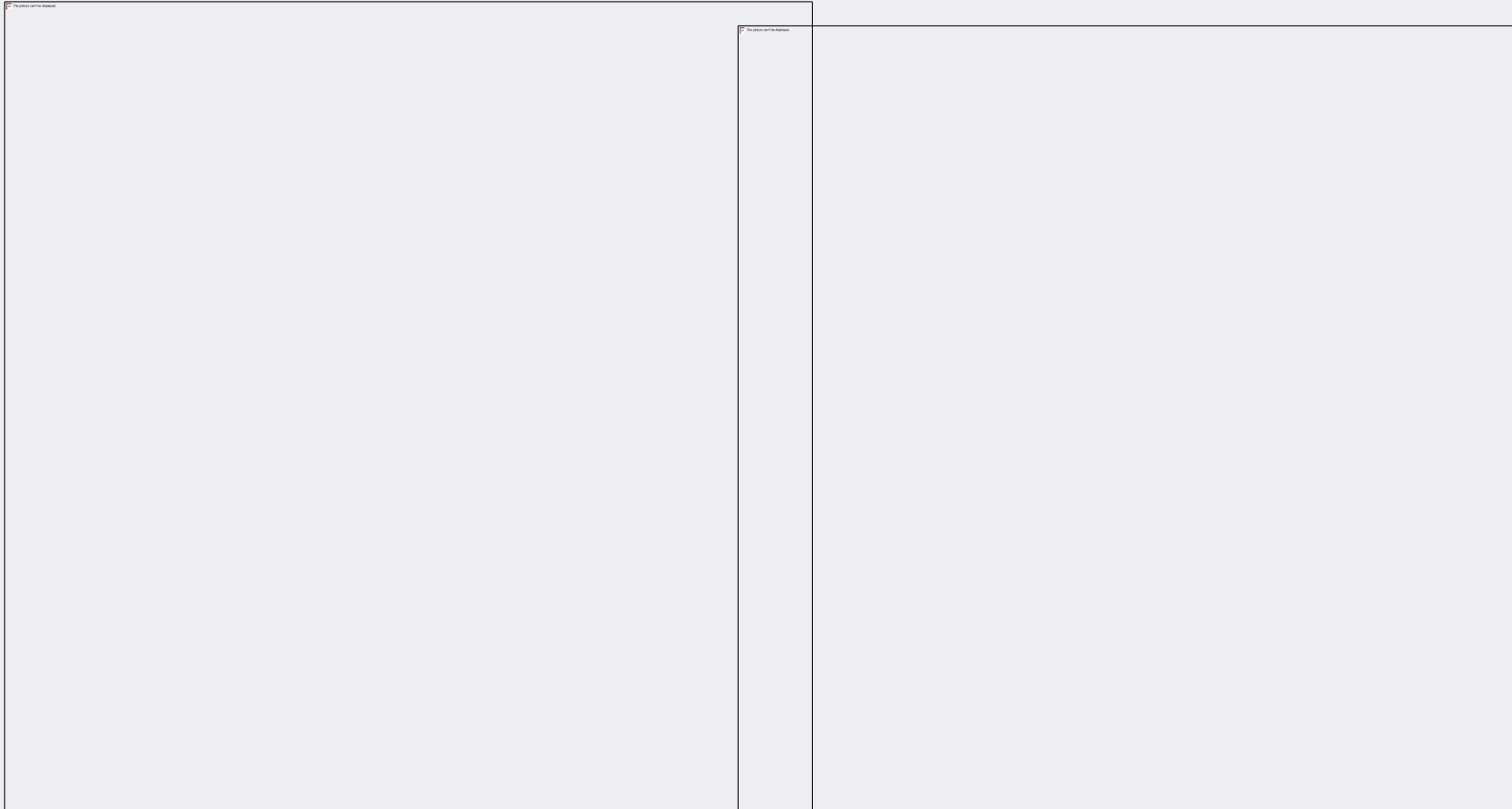
Routine Platelet Count

Intrapartum Platelet Count.

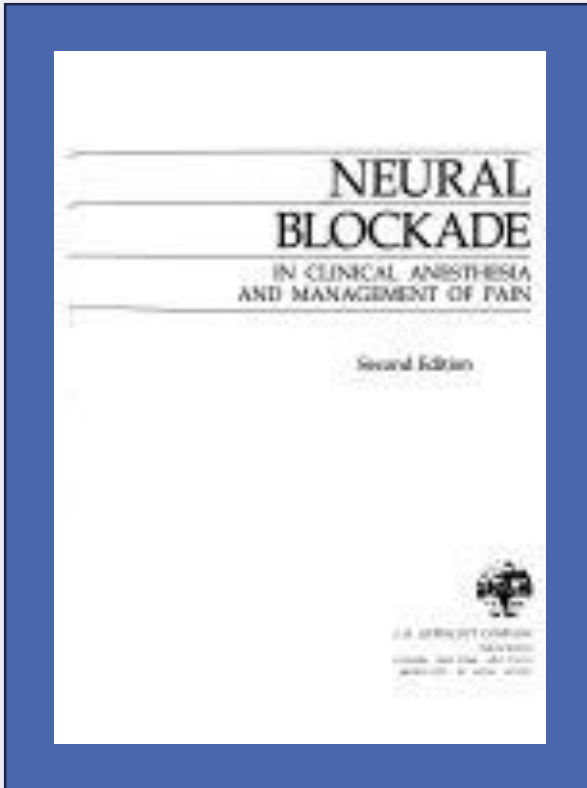
- The anesthesiologist's decision to order or require a platelet count should be individualized and based on a patient's history (*e.g.*, preeclampsia with severe features), physical examination, and clinical signs.#
 - A routine platelet count is not necessary in the healthy parturient.

- History
- Clinical signs
- Physical examination

What's the magic number?



100,000?

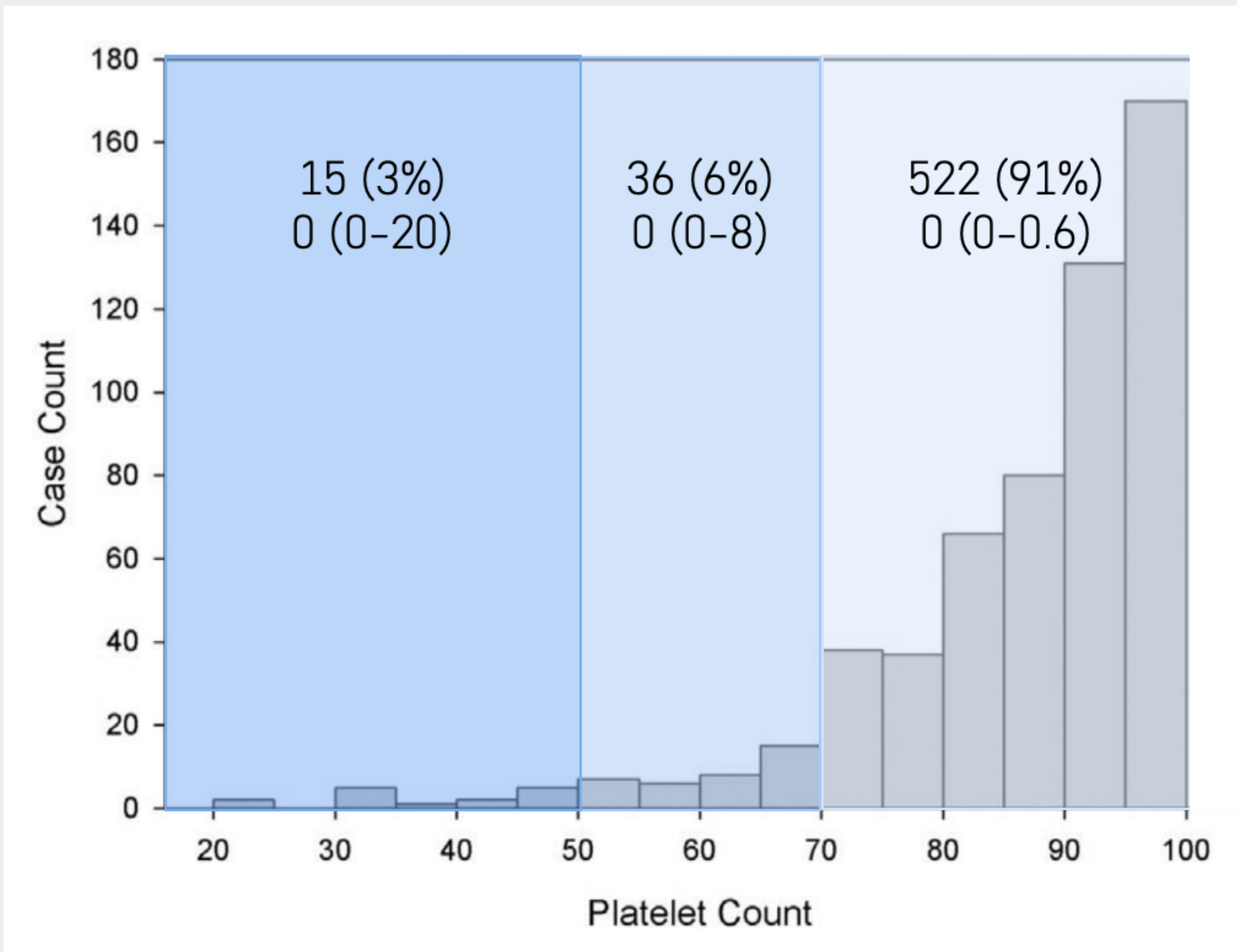


“Epidural puncture should be avoided if platelet count falls below 100,000/mm³”

Cousins MJ, Bromage PR. Neural blockade in clinical anesthesia and management of pain, 1988: 335.

Multicenter Perioperative Outcomes Group

- Inclusion: pregnant patients, platelet count $<100,000$, AND neuraxial anesthesia
- Performed a literature search with same inclusion criteria to expand denominator
- Patients stratified by platelet count
- Estimate risk of epidural hematoma



MPOG + Systematic Review

Platelet Range (mm ⁻³)	n (%)	Frequency of Epidural Hematoma Requiring Surgical Decompression	95% CI for Risk of Epidural Hematoma, %
0-49,000	27 (2)	0	0-11
50,000-69,000	89 (6)	0	0-3
70,000-100,000	1286 (84)	0	0-0.2

Platelet Disorders

Disorder	Incidence	Process	Platelet Function
Gestational thrombocytopenia	5-11%	Static	Normal
Idiopathic thrombocytopenic purpura	<1%	Static	Normal
Preeclampsia	5-8%	Dynamic	Abnormal
HELLP syndrome	<1%	Dynamic	Abnormal

The Society for Obstetric Anesthesia and Perinatology Interdisciplinary Consensus Statement on Neuraxial Procedures in Obstetric Patients With Thrombocytopenia

- Recommendation for neuraxial anesthesia in face of thrombocytopenia
- Composition: 4 hematologists, 2 obstetricians, 9 anesthesiologists, 1 statistician, 1 library scientists



Clinical history concerning for bleeding associated with thrombocytopenia or an underlying disorder of hemostasis (Table 2)
or
Current signs of coagulopathy (bleeding from IV sites, catheters; new mucocutaneous bleeding)

Clinical History

NO

YES

Etiology of thrombocytopenia

It may be reasonable to avoid neuraxial procedures (Class IIb, Level C-LD)

Unknown etiology

Immune Thrombocytopenia

Gestational Thrombocytopenia

Hypertensive disorders of pregnancy

Etiology

Consistent with HELLP Syndrome?

NO

YES

Platelet count within 6 hours?

YES

NO

Is the platelet count $> 70,000 \times 10^6/L$?

$70,000 \times 10^6/L$

YES

NO

count (Class IIb, Level C-LD)

Likely to be low risk for spinal epidural hematoma, May be reasonable to proceed with neuraxial procedure* (Class IIa, Level C-LD)

Known etiology of thrombocytopenia

NO

YES

For cases with unknown etiology of thrombocytopenia, additional hematologic workup may be beneficial prior to proceeding with neuraxial procedures (Class IIb, Level C-LD)

Data are limited.
For platelet count between $50,000$ and $70,000 \times 10^6/L$, there may be scenarios when competing risks/benefits justify proceeding with neuraxial procedure* (Class IIb, Level C-LD)

For platelet count $< 50,000 \times 10^6/L$, there may likely be an increased risk of spinal epidural hematoma; it may be reasonable to avoid neuraxial procedure* (Class IIb, Level C-LD)

Maintenance Analgesia: Choice of Infusion

Bupivacaine	0.5%	0.2%	0.1%
	Group 1 (n = 19)	Group 2 (n = 19)	Group 3 (n = 20)
VAS before test	8.1 ± 1.6	7.9 ± 1.8	8.5 ± 1.1
Time between test and study dose	9 ± 3	10 ± 3	9 ± 4
VAS after test	7.1 ± 1.7	6.5 ± 2.3	6.2 ± 2.7
Onset (min)	12 ± 8	7 ± 2	11 ± 6*
Time to minimum VAS (min)	22 ± 10	14 ± 7	22 ± 12*
Minimum VAS	4.37 ± 2.57	0.88 ± 1.34 [†]	0.25 ± 0.61 [†]
Duration (min)	43 ± 21 [†]	100 ± 26 [†]	120 ± 21 [†]
Number of dermatomes blocked			
Left	5 ± (3)	9 ± (3) [†]	9 ± (2) [†]
Right	4 ± (3)	8 ± (3) [†]	9 ± (3) [†]

Maintenance Analgesia: Choice of Infusion

	Bupivacaine 0.125% (w/v)	Bupivacaine 0.25% (w/v)
MLAV		
Up-down analysis (mL)	13.6 (12.4–14.8)	9.2 (6.9–11.5)
Probit (mL)	13.5 (11.4–15.9)	8.6 (7.2–10.3)
MLAD		
Up-down analysis (mg)	17.0 (15.5–18.5)	23.1 (17.2–28.9)
Probit (mg)	16.8 (14.2–19.9)	21.5 (17.9–25.7)

MLAV = Minimum local analgesic volume; MLAD = minimum local analgesic dose.

Maintenance Analgesia: Choice of Infusion

Epidural Use Only

Fentanyl Citrate

2 mcg per mL
(200 mcg per 100 mL)

and **Bupivacaine HCl**

0.1%

Injection

100 mL total volume in a 100 mL Yellow Cassette Reservoir
in Sodium Chloride 0.9%

NDC 61553-869-48 CII
Service Code 2K8869
Lot# MB3610001L

Store at room temp. Rx Only. Use as directed. Protect from light.
PharMEDium Services, LLC 912 N. Davis Ave. Cleveland, MS 38732 800-523-7749

This is a Compounded Drug. Not for Resale. Hospital/Office Use Only.

Epidural Use Only

Bupivacaine HCl

0.25%

400 mL total volume in a 400 mL Infusion Bag
in Sodium Chloride 0.9%

Injection

NDC 7110-020-07
Service Code 2K8120
Lot# MB1730001L

Store at room temp. Rx Only. Use as directed.
PharMEDium Services, LLC 912 N. Davis Ave. Cleveland, MS 38732 800-523-7749

This is a Compounded Drug. Not for Resale. Hospital/Office Use Only.

COMET. Lancet 2001; 358: 19-23.
Sultan P. Can J Anesth 2013; 60: 840-54.

Effects of Epidural Labor Analgesia With Low Concentrations of Local Anesthetics on Obstetric Outcomes: A Systematic Review and Meta-analysis of Randomized Controlled Trials

Ting-Ting Wang, Shen Sun , Shao-Qiang Huang

Table 2. Results of Meta-analysis of the Comparison of Epidural Labor Analgesia With Low Concentrations of Local Anesthetics With Nonepidural Analgesia						
Outcomes	Trails	Participants	Statistical Method	Effect Estimate	I ²	P
Duration of second stage (min)	8	1445	RE, MD, 95% CI	5.71 [−6.41, 17.83]	94%	.36
Instrumental birth rate	8	1442	RE, RR, 95% CI	1.52 [0.97, 2.40]	38%	.07
Cesarean delivery rate	9	1681	FE, RR, 95% CI	0.80 [0.6, 1.05]	0%	.11
Duration of first stage (min)	4	438	FE, MD, 95% CI	17.34 [−5.89, 40.56]	0%	.14
Spontaneous vaginal delivery rate	6	1456	RE, RR, 95% CI	0.98 [0.91, 1.06]	25%	.62

Maintenance Analgesia: Choice of Infusion

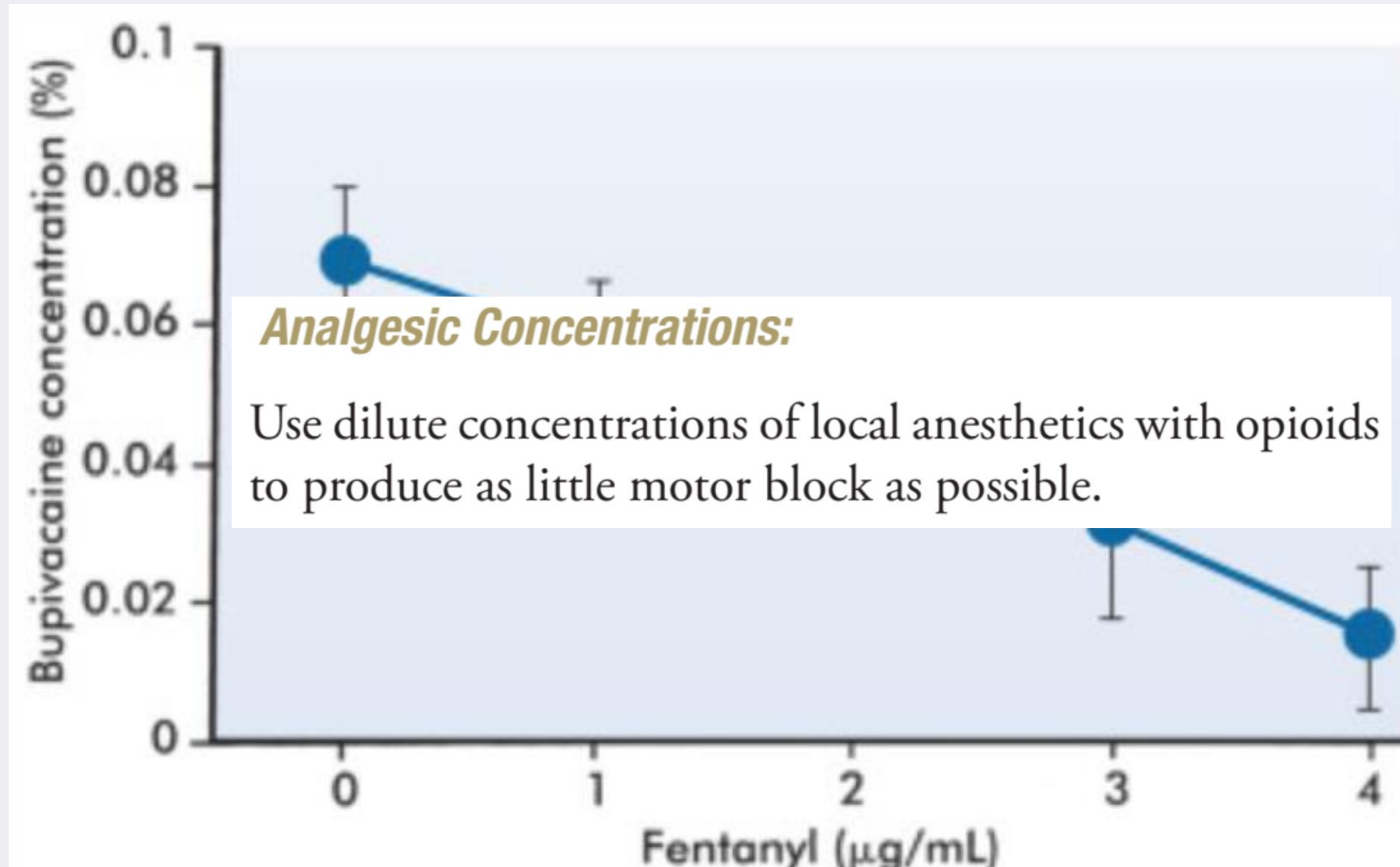
Use of low-concentration local anesthetic solutions with neuraxial opioids for administering neuraxial labor analgesia



Low concentration local anesthetic solutions for administering neuraxial labor analgesia

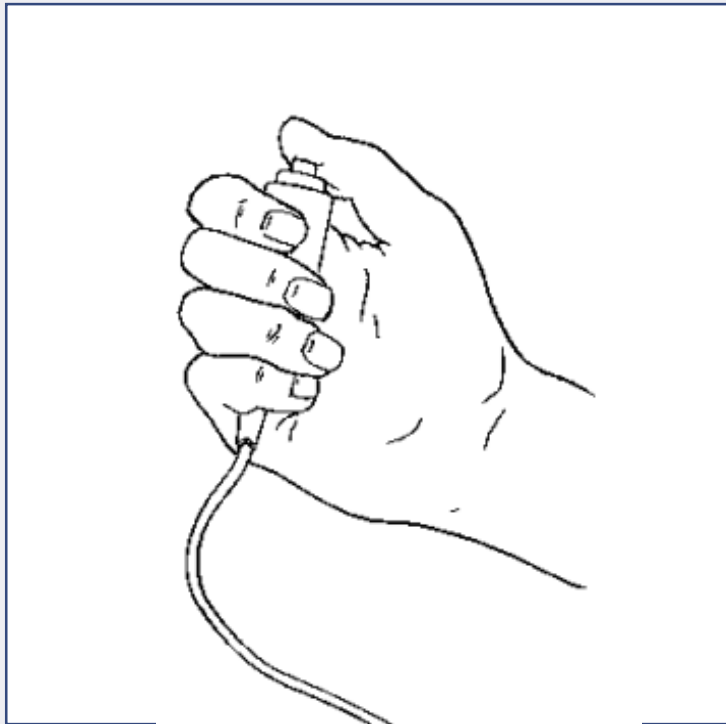
*Describe your use of low concentration local anesthetic solutions. Ideally $\leq 0.1\%$ bupivacaine or $\leq 0.15\%$ ropivacaine.

