

Committee on Trauma

Scientific Session

49th Annual Resident and Fellow Trauma Paper Competition

Presented during the
104th Annual Meeting
of the
**American College of Surgeons
Committee on Trauma**

Thursday, March 12, 2026
Birmingham, AL



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49th Annual Resident and Fellow Trauma Paper Competition

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of the
**American College of Surgeons
Committee on Trauma**

Moderators:

Warren C. Dorlac, MD, FACS
(Chair, Regional Committees on Trauma)

Lacey N. LaGrone, MD, MPH, MA, FACS
Deidre L. Wyrick, MD, FACS

Thursday, March 12, 2026
Birmingham, AL

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Acknowledgments

The American College of Surgeons gratefully acknowledges the generous support from the following individuals and organizations for the Resident and Fellow Trauma Paper Competition between **March 1, 2025, and December 31, 2025:**

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Continuing Medical Education Credit Information

CONTINUING MEDICAL EDUCATION CREDIT INFORMATION

Accreditation

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Program Objectives

- Discuss current research in patient care for trauma injuries
- Evaluate new methods for treatment of trauma patients

Continuing Medical Education Credit Information (Cont)

Disclosure Information

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Role: Consultant for Aspen Medical

Received: Salary received from Aspen Medical

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Continuing Medical Education Credit Information (Cont)

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Disclosure

Company: CSL Behring; Intuitive Surgical

Role: Travel Support

Received: Consultancy; Educational Event Support

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Disclosure

Company: Humacyte / Symvess

Role: Research Funding

Received: PI

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Role: Consulting Fee & Travel