Maintenance Analgesia: Choice of Infusion



Maintenance Analgesia: Delivery Technique

Patient-Controlled Epidural Analgesia



Picture: phoenixchildrens.org

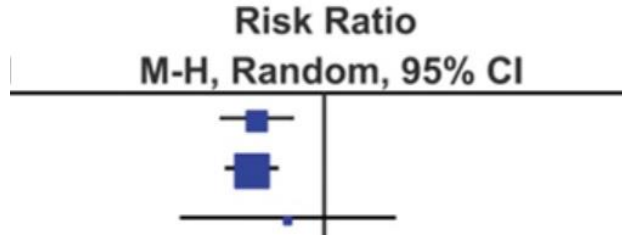
- Decrease total local anesthetic used
- Decrease incidence of motor blockade
- Decrease in provider administered supplemental analgesia
- Improved quality of analgesia
- Improved satisfaction

Gambling D. Can J Anaesth 1988; 35: 249-54.

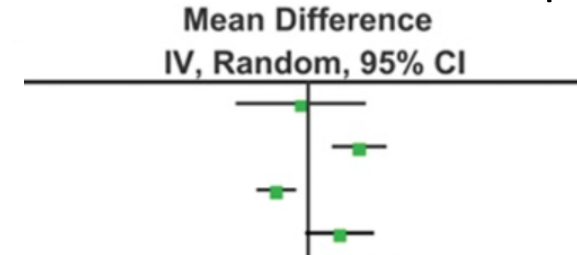
Halpern S. Anesth Analg 2009; 108: 921-8.]

van der Vyver M. Br J Anaesth 2002; 89: 459-65.

Provider-Administered Redose

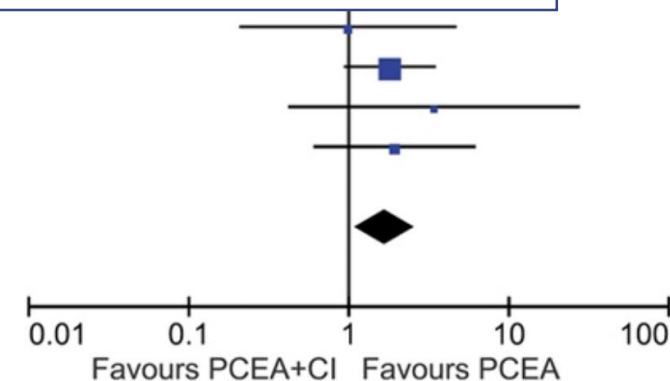
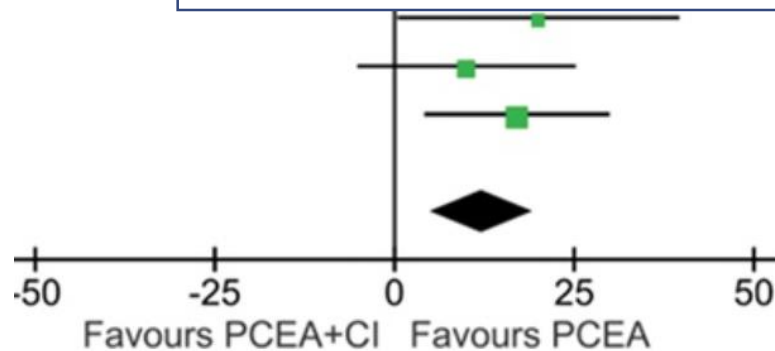


Local Anesthetic Consumption



Patient-controlled Epidural Analgesia:

- Patient-controlled epidural analgesia may be used to provide an effective and flexible approach for the maintenance of labor analgesia.
- The use of PCEA may be preferable to fixed-rate CIE for administering reduced dosages of local anesthetics.
- PCEA may be used with or without a background infusion.

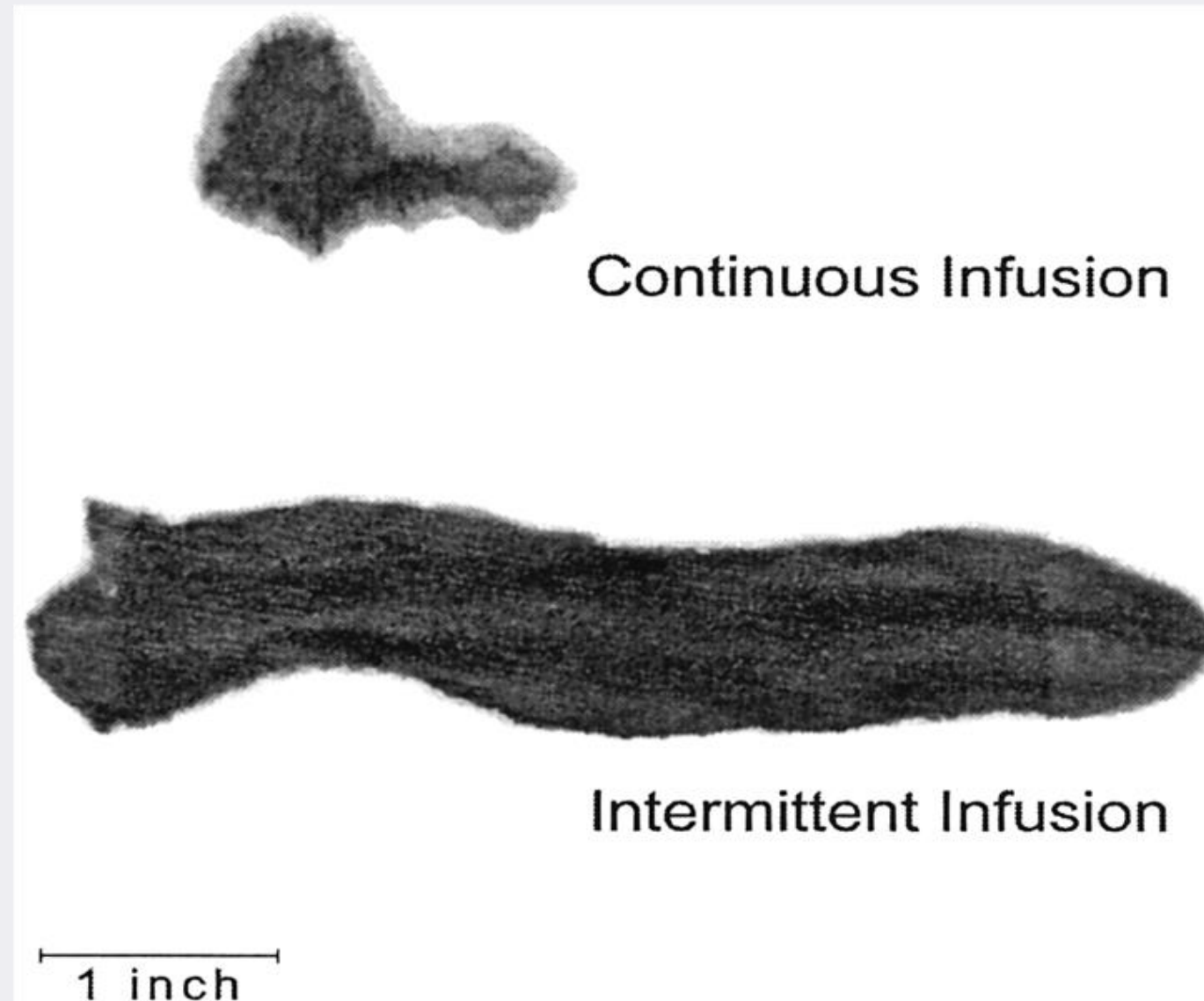


Maintenance Analgesia: Delivery Technique

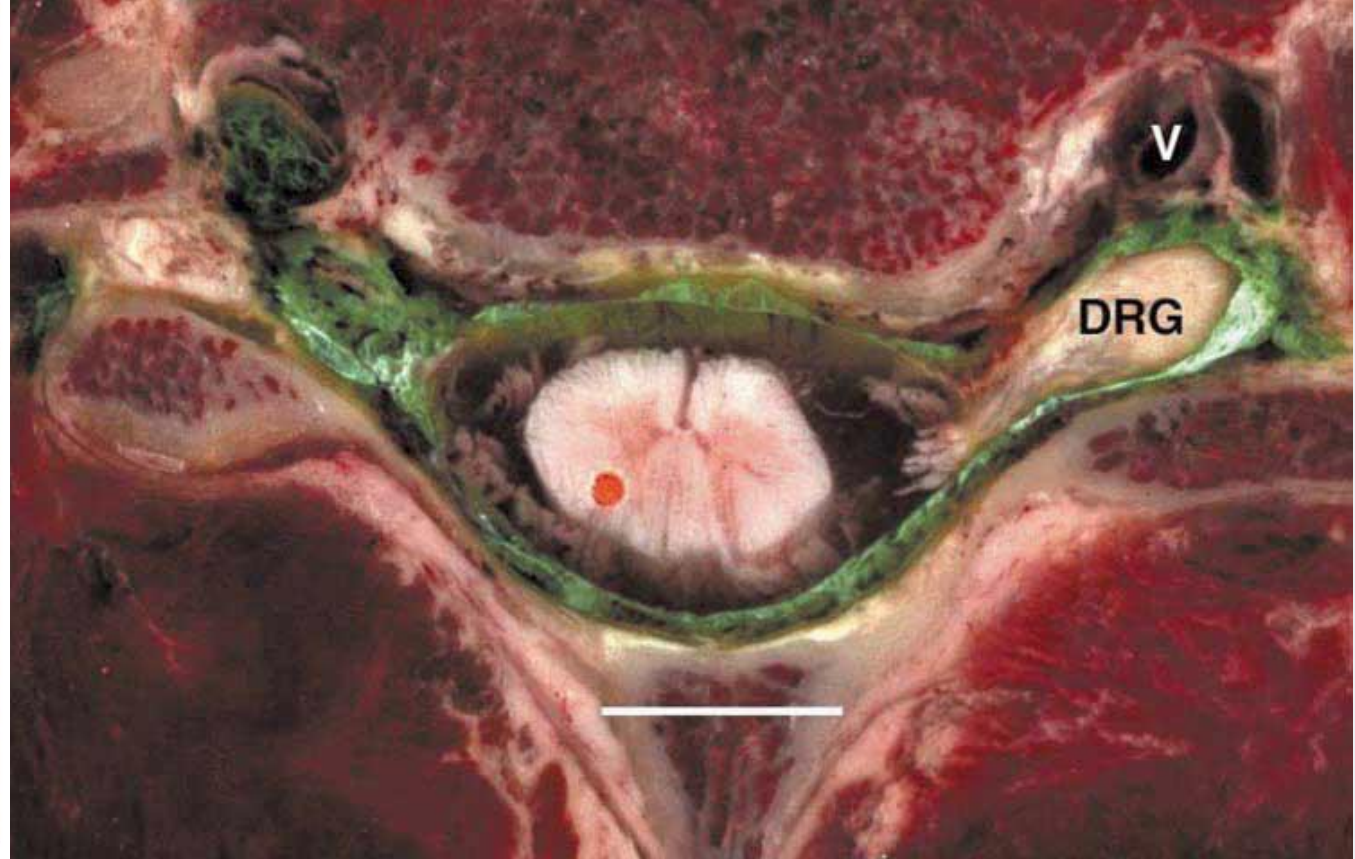
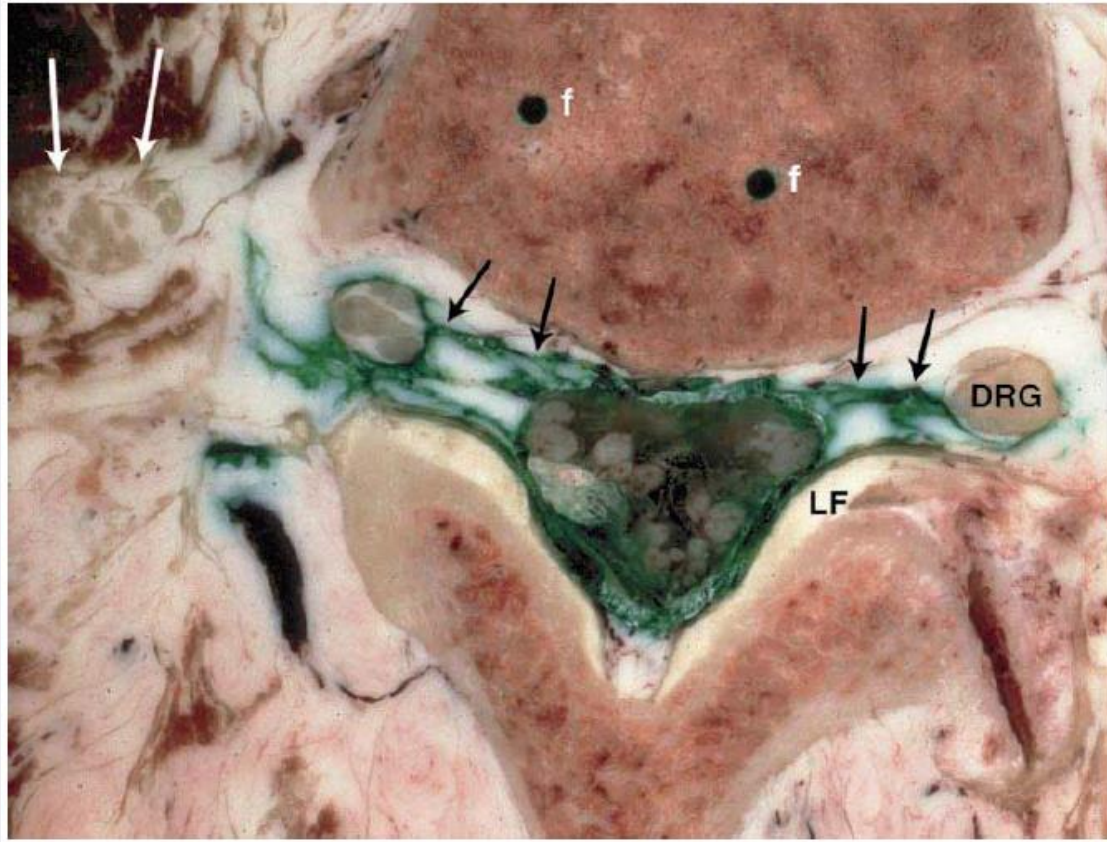
Table 3. Studies Comparing Bolus Volumes and Lockout Intervals for Labor Patient-Controlled Epidural Analgesia

References	Parity	N	Drug and concentration	Bolus volume and lockout interval	Comments	Outcomes
Change lockout interval only						
Stratmann et al. ³⁰	Mixed	60	B 0.125%, F 2 µg/mL	Bolus 5 mL Lockout Group 1: 5 min Lockout Group 2: 15 min	Continuous infusion of 6 mL/h for all patients. Patients and caregivers blinded. Groups unbalanced for parity.	All outcomes measured. No significant difference in any outcomes.
Change bolus volume and lockout interval						
Gambling et al. ²⁷	Nulliparous	55	B 0.125%, F 2.5 µg/mL, E 1:400,000	Group A: bolus 2 mL, lockout 10 min Group B: bolus 3 mL, lockout 15 min Group C: bolus 4 mL, lockout 20 min Group D: bolus 6 mL, lockout 20 min	Five PCEA groups, one continuous infusion group (not reported here). No continuous infusion in the PCEA groups. Patients and investigators blinded.	All outcomes were measured. No differences between groups for any outcome.
Bernard et al. ³²	Mixed	203	B 0.125, S 0.625 µg/mL, E 1:800,000	Group 1: bolus 4 mL, lockout 8 min Group 2: bolus 12 mL, lockout 25 min	No background infusion. Patients and investigators blinded.	Motor block was not measured. Significantly better analgesia in Group 2 at 6 and 9 cm dilation. Better maternal satisfaction in Group 2. No difference in clinician workload between groups.
Bernard et al. ²⁸	Nulliparous	75	R 0.1%, F 1 µg/mL	Group 1: bolus 12mL Group 2: bolus 16mL Group 3: bolus 20 mL	No background infusion. Lockout 25 min for all groups. Patients and caregivers blinded. In 3 groups (N = 75, not reported here) the bolus was reduced by 1/2 and the concentration of R and F doubled after 4 cm dilation (see Table 4). All patients on oxytocin infusions.	All outcomes were reported. There were no differences between groups.

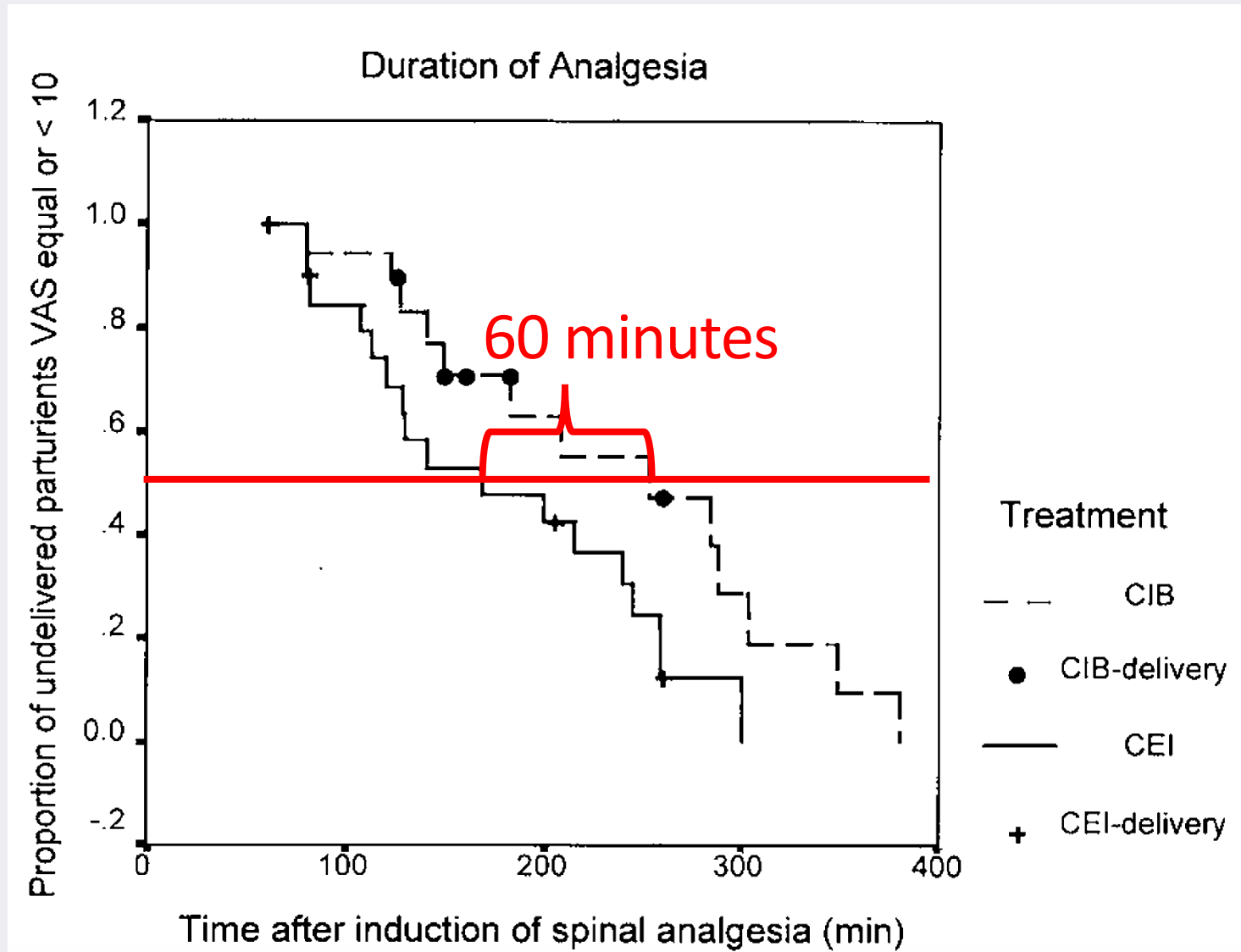
Maintenance Analgesia: Delivery Technique



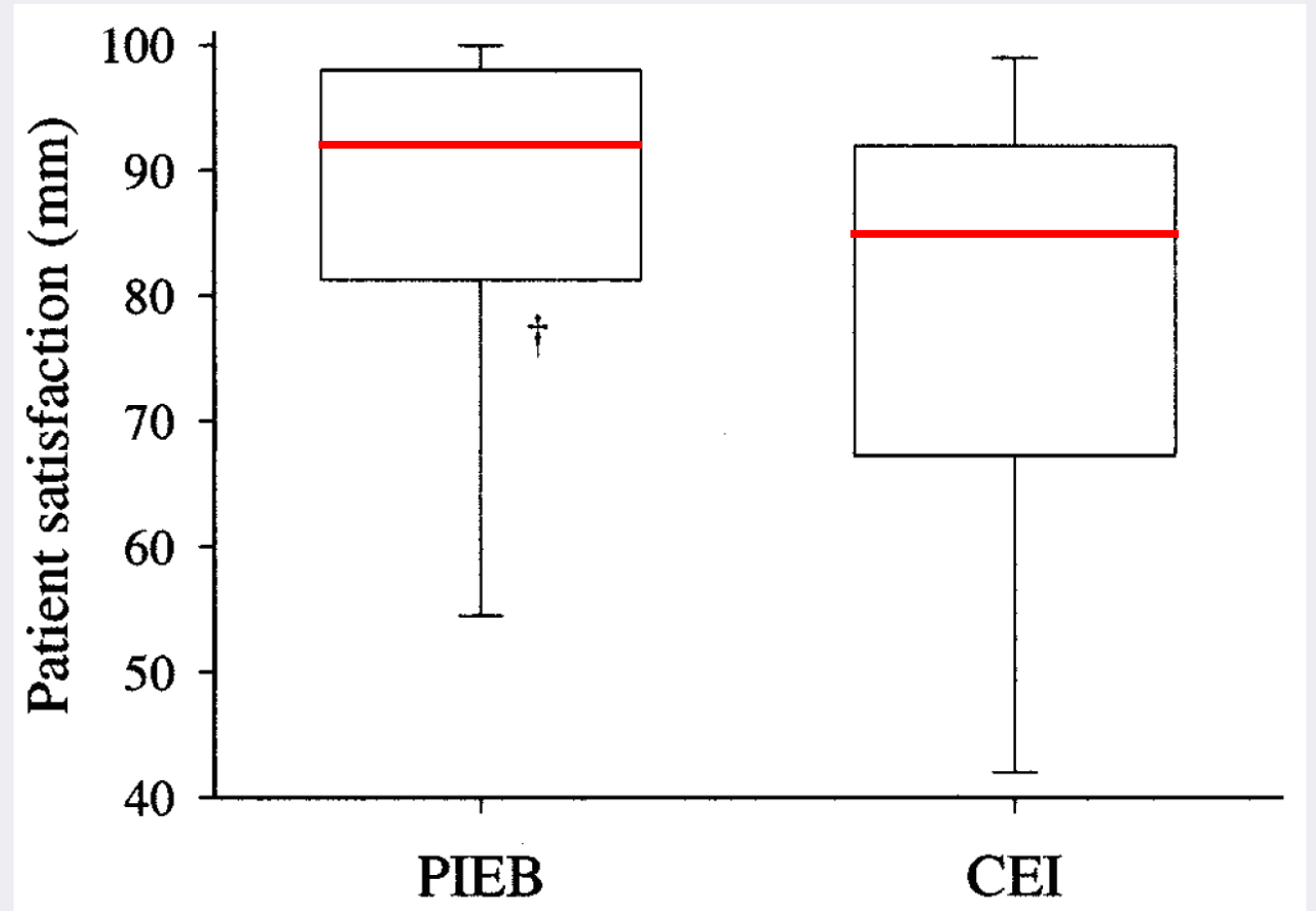
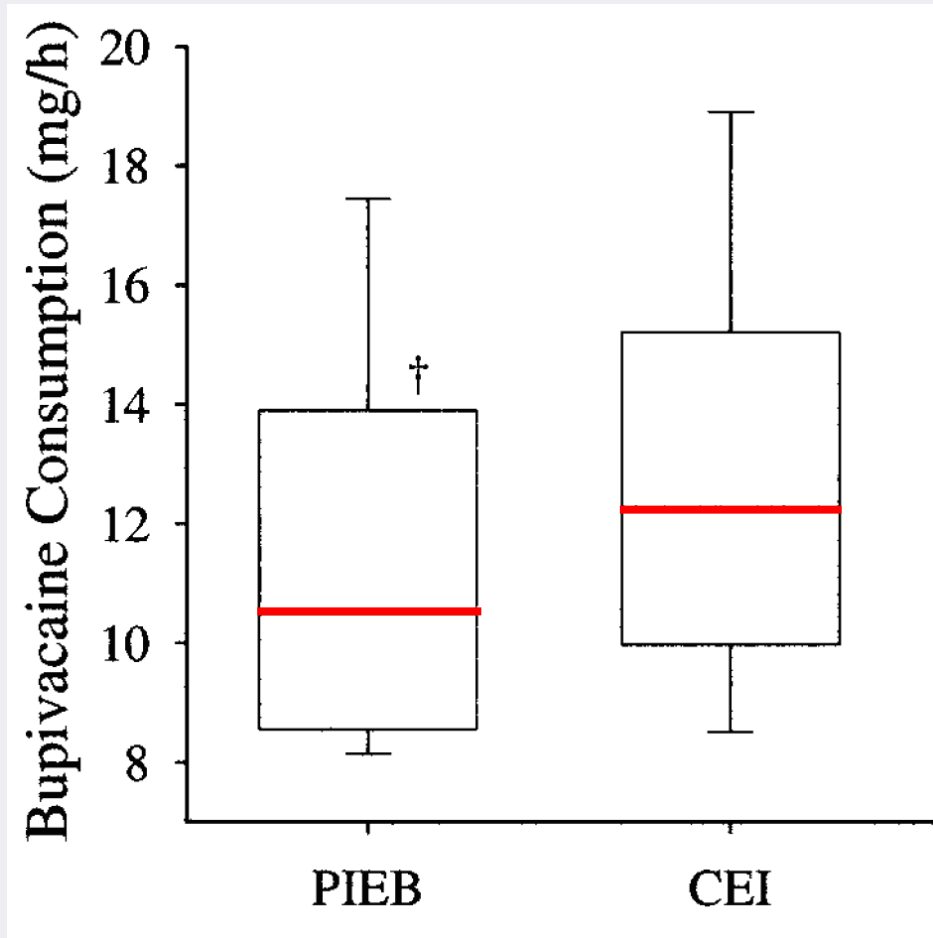
Maintenance Analgesia: Delivery Technique



Maintenance Analgesia: Delivery Technique

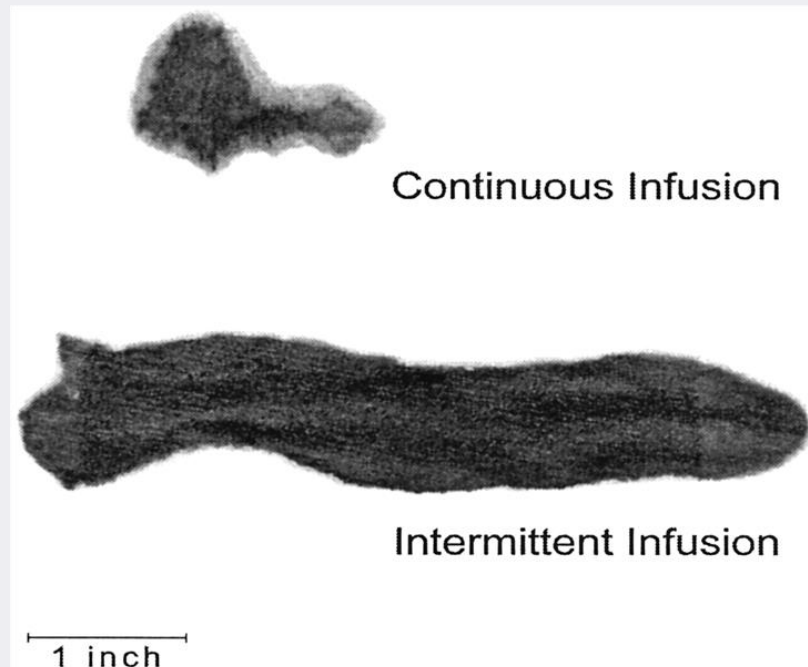


Maintenance Analgesia: Delivery Technique



Maintenance Analgesia: Delivery Technique

Programmed Intermittent Epidural Bolus



- Decrease total local anesthetic dose
- Longer duration of analgesia
- Decrease in provider administered supplemental analgesia
- Less motor block
- Fewer instrumental vaginal deliveries
- Improved satisfaction

Kaynar AM. Anesth Analg 1999; 89: 534.

Chua SM. Can J Anesth 2004; 51: 581-5.

Lim Y. Int J Obstet Anesth 2005; 14: 305-9.

Fettes PD. BR J Anesth 2006; 97: 359-64.

Wong CA. Anesth Analg 2006; 102: 904-9.

Leo S. Int J Obstet Anesth 2010; 19: 357-64.

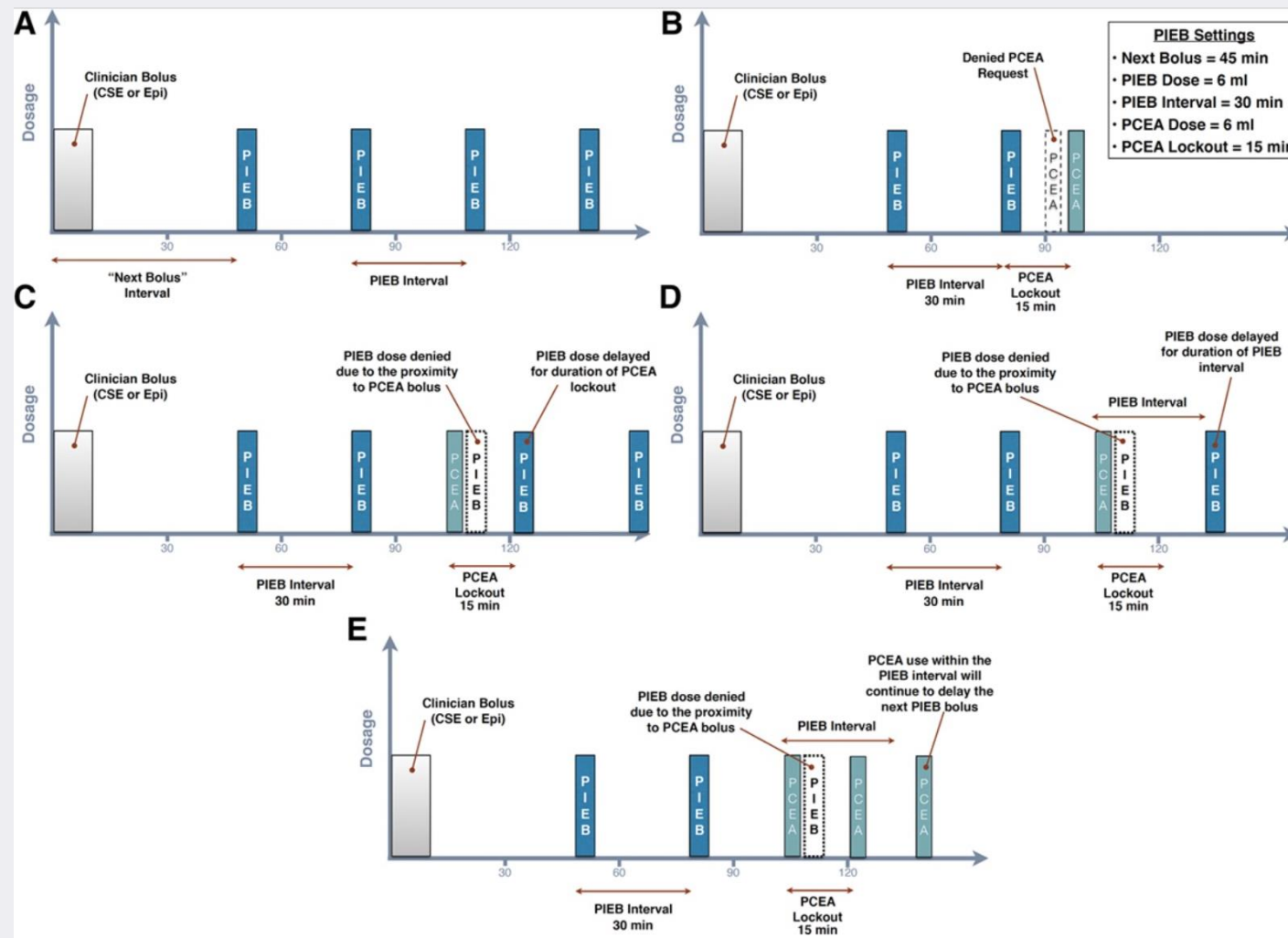
Maintenance Analgesia: Delivery Technique



2014
FDA clearance for epidural pump
capable of PIEB

Implementation of Programmed Intermittent Epidural Bolus for the Maintenance of Labor Analgesia

Brendan Carvalho, Ronald B. George, Benjamin Cobb, Christine McKenzie, Edward T. Riley



Programmed Intermittent Epidural Bolus for Labor Analgesia During First Stage of Labor: A Biased-Coin Up-and-Down Sequential Allocation Trial to Determine the Optimal Interval Time Between Boluses of a Fixed Volume of 10mL of Bupivacaine 0.0625% with Fentanyl 2mcg/mL

Marcelo E. Kanczuk, Nicholas M. Barrett, Christian Arzola, Kristi Downey, Xiang Y. Ye, Jose C.A. Carvalho

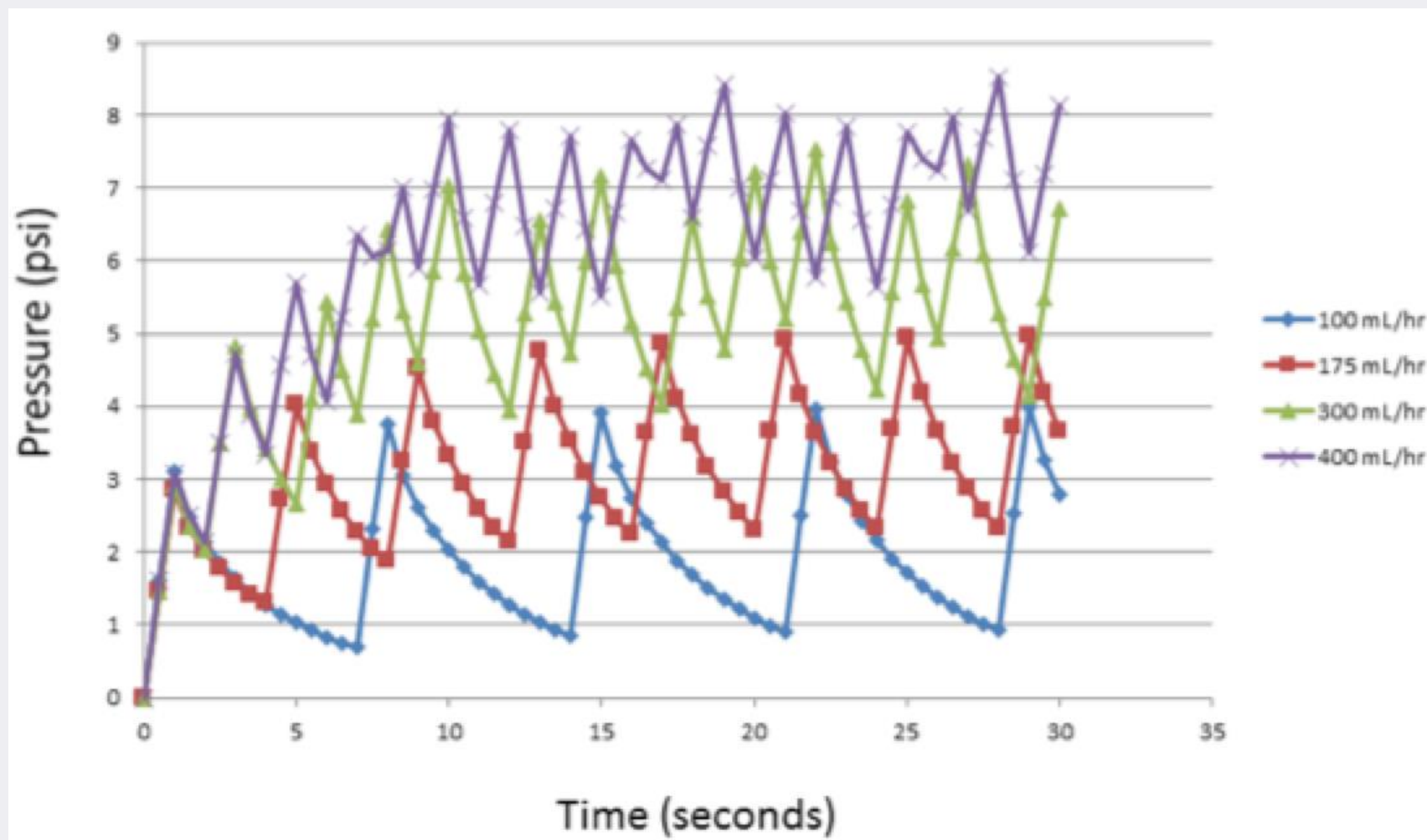
Table 2. Observed and PAVA-Adjusted Response Rate

Interval Time (minutes)	Success	Number of Patients	Observed Response Rate (%)	PAVA-Adjusted Response Rate (%)
60	7	9	0.78	0.73
50	6	9	0.67	0.73
40	8	9	0.89	0.89
30	12	13	0.92	0.92

PAVA-adjusted response rates were estimated by the use of a weighted isotonic regression method.
Abbreviations: PAVA, pool-adjacent-violators algorithm.

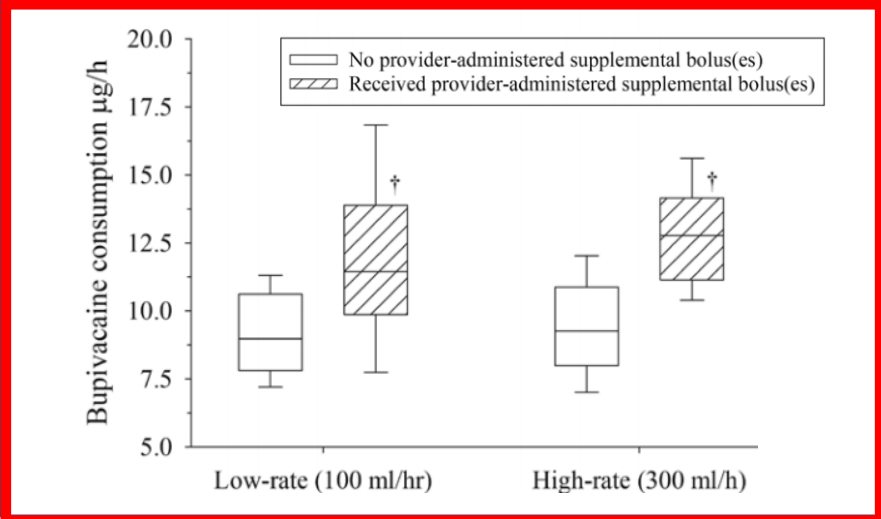
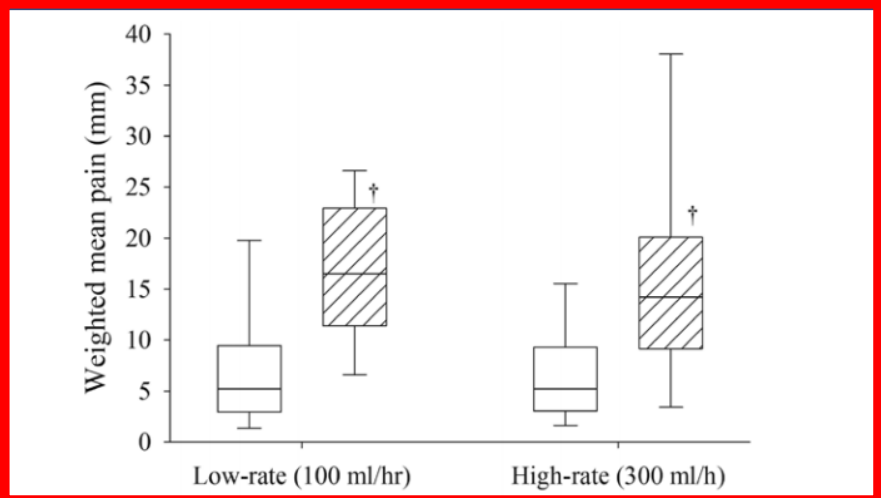
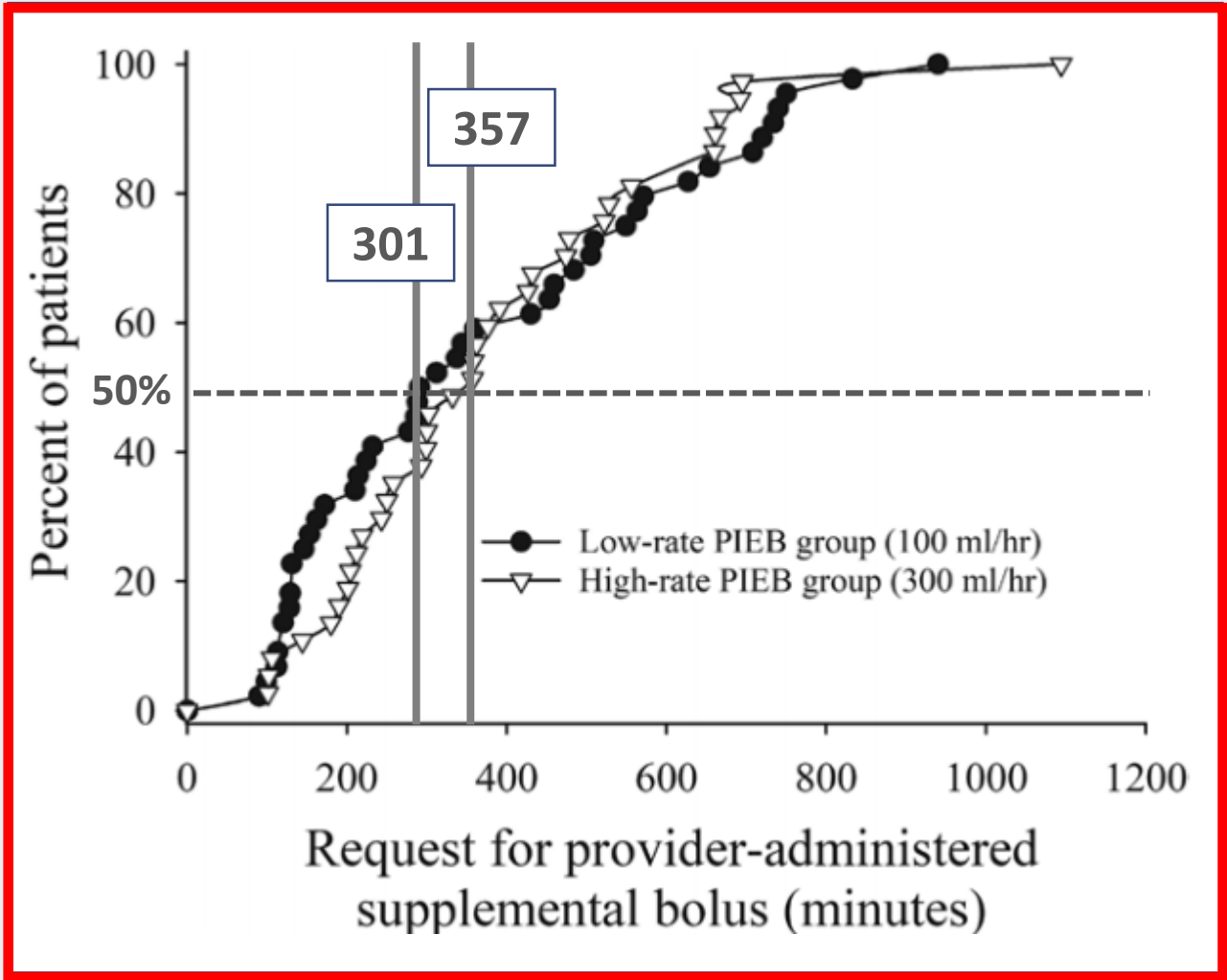
An In Vitro valuation of the Pressure Generated During Programmed Intermittent Epidural Bolus Injection at Varying Infusion Delivery Speeds

Thomas T. Klumpner, Elizabeth M. S. Lange, Heena S. Ahmed, Paul C. Fitzgerald, Cynthia A. Wong, Paloma Toledo



Effects of Epidural Infusion Bolus Delivery Rate on the Duration of Labor Analgesia: A Randomized Clinical Trial

Elizabeth M.S. Lange, Cynthia A. Wong, Paul C. Fitzgerald, Wilmer F. Davila, Suman Rao, Robert J. McCarthy, Paloma Toledo



Neuraxial Adjuvants

Fentanyl



Clonidine



Neostigmine



Neuraxial Adjuvants

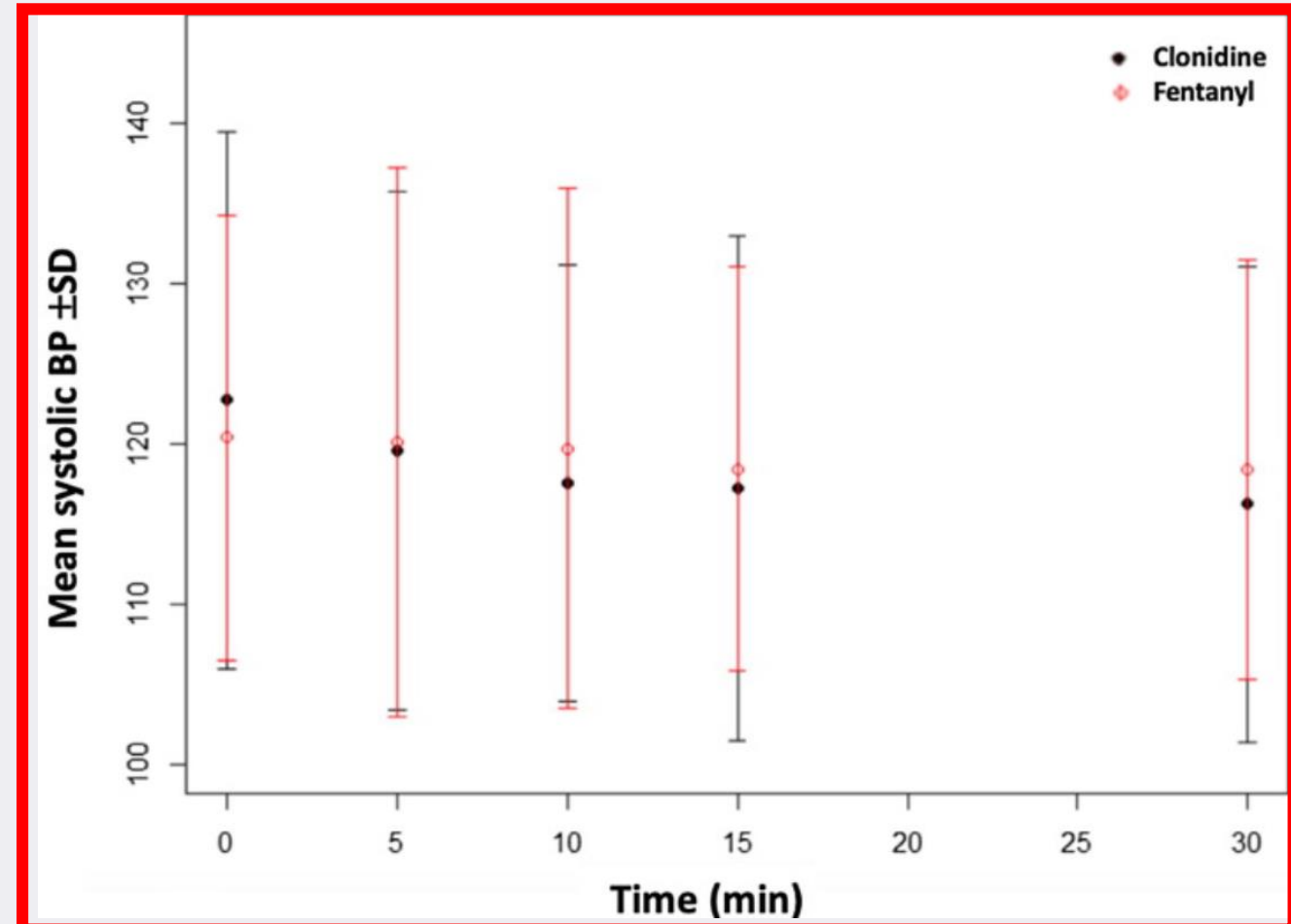
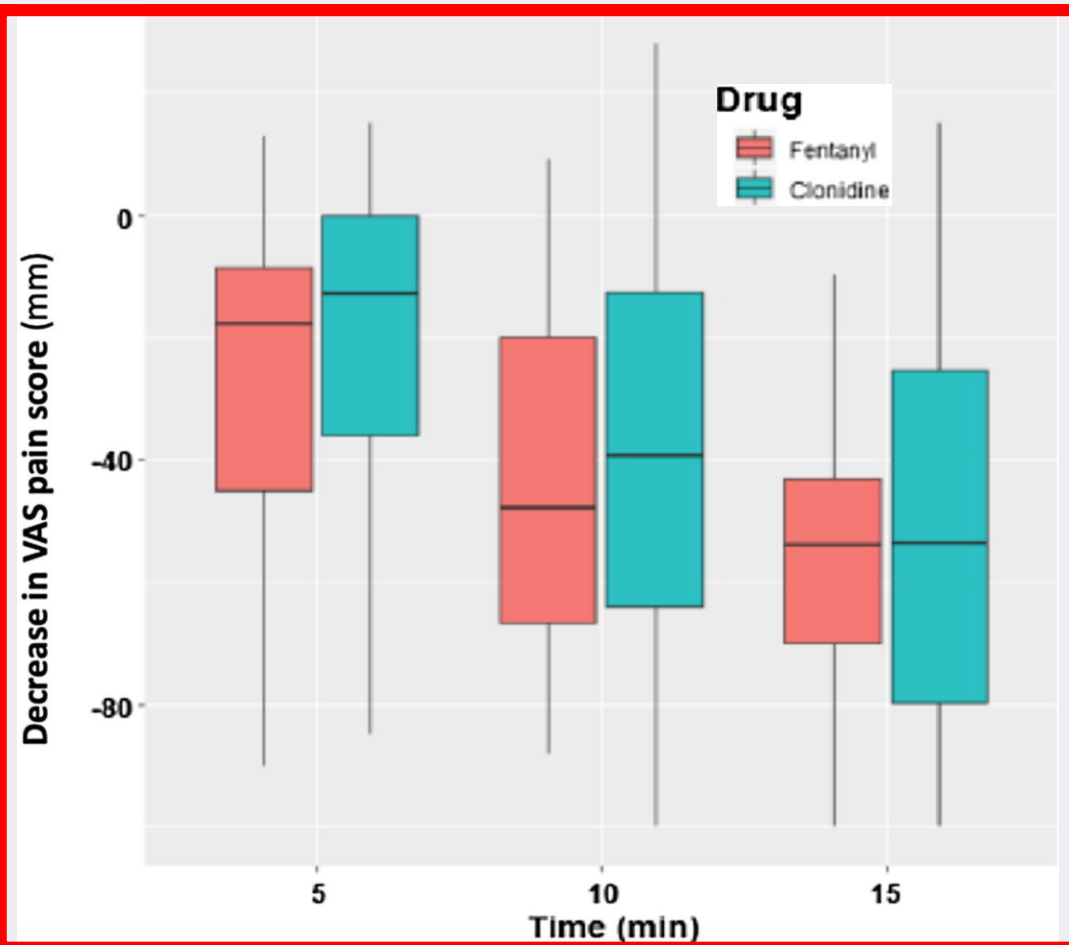
Clonidine



- Administered as bolus or infusion
- Improved quality of analgesia
- Decreased provider-administered supplemental analgesia
- Decreased pruritus
- Increase hypotension

Comparative Efficacy of Epidural Clonidine Versus Epidural Fentanyl for Treating Breakthrough Pain During Labor: A Randomized Double-Blind Clinical Trial

A. Lee, R. Landau, T. Lavin, S. Goodman, P. Menon, R. Smiley



Use of Epidural Clonidine for the Management of Analgesia in the Opioid Addicted Parturient on Buprenorphine Maintenance Therapy: An Observational Study

M.R. Hoyt, U. Shah, J. Cooley, M. Temple

Patient number	Bupivacaine (%)	Clonidine (µg/mL)	Pain score pre-epidural	Pain score immediately post-epidural
1	0.1	1.2	6/10	0/10
2	0.1	1.2	9/10	0/10
3	0.1	1.2	10/10	4/10
4	0.0625	2	9/10	0/10 [#]
5	0.1	1.2	9/10	0/10
6	0.1	1.2	3/10	1/10
7	0.1	1.2	10/10	0/10

How to Assess:

1. Have patient describe pain (timing, severity, where)
2. Check a level to cold
3. Check a level under kneecaps
4. Check where the catheter is taped (still in place?)

Other Adjuvants:

- Fentanyl 100mcg (5min onset, duration 45min)
- Clonidine 100mcg (5min onset, duration 4hr)
- Lidocaine 1% 10mL (5-10min onset, 45min duration)

Redose Requested

10 – 15mL 0.125%
Bupivacaine
(Onset 10-15min, peak 30min)

Density Issue

Volume Issue

Back Labor

Good Level (T8 to cold, T10 sharp), but still pain

Window

One-Sided Block
(consider pulling back catheter)

Low Level (<T8 to cold, <T10 sharp), but still pain

Sacral Sparing
(vaginal pain, check sensory under kneecaps)

CHANGE THE PUMP

Consider clonidine

If patient maxed out on settings (↑ volume and clonidine) and still uncomfortable, then REPALCE

Increase the Volume Being Given (increase hourly consumption)

Dosing Strategies for Neuraxial Labor Analgesia

Initiation of Neuraxial Analgesia

Drugs		Traditional Epidural Technique	Combined Spinal-Epidural Technique
Local Anesthetics (10–15mL)	Bupivacaine	0.0625% – 0.125%	1.25 – 2.5mg
	Ropivacaine	0.08% – 0.2%	2.0 – 3.5mg
	Levobupivacaine	0.0625% – 0.125%	2.0 – 3.5mg
Opioids	Fentanyl	50 – 100µg	15 – 25µg
	Sufentanil	5 – 10µg	1.5 – 5µg

PIEB Settings

PIEB Initial Bolus Time	15 – 45 min
PIEB Bolus Volume	5 – 10 mL
PIEB Delivery Rate	100 – 250 mL/h
PIEB Bolus Interval	30 – 60 min
PCEA Bolus Volume	5 – 10 mL
PCEA Lockout Interval	10 – 15 min

Maintenance Infusion

Drugs		Concentration
Local Anesthetics	Bupivacaine	0.05% – 0.125%
	Ropivacaine	0.08% – 0.2%
	Levobupivacaine	0.05% – 0.125%
Opioids	Fentanyl	1.5 – 3µg/mL
	Sufentanil	0.2 – 0.4µg/mL

PCEA Settings

PCEA Technique	Without Background Infusion	With Background Infusion
Basal Infusion Rate (mL/h)	0	4 – 8
Bolus Dose (mL)	8 – 12	5 – 8
Lockout Interval (min)	10 – 20	10 – 15

GEORGIA SOCIETY OF ANESTHESIOLOGISTS · ANNUAL CONFERENCE 2026

Preoperative Optimization in the AI Era

AKBAR HEREKAR, MD MPH FASA

Associate Professor of Anesthesiology and Perioperative Medicine

Associate Chief Medical Officer

Wellstar Medical College of Georgia Health

DISCLOSURE

Disclosures

Founder, **SurgeryReady** — Health Tech company

LEARNING OBJECTIVES

At the conclusion, participants will be better able to...

Describe the current landscape regarding preoperative optimization

Explain how algorithmic clinical decision support and agentic AI can operationalize complex, individualized evidence-based perioperative pathways that were previously too resource-intensive to deliver.

Integrate personalized prehabilitation measures, such as VO₂ max, grip strength, protein targets, and staged exercise progression, into a patient-specific preoperative plan.

Evaluate the opportunities, limitations, and team-based implementation considerations of AI-augmented perioperative optimization in the preoperative clinic.

Mahvash & Jahangir
Siddiqui Foundation

Everyone needs to know how to

SAVE A LIFE

Your first response to an emergency situation could make all the difference within seconds. Learn these simple techniques and you could save a life!

Venue

HUSSAIN BUA
CHANDIO

Date

21-02-2018

contactus@frip.org.pk
www.frip.org.pk



/Fripakistan/



FRIP



Postoperative complications: a hidden pandemic

>51

surgical procedures
performed each year in
the United States

M

10–17%

of surgical patients
experience one or
more complications

upto 34%

of scheduled surgeries
cancelled for preventable
reasons, often inadequate
preoperative preparation

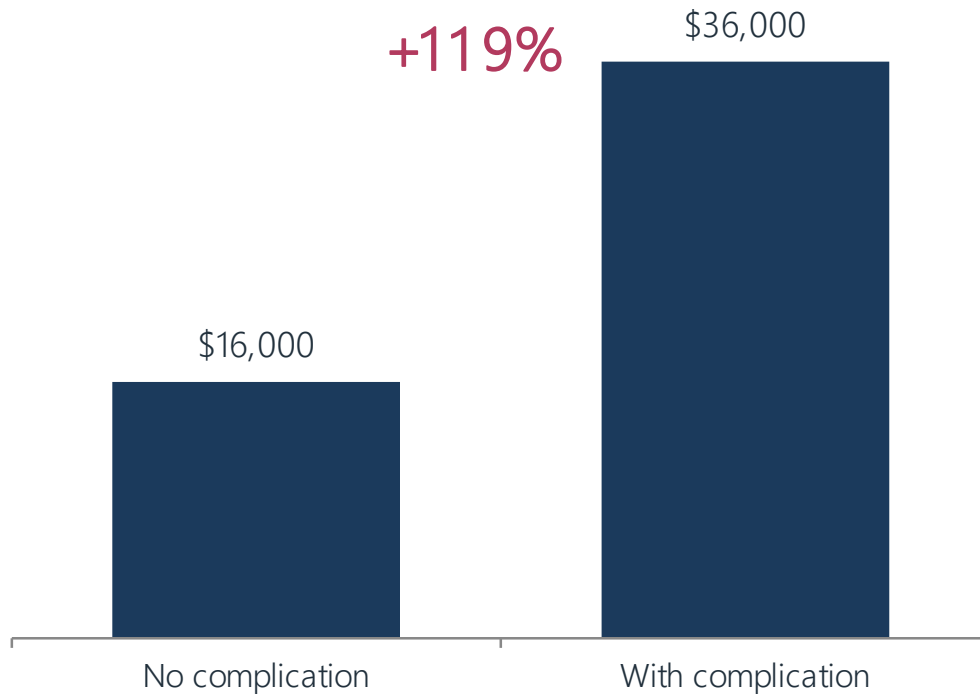
>50%

of surgical patients were
rehospitalized or died
within one year of
discharge

*Every complication avoided and every operation that proceeds on schedule is a **public health gain**, not just a clinical one.*

What it costs when we do not prepare

Mean hospital cost per surgical episode



Surgical site infection alone adds 7 to 8 hospital days and roughly \$15,000 per patient.

Wasted operating room time. OR time averages \$62 per minute; one system recovered 1,343 hours and \$771,000 a year by fixing first-case delays.

Readmissions. Medicare spends about \$17 billion a year on avoidable readmissions; preventing surgical complications could avert 41,846 readmissions and \$620.3 million annually.

ERAS: Rewriting the Surgery Recovery Blueprint

THE PROBLEM: THE SURGICAL STRESS RESPONSE

Surgery Unleashes a
Physiological “Storm”

Neuroendocrine
Stress

Massive
Cortisol

Systemic
Inflammation

Traditional Care vs.
The Stress Response



vs.



Prolonged
Fasting

Heavy
Opioids



Worsen Insulin
Resistance &
Gut Dysfunction



The “Catabolic State”

Without intervention, body rapidly breaks down
protein & muscle for energy demands.

THE SOLUTION: THE ERAS EVIDENCE BASE

1.88
DAYS
SAVED

A 2024 meta-analysis
of 6,076 patients

29%

**REDUCTION IN
COMPLICATIONS**

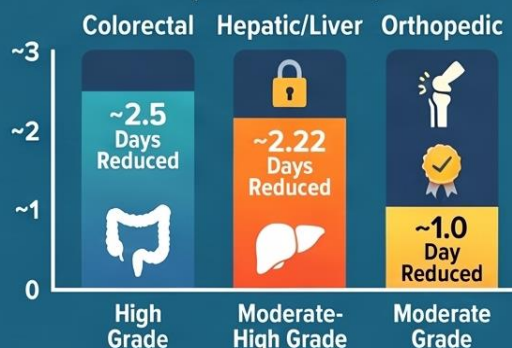
High-quality evidence confirms
significantly lowers risk

The “Compliance-Outcomes” Link

10%
protocol
adherence
increase

Further reduces hospital stay by 0.26 days.

Specialty-Specific LOS Reduction
(Evidence Grade)



THE CORE ERAS “BUNDLE”



**Preoperative
Carbohydrate Loading**

Consuming clear carb drinks 2–3
hours before surgery switches
body from catabolic to anabolic.

**Opioid-Sparing
Multimodal
Analgesia**

Combining regional blocks
with non-opioid meds
reduces gut paralysis
and immune suppression.



**Early Mobilization
(Within 24 Hours)**

Standing and walking
day-of-surgery stimulates
gut motility and prevents
rapid muscle atrophy.



THE TAKEAWAY: FLOOR VS. CEILING



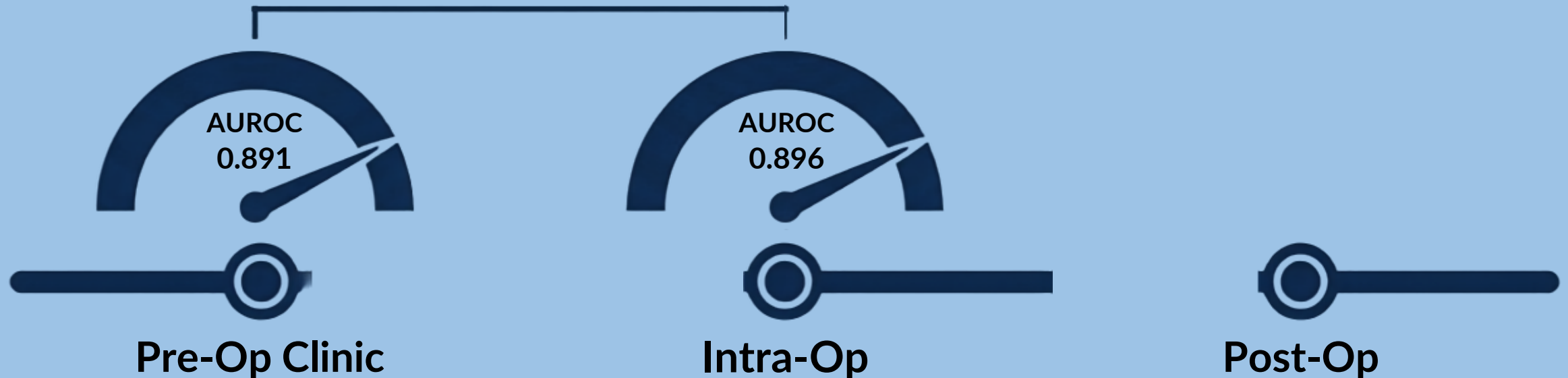
**ERAS is the Floor;
Preparation is the Ceiling**

“ERAS is the institutional
standard, but patient-
directed prehabilitation
raises the physiological
limit for recovery.”

The highest-leverage data exists before the patient enters the OR

For AKI and delirium, adding intraoperative monitoring data to machine learning models **barely** improves discrimination.

+0.005 gain. The signal is already there before incision.



MARATHON

— 26.2 MILES —

START

HOW HARD
CAN IT BE?

I'LL JUST
FIGURE IT OUT
AS I GO!

0001

NO TRAINING ☒

NO PLAN ☒

NO PROBLEM! ☒

MILE 5

- ☒ CRAMPING
- ☒ EXHAUSTED
- ☒ WHY DID I
THINK THIS
WAS A GOOD
IDEA?

WE WOULDN'T DO THIS FOR A MARATHON...

SO WHY DO WE DO IT FOR SURGERY?

SURGERY

I'LL JUST
FIGURE IT OUT
AFTER!

NO PREHAB ☒

NO PLAN ☒

JUST
HOPE FOR
THE BEST! ☒

SURGERY IS A MARATHON FOR YOUR BODY.



Prehabilitation is your training.



It builds strength, improves recovery,
and reduces complications.



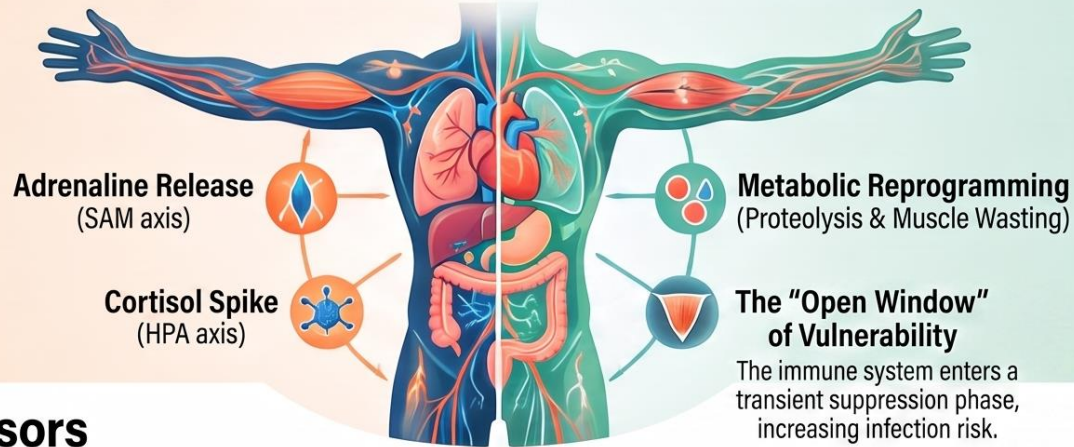
Better prepared = better outcomes.

The Athlete Within: Preparing Your Body for the “Marathon” of Surgery

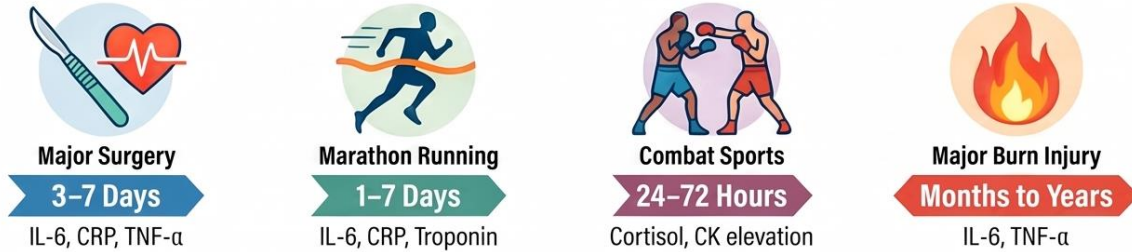


The Universal Stress Response

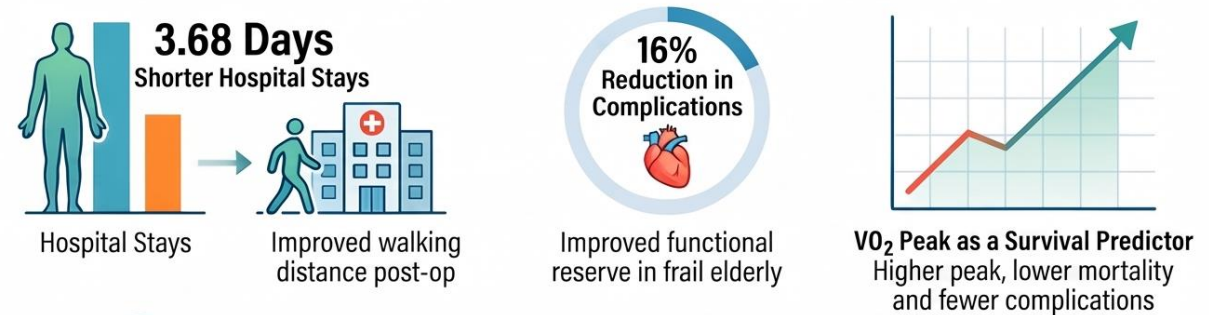
The Body Doesn't Distinguish Between a Scalpel and a Mile Marker.



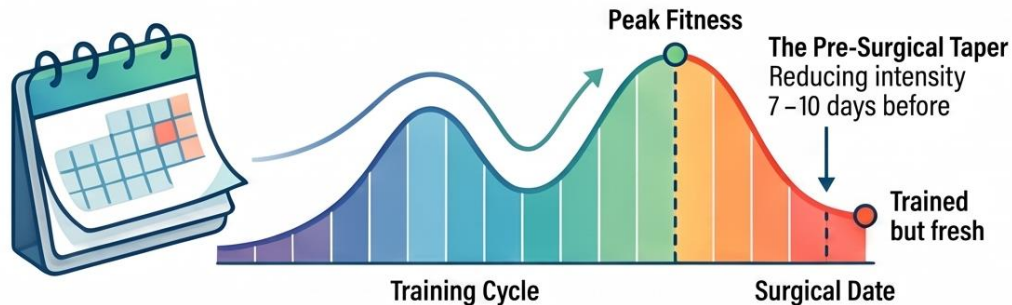
Surgery vs. Other Stressors



The Power of Prehabilitation



The Athlete's Blueprint: Periodization



The “Surgical Athlete”

“The only preparation that doesn't work is the preparation that never happens.”

Even modest increases in conditioning—progressive exercise, sleep, and nutrition—shift the biological equation in the patient's favor.

The chain has three links. We have proven two.



The adherence paradox (n=847, 13 centres): no benefit by intention to treat, but at 75% or greater adherence, walk distance rose 76.

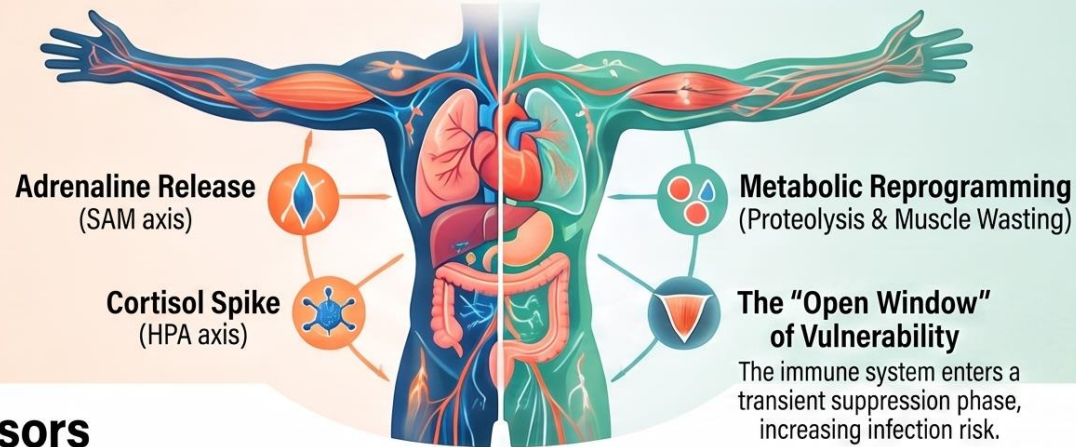
A Dutch nationwide cohort (n=2,000+, 18 hospitals) similarly showed benefit only in the per-protocol analysis ($\geq 75\%$ adherence: ~20% reduction in complications, 31% shorter LOS), not conclusively on ITT.

The Athlete Within: Preparing Your Body for the “Marathon” of Surgery

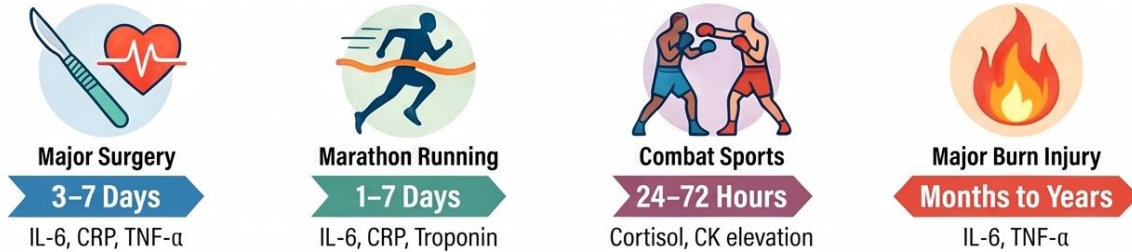


The Universal Stress Response

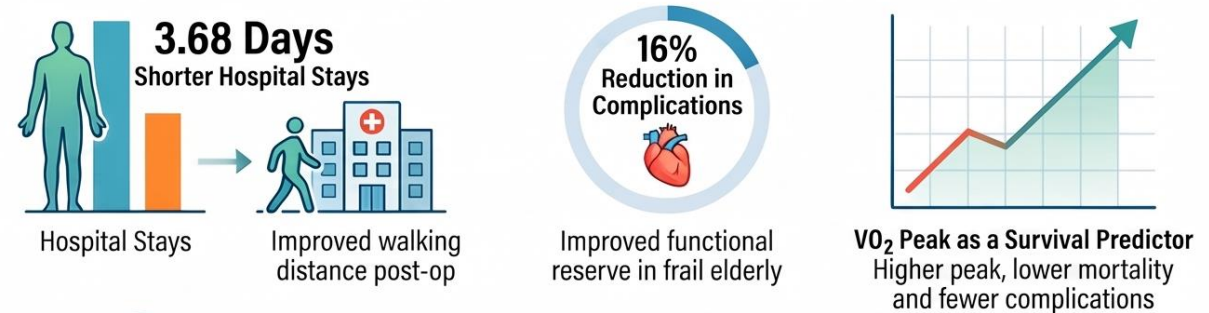
The Body Doesn't Distinguish Between a Scalpel and a Mile Marker.



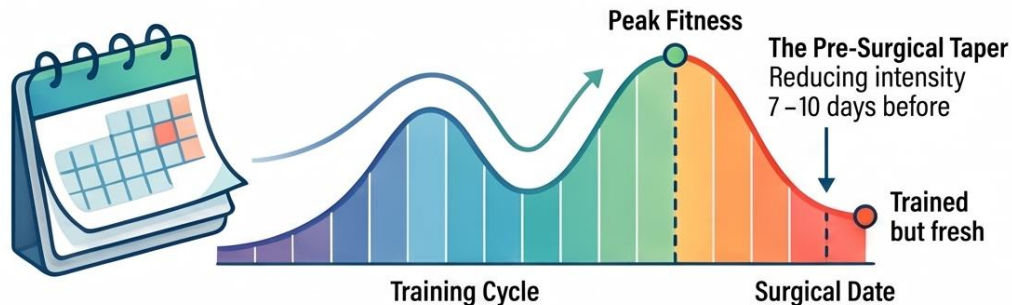
Surgery vs. Other Stressors



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The Athlete's Blueprint: Periodization



The “Surgical Athlete”

“The only preparation that doesn't work is the preparation that never happens.”

Even modest increases in conditioning—progressive exercise, sleep, and nutrition—shift the biological equation in the patient's favor.



Heart Rate
Variability



VO₂ Max /
DASI



Exercise
Prehabilitation



Nutrition



Fasting
(NPO)



Sleep



Stress
Resilience



Wearable
Self-Tracking



Thermal
Conditioning



Cardiac Risk
(CAD / MI)



Heart
Failure



Atrial
Fibrillation



Hypertension



Pacemaker
/ ICD



Vascular
Risk



COPD



Sleep
Apnea



Asthma



Diabetes /
Glucose



GLP-1
Agonists



Steroid
Coverage



Anemia



Anticoagulation



VTE
Prophylaxis



Smoking
Cessation



Alcohol
Use



Liver
Disease



Kidney /
Dialysis



Cancer /
Chemotherapy



Frailty



Delirium
Prevention



Joint
Implant



Why now: three curves are converging

~6,300

Projected U.S. anesthesiologist shortage by 2036;
57% of the workforce is over age 55

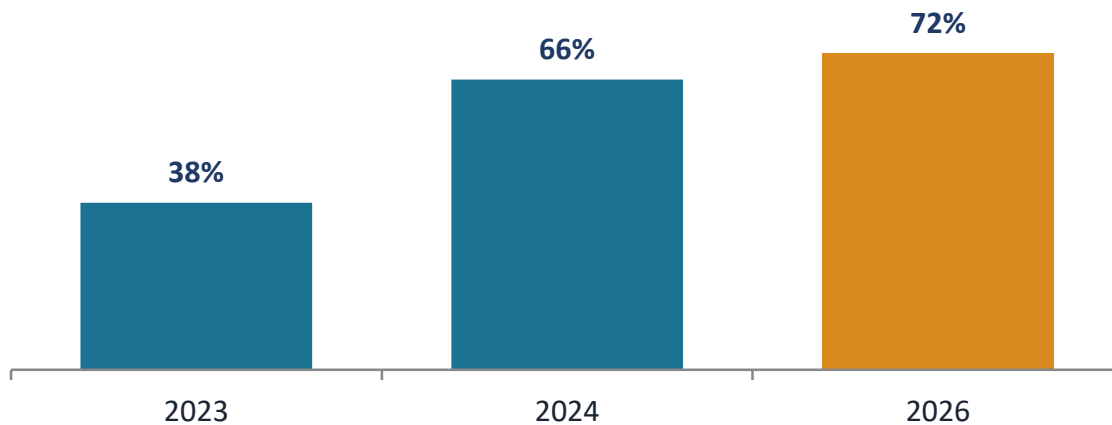
>1,400

FDA-authorized AI-enabled devices — 331 cleared
in 2025 alone, the most ever in one year

USD 36.7B

Global AI-in-healthcare market (2025), growing ~39%
per year into the 2030s

Physician adoption of at least one AI tool



● The clinical implication

A shrinking, aging workforce must serve rising surgical demand in older patients.

Tools that triage who truly needs an in-person visit, draft documentation, and surface high-risk patients automatically are a response to a structural staffing constraint — not a novelty.

Enthusiasm now outpaces anxiety, but physicians attach conditions: data privacy (85%), EHR integration (84%), and malpractice clarity (82%).

Sources: Medicus/Becker's workforce analysis; FDA AI device list (2026); Grand View Research; AMA Augmented Intelligence surveys 2023–2026.

Large language models as prediction engines

These systems read the unstructured narrative — comorbidity lists, prior operative notes — that structured risk scores throw away.

94.9%

NYUTron — LLM pretrained on 7.25M notes — AUC for in-hospital mortality, beating SAPS-2 / APACHE by 5–7 points

~0.88

Pretrained clinical LLMs on 84,875 preoperative notes — AUROC for 30-day mortality; ~0.84 for pulmonary embolism

0.957

Retrieval-augmented LLaMA-3.1 — AUROC for 30-day mortality; excels at flagging rare high-risk patients

● Why this matters for preoperative optimization

Structured scores discard most of the chart. LLMs turn the free text of a preoperative note into a calibrated risk estimate — and can be grounded in your own institutional guidelines via retrieval so their answers cite real protocol rather than generic training data. The same capability that reads notes for risk can also draft the assessment.

Query Handling: Detailed View

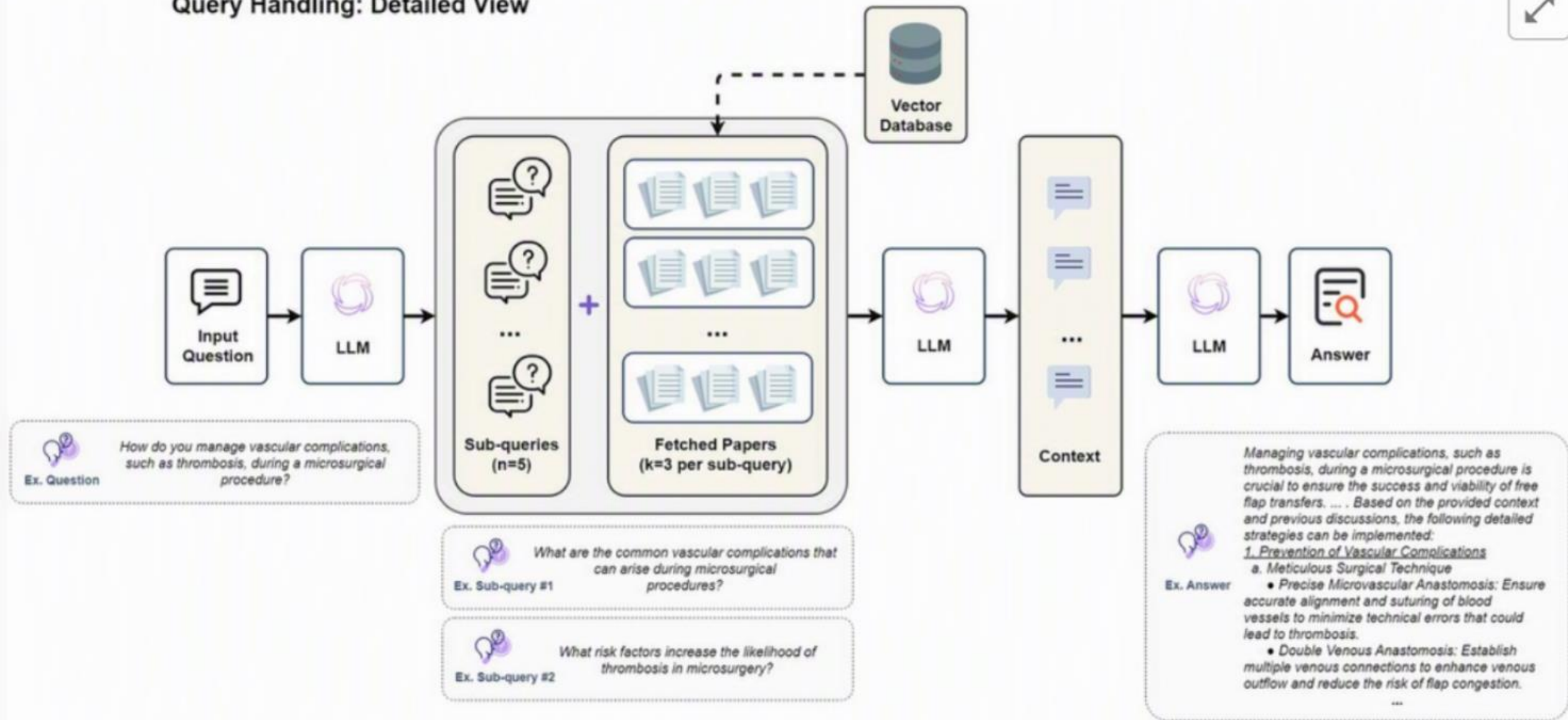


Figure 2. Detailed query handling process. [Read more](#)

The AI-ECG: information invisible to human readers

THE BREAKTHROUGH

0.93

AUROC for detecting an ejection fraction $\leq 35\%$ from a standard 12-lead ECG

A positive screen flags $\sim 4\times$ higher future risk of overt dysfunction — directly relevant to screening for occult cardiomyopathy before surgery.

THE HUMILITY CHECK

0.707

AUROC when an ECG deep-learning model (PreOpNet) was prospectively validated for 30-day mortality after major noncardiac surgery

It was beaten by a single high-sensitivity troponin (0.762). The authors concluded it had limited stand-alone preoperative value. Powerful $\neq$ universally useful.

Direct head-to-head performance across validated cohorts

Outcome	AI Model (AUROC)	Legacy Score (AUROC)	Margin of Improvement
In-Hospital Mortality	Random Forest (0.932)	ASA-PS (0.866) & POSPOM (0.660)	+0.066 to +0.272
Postop Mortality	BERT Neural Net (0.964)	ASA-PS (0.892)	+0.072
Myocardial Injury	Explainable Boosting (0.730)	Modified RCRI (0.524)	+0.206

Data mapped from validated external cohorts (Hill 2019, Chen 2022, Sailer 2026).

Competence ≠ reliable judgment

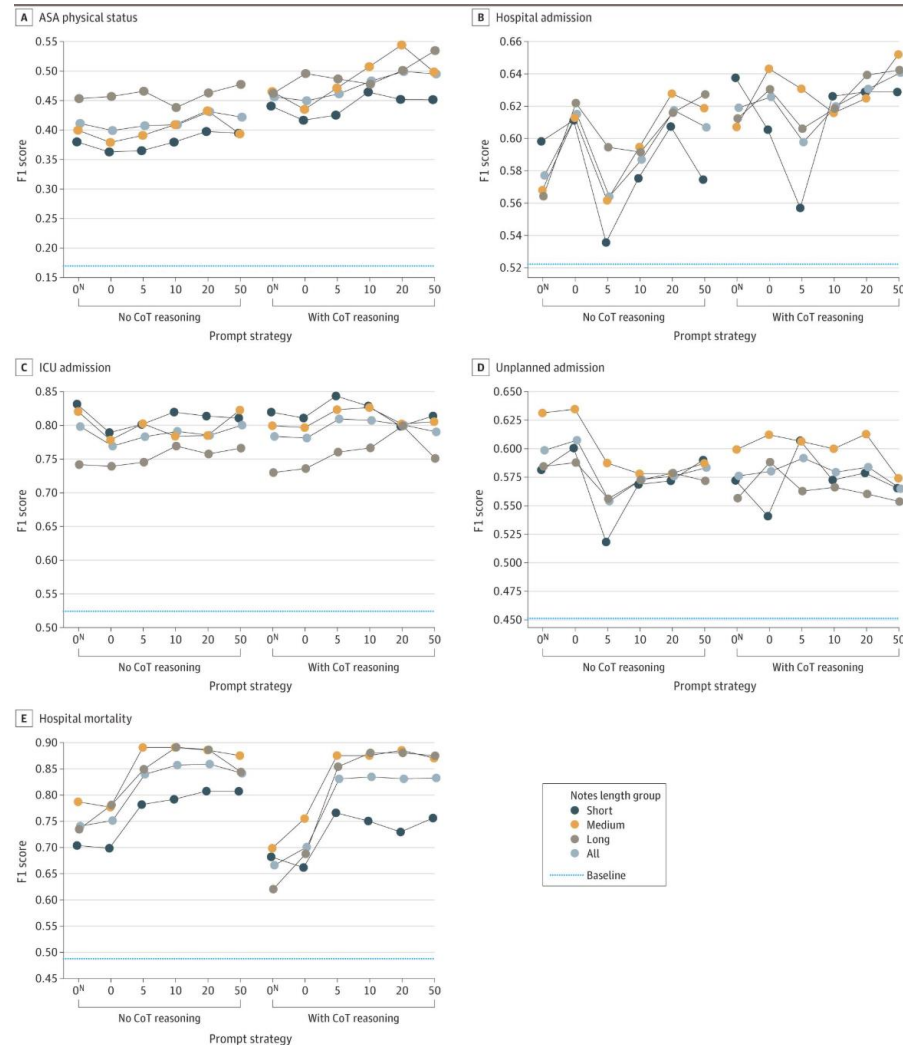


Figure 3. Association of Prompt Strategy With Binary and Categorical Prediction Tasks

[Large Language Model Capabilities in Perioperative Risk Prediction and Prognostication](#). JAMA Surg. July 31, 2024.

THE SAFETY GAP — Neuraxial vs. general for hip surgery

76-89% 5 LLMs said “neuraxial anesthesia”

Issued **strong neuraxial recommendations despite lack of clinical justification**, citing benefits unsupported by recent RCTs.

The teaching point

LLMs are competent at structured classification yet can be systematically miscalibrated on judgment-laden dispositions

Bias enters through the data; LLMs hallucinate

● Algorithmic bias

A commercial population-health algorithm underestimated the needs of Black patients by using cost as a proxy for illness. Correcting the target would raise the share of Black patients flagged for extra care from 17.7% to 46.5%. Bias also enters through inputs — pulse oximetry produces ~3× more occult hypoxemia in darker skin.

● Automation bias

When AI gave INCORRECT suggestions in a mammography study, the accuracy of a **very experienced radiologists** collapsed from 82.3% to 45.5%. (inexperienced: 79.7% → 19.8%; moderately experienced: 81.3% → 24.8%)

An accurate tool can still degrade human performance the moment it is wrong — and we tend to defer.

LLM hallucination — low, but never zero

50–82.7% of the time, leading LLMs elaborated on fabricated clinical details in adversarial testing. **~1.5%** of summarized sentences were hallucinated in clinical documentation (44% of them clinically major).

In a preoperative summary, a single fabricated allergy or omitted cardiac history can be catastrophic

Obermeyer 2019 (Science); Sjoding 2020 (NEJM); Dratsch 2023 (Radiology); Omar 2025 (Commun Med); Asgari 2025 (npj Digit Med).

What is the responsible deployment model

**A guideline-grounded, retrieval-augmented system
with human verification.**

RCT: Effect of Multimodal Prehabilitation on Reducing Postoperative Complications and Enhancing Functional Capacity Following Colorectal Cancer Surgery

POPULATION

138 Men, 113 Women



Adults scheduled for elective surgical resection of nonmetastasized primary colorectal cancer

Median age, 69 y

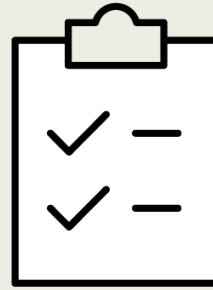
INTERVENTION

251 Participants randomized and analyzed



123 Multimodal prehabilitation

4-wk High-intensity supervised exercise and nutritional, mental health, and smoking cessation support



128 Standard care

Perioperative care per local standards

SETTINGS / LOCATIONS



**7 Hospitals from
7 countries**

PRIMARY OUTCOME

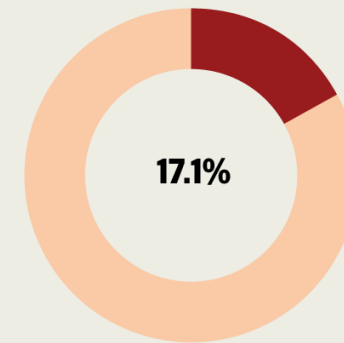
Rate of severe postoperative complications, measured by the Comprehensive Complication Index (CCI; range 0-100; score >20 indicates severe complications), and functional capacity, measured by the 6-min walking distance, at 30 d

FINDINGS

30 d Postprocedure, the prehabilitation group had a significantly lower rate of severe complications than the standard care group, but no significant difference in functional capacity

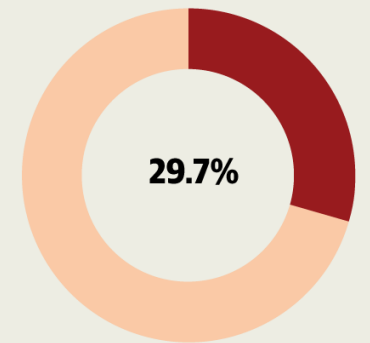
Rate of severe postoperative complications (CCI >20):

Multimodal prehabilitation



Standard care

<



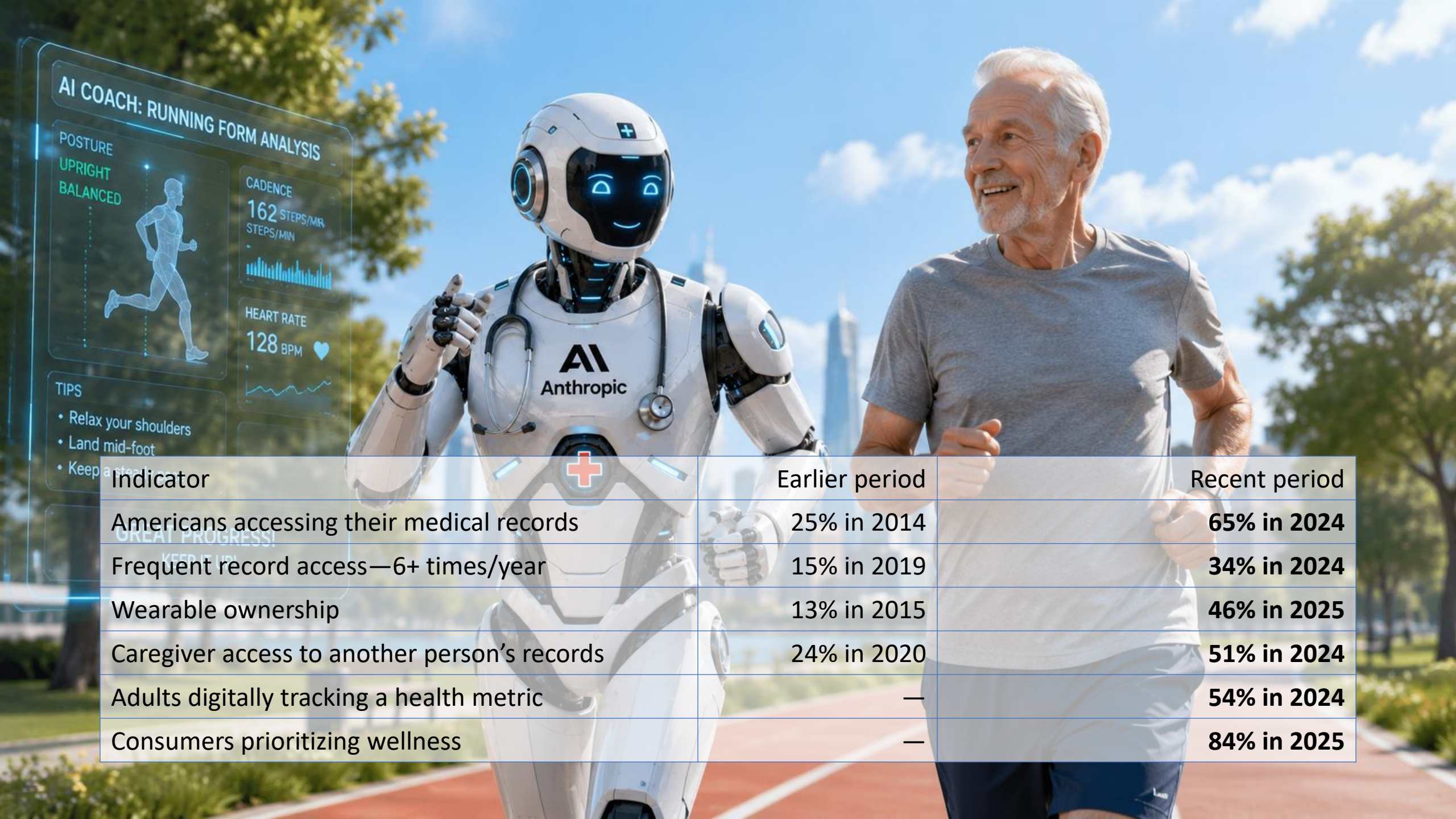
Between-group differences, prehabilitation vs standard care:

Decrease in severe complications (CCI >20):

Odds ratio, 0.47 (95% CI, 0.26 to 0.87); $P = .02$

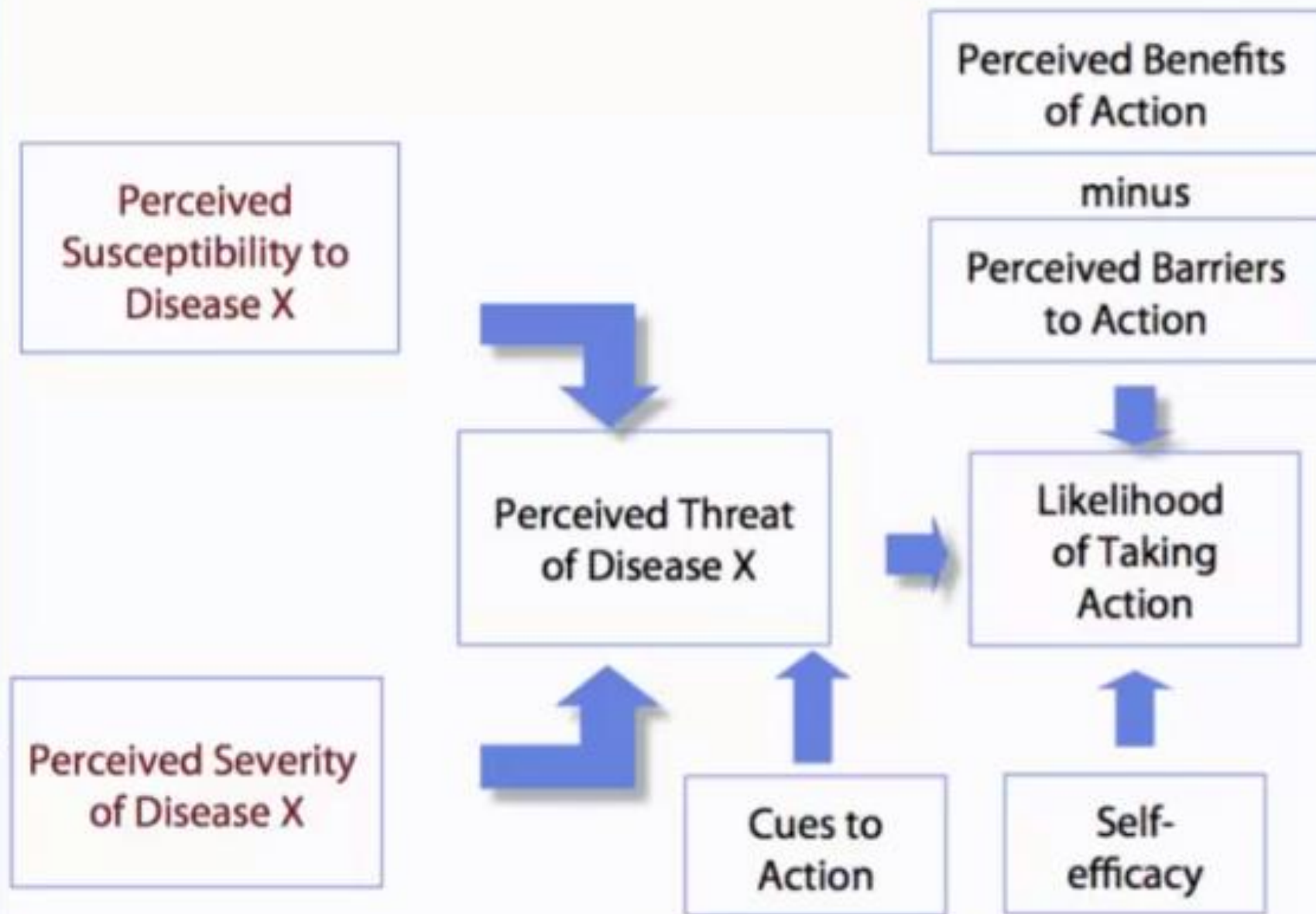
Mean difference in 6-min walking distance:

15.6 m (95% CI, -1.4 to 32.6); $P = .07$



Indicator	Earlier period	Recent period
Americans accessing their medical records	25% in 2014	65% in 2024
Frequent record access—6+ times/year	15% in 2019	34% in 2024
Wearable ownership	13% in 2015	46% in 2025
Caregiver access to another person’s records	24% in 2020	51% in 2024
Adults digitally tracking a health metric	—	54% in 2024
Consumers prioritizing wellness	—	84% in 2025

Health Belief Model



Lifestyle Habits

9:41

Lifestyle Habits

Tell us about your habits; no pressure.

Monthly Daily

Alcohol

Continue

Lifestyle Habits

9:41

Lifestyle Habits

Tell us about your habits; no pressure.

Fitness Level

Sedentary Active

Continue

Lifestyle Habits

9:41

Calculating Your Readiness Score



Crunching the numbers...

We've reviewed your health markers to personalize your journey. Your score reflects how prepared you are—and where we can help.

Continue

Lifestyle Habits

9:41

Almost There...
Just Calculating Your Score



I used to feel lost before every appointment. Now, everything's right here — reminders, trackers, even my checklist. I finally feel like I'm in control, and I'm doing something for me.

— Jessica, SurgeryReady user

Hang tight—your personalized readiness score is on the way.

Continue

Lifestyle Habits

9:41

Here's your Surgery Readiness Score!

Functional Readiness Mobility Exercises, Breathing Exercises etc. Based on the DASI score and all	75%
Lifestyle Readiness Smoking, Alcohol, Sedentary Lifestyle	40%
Medical Readiness BP, Glucose etc.	85%
Day of Surgery Readiness Watching videos, CHG, finding someone to drive them there etc.	60%

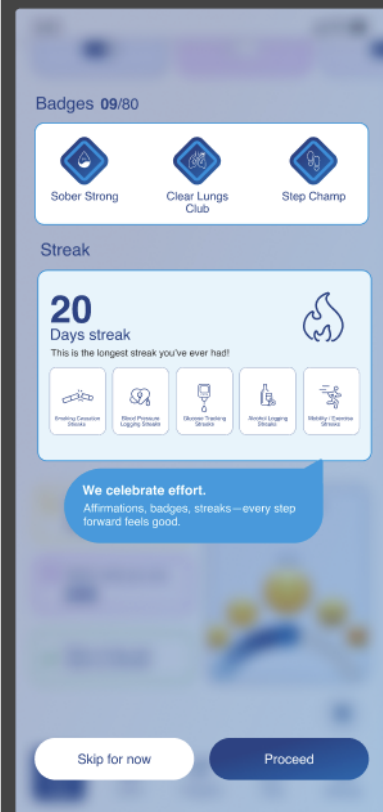
K

Continue

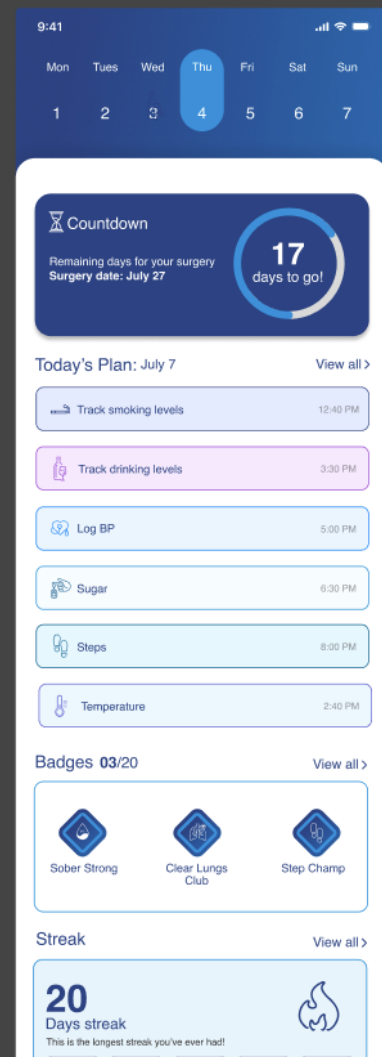
Lifestyle Habits

Lifestyle Habits

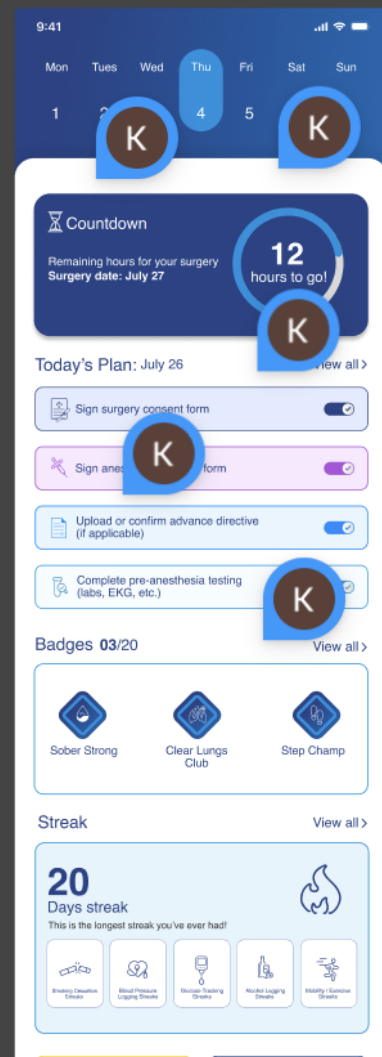
Slide 12: Motivation, Built...



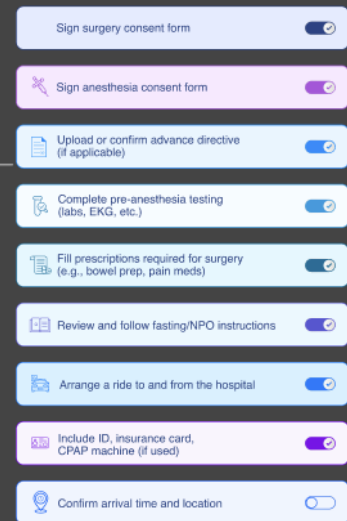
Dashboard-1



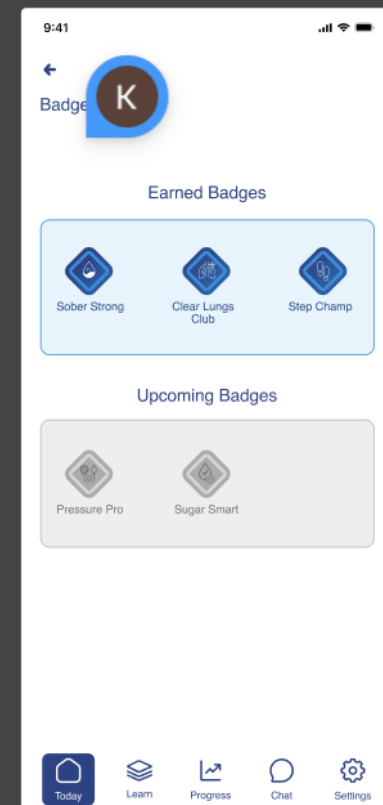
Dashboard-2



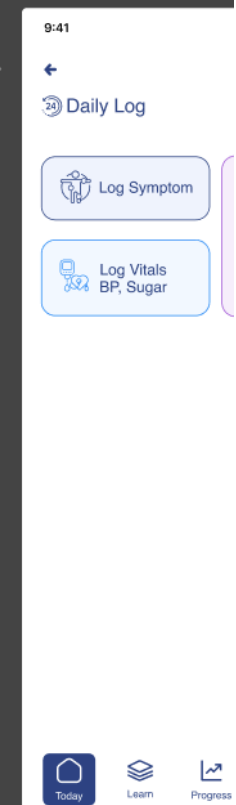
Frame 1000004239



Badges



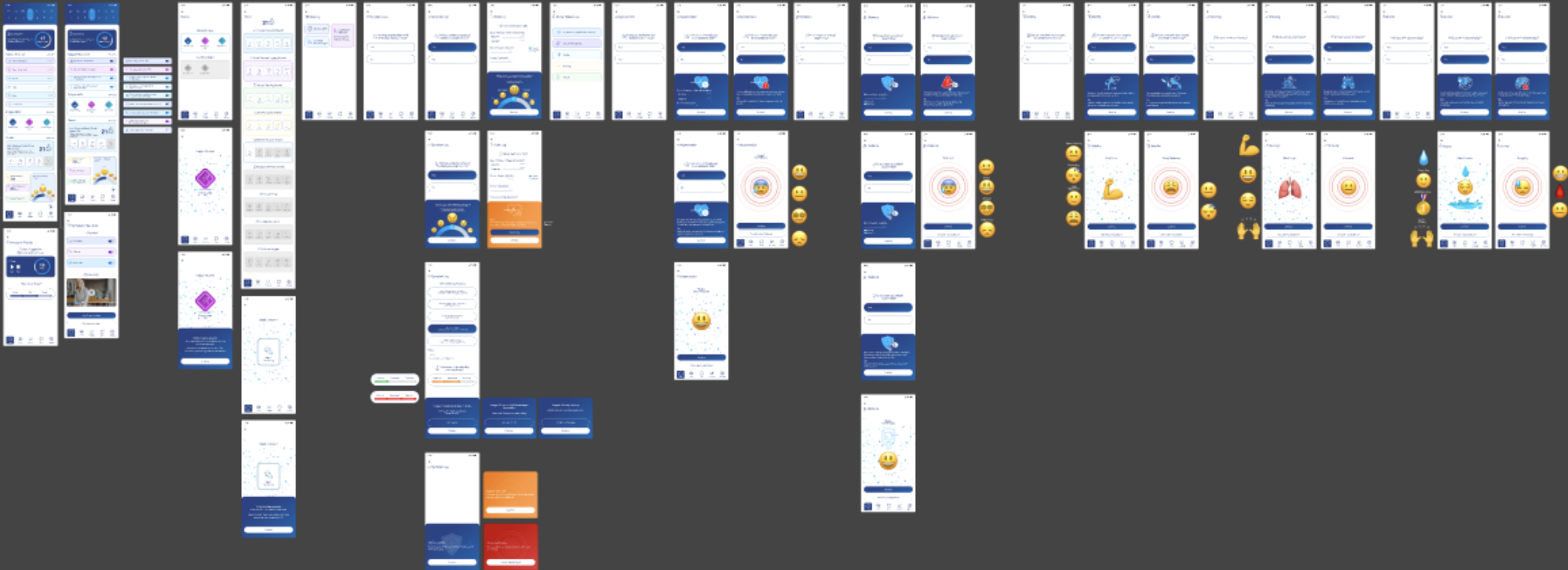
Floating + Button



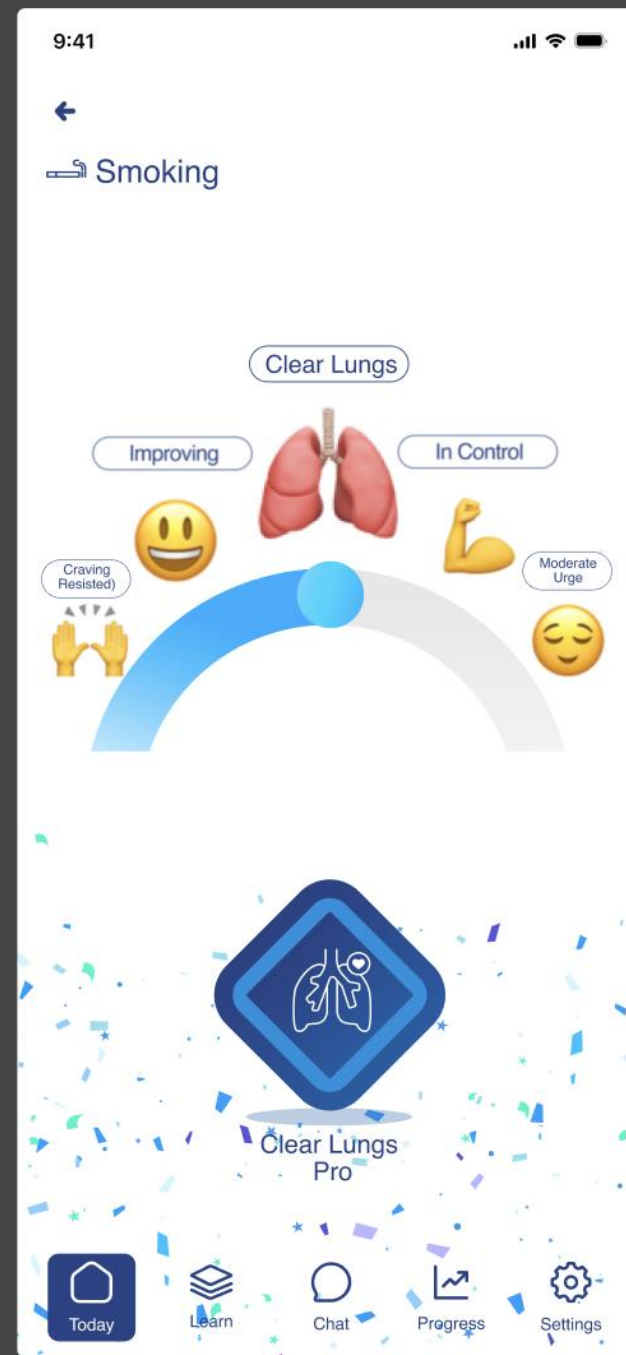
Start Screens/Login



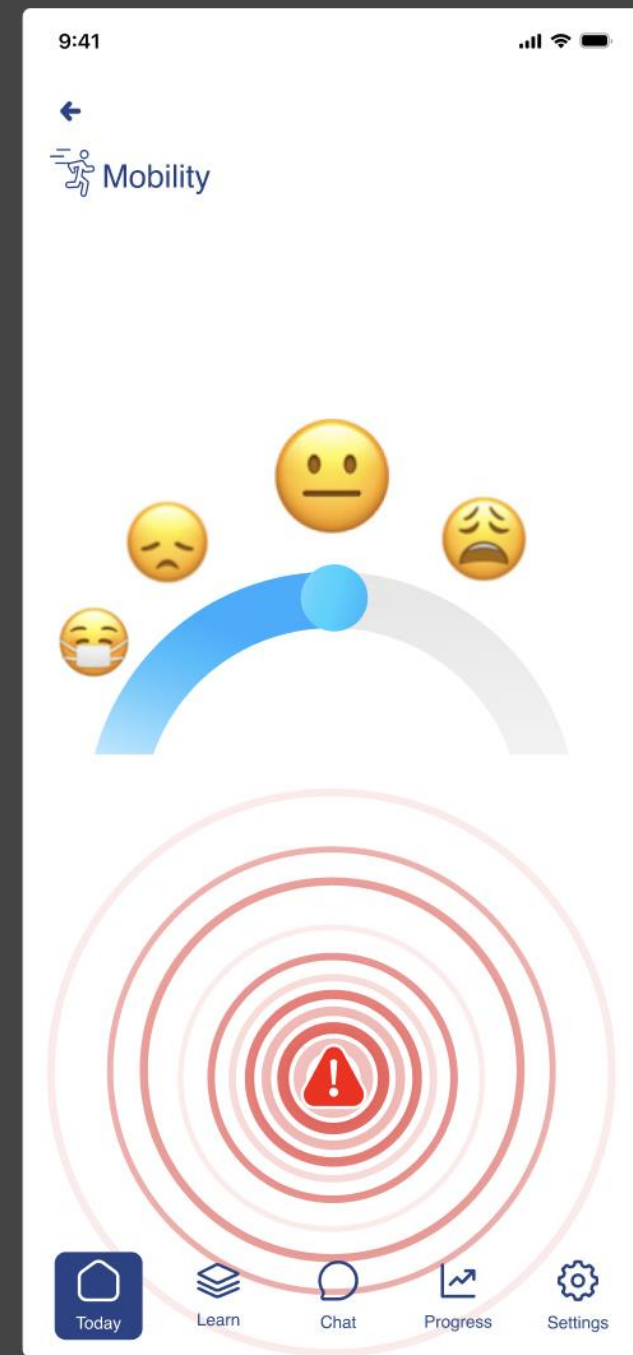
Dashboard/Home



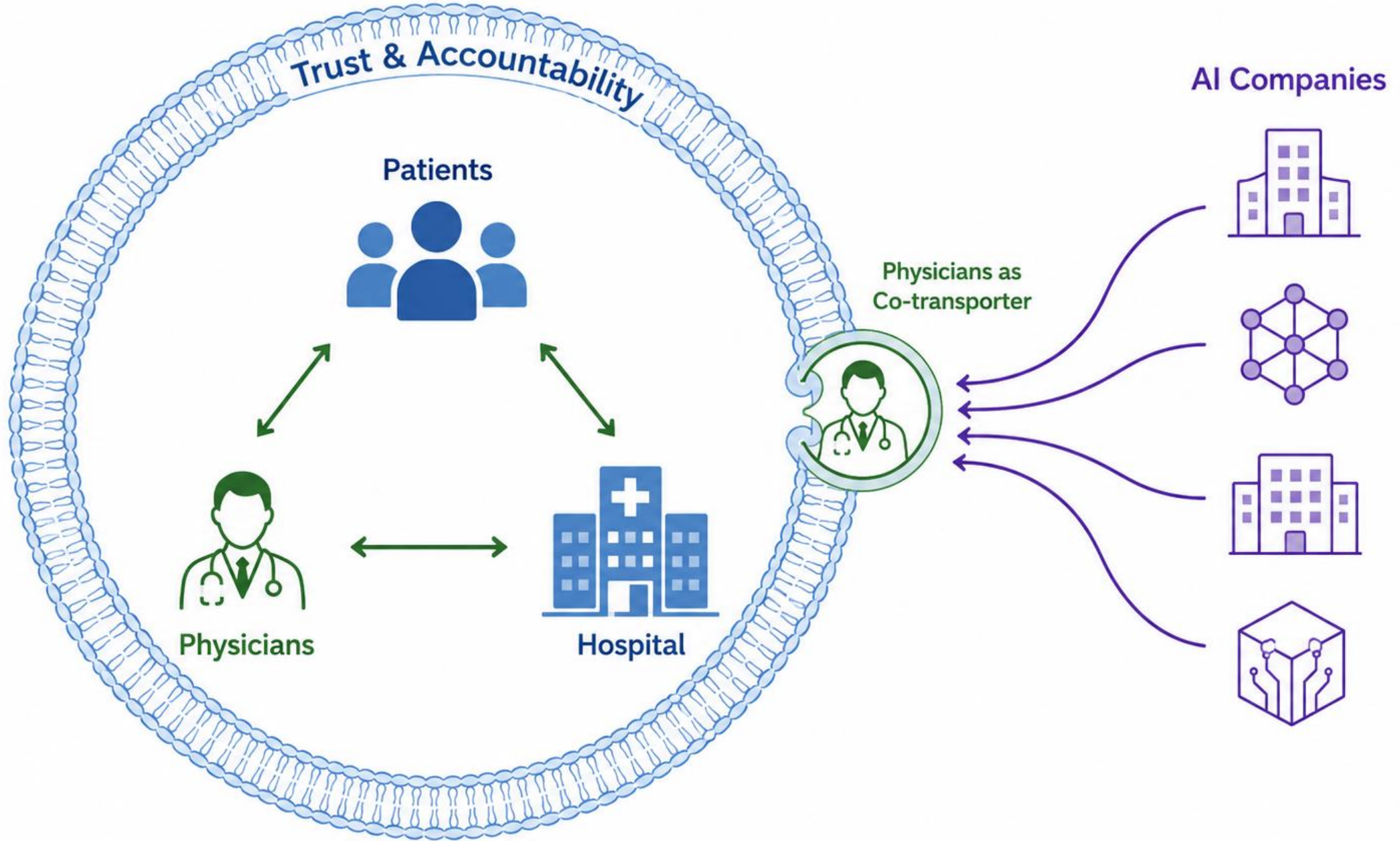
Log Screen 4 smoking no

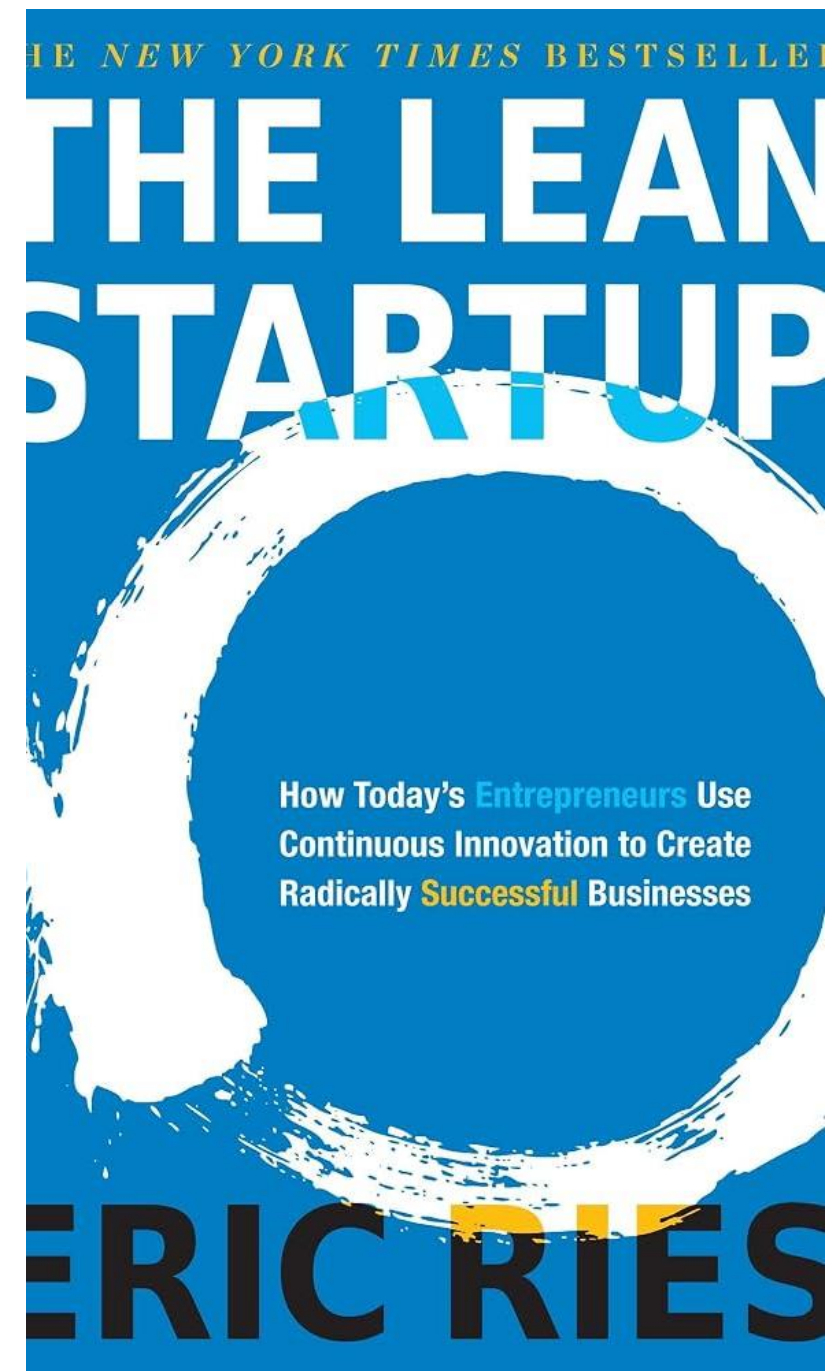
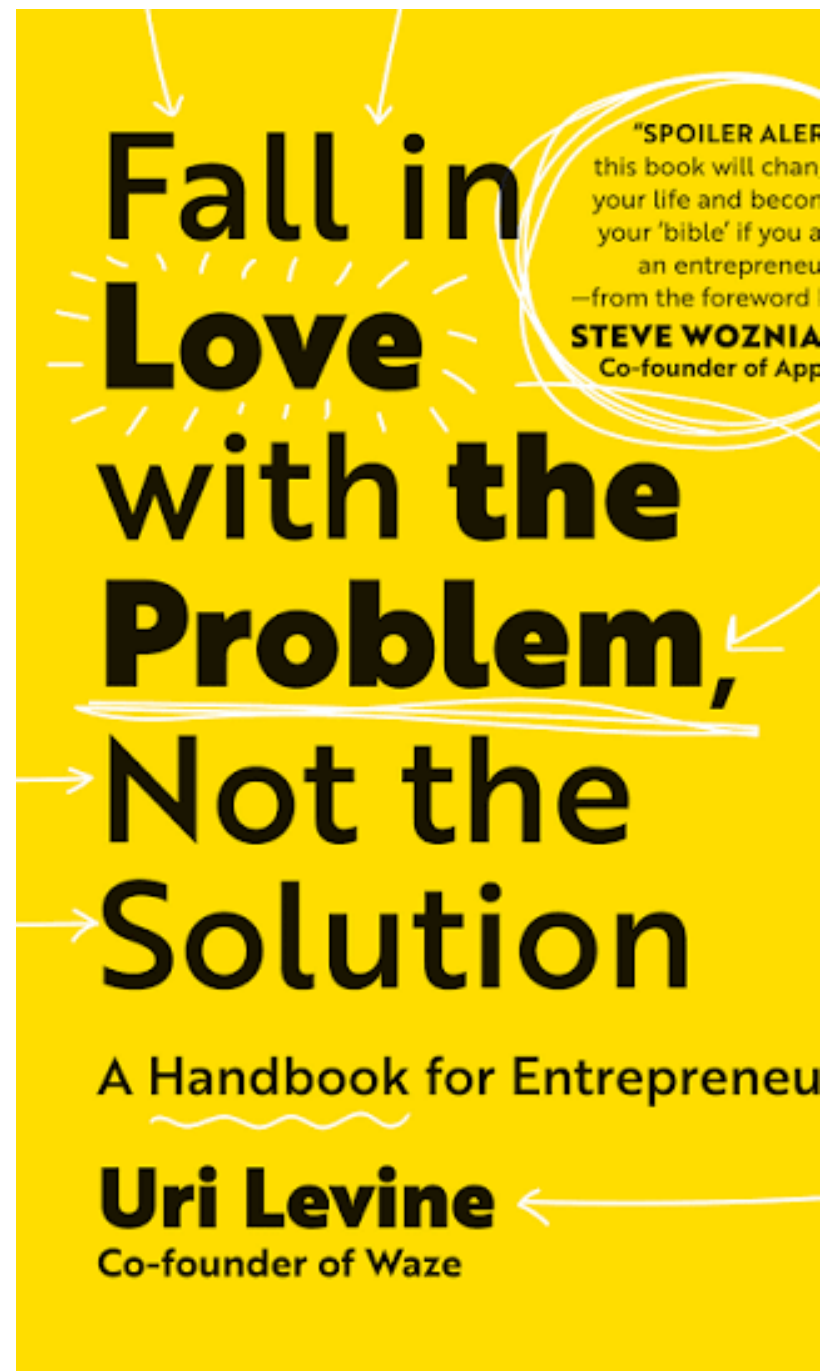


Log Screen 4 smoking yes



Healthcare Ecosystem as a Cell





So where does AI add value in the preoperative space?

Allows anesthesiologists to build software tailored to their practice including dashboards

Allows externalization and categorization of complex algorithms that were typically stored in our brains, so that nurse and APPs can provide broader preoperative support

Create a usable tool that you can tailor

Track behavior change, non-traditional metrics such as heart rate variability, VO2 max, grip strength and frailty along with medical testing to improve compliance



Allows anesthesiologists to
build software tailored to
their practice including
dashboards

Jan 13, 2026 – Technology

Anthropic's viral new work tool wrote itself



Megan Morrone



Add Axios on Google





Welcome back, Akbar

Sessions

• Needs input CV builder app Waiting on permission: mcp__Claude_Code_Remo... akbarherekar/CV-builder 3w ago >

Default Herihealth main +

Describe a task or ask a question



Accept edits +

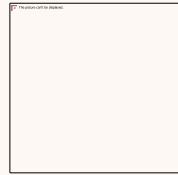


Table 5 High

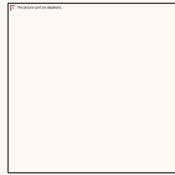
Keys to success:



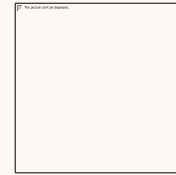
Use clear prompts. The more detail the better.



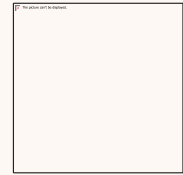
Use JSX and HTML.



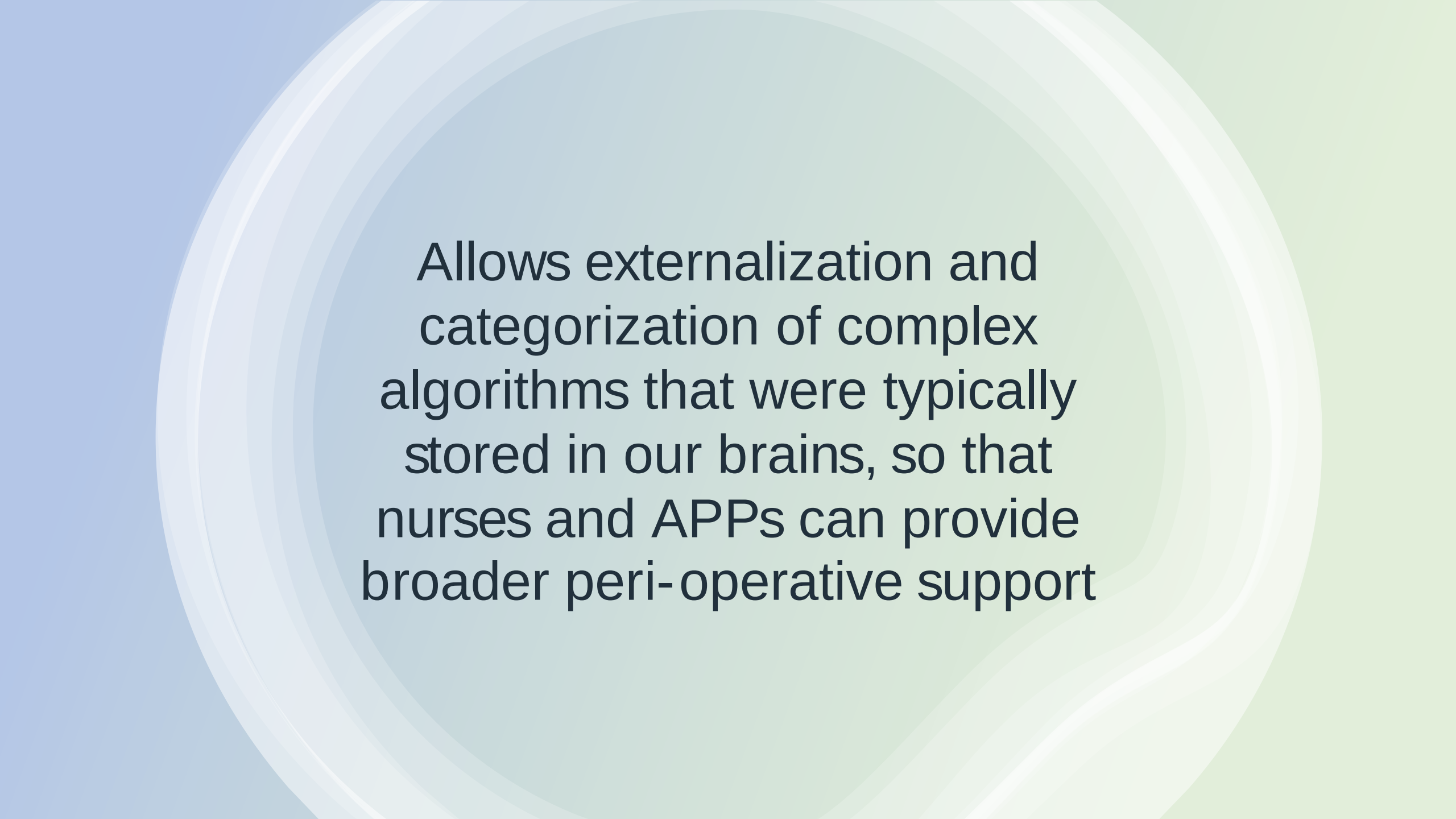
Use your phone for the chat and your computer for the phone



Create documents – Ask claude to do it.



Commit and push to Github regularly.



Allows externalization and categorization of complex algorithms that were typically stored in our brains, so that nurses and APPs can provide broader peri-operative support

The whole patient: a web of interacting guidelines

Every factor interacts with the others — reviewing each guideline in isolation misses the connections



Nine domains we assess in every patient.

Now every interaction between them — this is **one** patient.

AI collapses the web into a **plan**.

A **deterministic algorithm** encodes the clinical logic — the same reasoning, every time.

The **AI layer** handles the messy input and output around it — not the decisions.

Perioperative optimization — the algorithm at a glance

Recommendation domains across both tracks, each leaf with its evidence base



Trace any factor to its recommendations

Tap an intake factor — the recommendations it triggers light up (interactive in the live HTML version).

GLP-1: escalation / GI

Diabetes (any)

Recent MI

Low hemoglobin

Current smoker

Frailty / falls

GLP-1: escalation / GI → Escalation phase or active GI: liquid diet, gastric ultrasound, consider RSI.

SAFETY

GLP-1 GI: gastric US / RSI

SAFETY

SGLT2: hold, ketones

PATIENT

Exercise prehab

PROVIDER

GLP-1 RA management

PROVIDER

Glucose management

PROVIDER

Anemia workup



Create a usable tool that
you can tailor

03 Medical History

Cardiovascular

CAD/AnginaCHFHFReFHfPEFValvular disease

Severe aortic stenosis (symptomatic)Severe aortic stenosis (asymptomatic)

Mechanical valveArrhythmia/AFatrial fibrillation / flutterPacemaker/AICD

Cardiomyopathy/HCMPulmonary hypertensionPrior MI (within 6 months)

Prior PCI/stentPeripheral vascular diseasePrior strokeUncontrolled HTN (DBP >110)

Respiratory

COPD/EmphysemaAsthmaOSA (diagnosed)OSA (suspected/STOP-BANG ≥3)

Unexplained dyspnea

Endocrine / Metabolic

Type 1 DiabetesType 2 DiabetesHbA1c > 8Insulin pump

PheochromocytomaAdrenal diseaseAdrenal insufficiency / Addison's

Chronic steroid use

Other

Cirrhosis/liver diseaseChronic kidney disease (CKD)On dialysis

Renal insufficiency/dialysisAnemia (Hgb <13)Bleeding disorderSickle cell di

Seizure disorder / epilepsySeizure disorderMyasthenia gravis

Rheumatoid arthritis / autoimmuneRheumatoid arthritisDown syndrome

Active cancer/chemoHistory of MHDifficult airway historyFrailty/recent fall

Smoking, Alcohol & Anemia Assessment

Smoking Status

Select...▼

Alcohol Use

Select...▼

Hemoglobin (g/dL)

e.g. 11.5

Enables severity-graded anemia protocol

Known Iron Deficiency?

Select...

03 Medical History

Cardiovascular

CAD/Angina

CHF

HFrEF

HFpEF

Valvular disease

Severe aortic stenosis (symptomatic)

Severe aortic stenosis (asymptomatic)

Mechanical valve

Arrhythmia/AF

Atrial fibrillation / flutter

Pacemaker/AICD

Cardiomyopathy/HCM

Pulmonary hypertension

Prior MI (within 6 months)

Prior PCI/stent

Peripheral vascular disease

Prior stroke

Uncontrolled HTN (DBP >110)

Respiratory

COPD/Emphysema

Asthma

OSA (diagnosed)

OSA (suspected/STOP-BANG ≥3)

Unexplained dyspnea

Endocrine / Metabolic

Type 1 Diabetes

Type 2 Diabetes

HbA1c > 8

Insulin pump

Pheochromocytoma

Adrenal disease

Adrenal insufficiency / Addison's

Chronic steroid use

Other

Cirrhosis/liver disease

Chronic kidney disease (CKD)

On dialysis

Active cancer/chemo

History of MH

Difficult airway history

Frailty/recer

Clinical Detail (optional — unlocks more specific recommendations)

Leave any field blank if unknown.

Time since last cardiac event (MI/PCI/CABG)

Unknown

Rate-controlled (resting HR < 110)?

Unknown

STOP-BANG score (0–8)

0–8

0–2 low / 3–4 intermediate / ≥5 high

CPAP adherent?

Unknown

Last HbA1c (%)

e.g. 7.8

Tier 1 <7 · Tier 2 7–8.5 · Tier 3 8.5–10 (delay) · Tier 4 >10 (strong delay)

Diabetes type

Unknown

Diabetes duration

Unknown

Insulin use

Unknown / not on insulin

CGM use

Unknown



Your Readiness Plan

Surgery • ? weeks out • Risk: **HIGH**

Both Tracks

Patient View

Provider View

My Timeline

Download PDF

Save my plan

Track Progress

Refine details

Start Over

CRITICAL ALERTS



MI within 6 months — optimal to wait ≥ 60 days for elective NCS (2024 AHA/ACC Class 1). Proceed only after careful risk-benefit analysis.

PERIOPERATIVE RISK: HIGH

Comprehensive evaluation required. All provider protocols activated. Consider cardiology/specialty consultation.



Your Preparation Plan

7 action items



● Important Get Moving

Exercise — Physician Clearance Required

Active cardiac conditions detected (recent MI or uncontrolled HTN).

[Read more](#) ▼ ⓘ [Learn more](#) ▼



● Important Fuel Up

Protein Target: 272g/day (1.5 g/kg body weight)

Calculated on your recorded weight of ~181 kg.

[Read more](#) ▼ ⓘ [Learn more](#) ▼

[View Detailed Plan](#) →



Provider Optimization Track

10 clinical items

HIGH CARDIAC RISK

CAD / Prior MI — timing unknown

≥ 8 WK: Optimize GDMT: high-intensity statin, BB (continue; do NOT start <7d preop per POISE), aspirin, ACEi/ARB. BNP/NT-proBNP if elevated risk. DASI to replace subjective METs.

4–7 WK: If BNP >92 or NT-proBNP >300 → echo. DASI ≤ 34 + elevated risk → cardiology consult. Verify stent intervals: BMS ≥ 3 mo time-sensitive / ≥ 6 mo elective DES / ≥ 12 mo ACS. Plan DAPT management.

1–2 WK: Continue statin + beta-blocker. Verify antiplatelet plan.

DAY OF SURGERY: Continue BB + statin. Hold ACEi/ARB if HTN-only (STOP-or-NOT). Postop troponin at 24h and 48h (Class 2b). If MINS: ASA + high-intensity statin; consider dabigatran 110 mg BID (MANAGE); cardiology ≤ 30 d.



HIGH CARDIAC RISK

CAD / Prior MI — timing unknown

≥8 WK: Optimize GDMT: high-intensity statin, BB (continue; do NOT start <7d preop per POISE), aspirin, ACEi/ARB. BNP/NT-proBNP if elevated risk. DASI to replace subjective METs.

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READINESS: ≥60 d since MI (Class 1). GDMT optimized. Cardiology clearance documented.

Source: 2024 AHA/ACC; POISE Lancet 2008; MANAGE Lancet 2018; ASRA 5th Ed 2025

① Hide evidence ▲

CLINICAL RATIONALE

CAD and prior MI markedly amplify perioperative MACE risk via catecholamine surge, hypercoagulability, and systemic inflammation. The 2024 AHA/ACC guideline replaces subjective METs estimation with the validated DASI questionnaire and introduces BNP/NT-proBNP thresholds (>92 or >300 pg/mL) for selective echo referral. Beta-blockers must NOT be started within 7 days of surgery — the POISE trial showed acute initiation reduces MI but significantly increases stroke and all-cause mortality.

WHAT THE EVIDENCE SHOWS

POISE (Lancet 2008, n=8,351) demonstrated perioperative beta-blocker initiation reduced non-fatal MI by 27% but increased stroke by 100% and total mortality. MANAGE (Lancet 2018, n=1,754) showed dabigatran 110 mg BID significantly reduced major vascular complications in patients with MINS. The 2024 AHA/ACC perioperative guideline codifies these findings into current Class recommendations.

GUIDELINE SOURCES

1. Thompson A et al. 2024 AHA/ACC/ACS/ASNC/HRS/SCA/SCCT/SCMR/SVM Guideline for Perioperative Cardiovascular Management for Noncardiac Surgery. *Circulation*. 2024;150:e351–e442.
2. Devereaux PJ et al. Effects of extended-release metoprolol succinate (POISE). *Lancet*. 2008;371:1839–47.



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Protein Target: 272g/day (1.5 g/kg body weight)

Calculated on your recorded weight of ~181 kg.

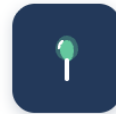
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WHY THIS WORKS

Surgery triggers accelerated protein catabolism — without adequate protein reserves before surgery, your body breaks down muscle to fuel the stress response, the inflammatory cascade, and wound repair. Preloading protein means your body has the raw material to maintain immune function, support tissue healing, and preserve the muscle you will need during recovery. Protein synthesis occurs in 25–40g per-meal doses; spreading intake across 3–4 meals is more effective than front- or back-loading.

WHAT THE EVIDENCE SHOWS

ESPEN (European Society for Clinical Nutrition and Metabolism) guidelines establish 1.2–2.0 g/kg/day as the perioperative protein target. Because protein requirements scale with lean body mass rather than total body mass, ESPEN advises dosing on ideal or adjusted body weight in overweight and obese patients — otherwise the target overestimates need. Higher preoperative protein intake is associated with reduced complications and



● Important Fuel Up

Protein Target: 110g/day (1.5 g/kg ideal body weight)

Your ideal body weight is ~73 kg (Devine formula, from your height and sex), below your recorded weight of ~136 kg. Protein needs track lean body mass rather than total weight, so your target is calculated on ideal body weight. Target range is 1.2–2.0 g/kg/day; 110g is the middle of that range. Distribute across 3–4 meals. Good sources: lean meats, fish, eggs, Greek yogurt, legumes, whey protein. If current intake is low, increase gradually over 1 week.

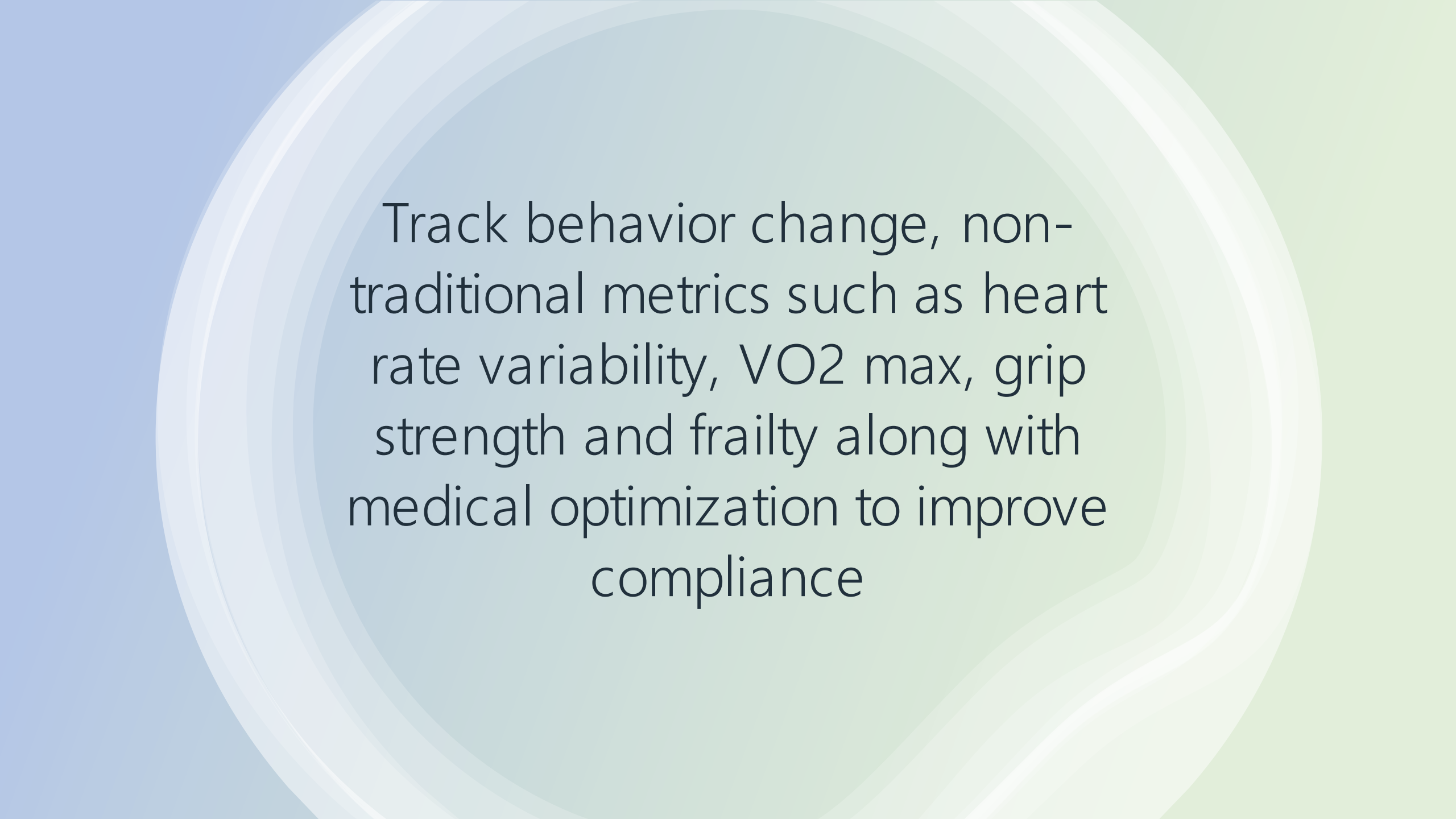
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Track behavior change, non-traditional metrics such as heart rate variability, VO2 max, grip strength and frailty along with medical optimization to improve compliance

Four windows into physiological reserve

VO₂MAX / ANAEROBIC THRESHOLD

22×

difference in perioperative mortality, 18% with AT below 11 mL/kg/min versus 0.8% at or above, in elderly major abdominal surgery

GRIP STRENGTH

HR 1.16

all-cause mortality per 5 kg reduction (n=139,691), a stronger predictor than systolic blood pressure; 46% versus 7% one-year mortality after esophagectomy

FRAILITY

RR 2.35

operative mortality in cardiac surgery (n=66,448); the Risk Analysis Index reaches a c-statistic of 0.87 for 30-day mortality

HEART RATE VARIABILITY

63 studies

systematic review: preoperative HRV predicts hemodynamic instability and postoperative atrial fibrillation

Correlated but not redundant. Each metric measures a different edge of the same surgical stress margin.

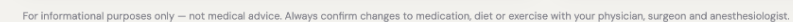
The clinic optimizes in parallel

PATIENT-FACING

- Exercise & prehabilitation
- Nutrition, protein, carb loading
- Sleep, stress, thermal, fasting
- Self-tracking & readiness

CLINICIAN-FACING

- Medication management
- Cardiac / respiratory / endocrine / heme
- Frailty & surgery-specific protocols
- Day-of-surgery verification



Robert Hayes 68 M · MRN 4471-882
Right total hip arthroplasty · 28 days · elective · intermediate-risk surgery

My Plan Care Team Timeline Export pre-op note

BMI 31.2 kg/m ² ●	HbA1c 8.4 % ●	Hgb 13.1 g/dL	EGFR 62 mL/min ●	VO ₂ MAX 15 est. ●	DASI 15 ≈4 METs ●	PLATELETS 244 k/μL
RCRI 2 Elevated eQTY MACF · 2024 AHA/ACC	ACS-NSQIP 8.4% Serious cx Predicted serious complication	CHA ₂ DS ₂ -VASc 4 Anticoag Stroke risk — resume DOAC post-op	CAPRINI VTE 7 High Pharm + mechanical prophylaxis	STOP-BANG 5 OSA high CPAP-dependent · opioid-sparing		

Critical perioperative actions 3 flags

- SGLT2 inhibitor — empagliflozin**

HOLD 3–4 days before surgery. Euglycemic DKA risk; check ketones perioperatively.
- GLP-1 RA — semaglutide (weekly)**

Hold 1 week per multi-society guidance. Aspiration risk — clear liquids 24h, consider gastric POCUS.
- Apixaban — neuraxial planning**

Hold 72h before neuraxial block (ASRA 5th Ed). Bridging not indicated; resume 24h post-op if hemostasis.

Medication hold timeline	days relative to surgery									
	-7	-5	-4	-3	-2	-1	OR	+1		
Semaglutide GLP-1 RA	LAST									
Empagliflozin SGLT2i			LAST							
Apixaban DOAC				LAST						
Metformin biguanide						LAST				
Atorvastatin statin										
Continue Last dose Hold Resume post-op										

Clinical decision support based on 2024 AHA/ACC, ASRA 5th Ed 2025, ESAIC 2025 and multi-society GLP-1 RA guidance. Does not replace physician judgment or establish a standard of care. The treating physician, surgeon and anesthesiologist retain full responsibility for all decisions.

Pre-Operative Briefing
Robert Hayes · 68 M · Right total hip arthroplasty · 28 days out

My Plan Care Team Timeline Print briefing

READINESS VERDICT

Proceed with optimization

No absolute contraindication. Four-week window supports glycemic, functional and medication optimization before an intermediate-risk elective case.

ProceedOptimizeCURRENTDelay

- S Situation**
- 68 M for elective right total hip arthroplasty in 4 weeks. Rate-controlled atrial fibrillation on apixaban, type 2 diabetes on triple therapy including SGLT2i and weekly GLP-1 RA, and CPAP-treated obstructive sleep apnea.
- B Background — active issues** severity
- Diabetes, HbA1c 8.4% — above pre-op target; on metformin + empagliflozin + semaglutide

Atrial fibrillation — CHA₂DS₂-VASc 4; anticoagulated with apixaban 5 mg BID

Obstructive sleep apnea — STOP-BANG 5; home CPAP, good adherence

Deconditioning — DASI 15 ≈ 4 METs; sedentary baseline, BMI 31

Hematology — Hgb 13.1, platelets 244 — no anemia workup indicated

Medication	Action	Rationale
Semaglutide	Hold 1 week	GLP-1 RA · aspiration risk
Empagliflozin	Hold 3–4 days	SGLT2i · euglycemic DKA
Apixaban	Hold 72 h	ASRA neuraxial interval
Metformin	Hold morning of	Lactic acidosis precaution
Atorvastatin	Continue	Cardioprotective

- R Recommendation — orders & consults**
- Endocrine / diabetes consultORDERED

Baseline 12-lead ECGORDERED

Anesthesia pre-op clinic visitSCHEDULED

Refer to 4-week prehabilitationOPEN

Type & screen, CBC, BMP, HbA1c recheckOPEN

Confirm CPAP brought day-of-surgeryOPEN

GENERATED: SurgeryReady · 7 Jun 2026 PREPARED FOR: Dr. A. Herekar — Anesthesiology STATUS: Awaiting attending review Attest & finalize

Clinical decision support — not a standard of care. All recommendations must be reviewed, verified and individualized by the responsible clinician. Sources: 2024 AHA/ACC, ASRA 5th Ed 2025, ESAIC 2025, multi-society GLP-1 RA guidance.

Amplification and decision support, not autonomous care

- **The interventions are unchanged.**

Prehabilitation, anemia management, frailty screening, guideline-directed cardiac evaluation — all well supported by trial data.

- **The human stays in the loop. This augments judgment; it does not replace it.**

It finds the right patient earlier and quantifies risk better than the scores we trained on, while extending a shrinking workforce.

- **The cautions are a specification for responsible use, not a veto.**

External validation, local calibration, bias auditing, continuous monitoring, and an accountable human in the loop.

The anesthesiologist who understands BOTH halves of this evidence base is the one who deploys AI to make surgery measurably safer.

"If Yan can cook, so can you!"



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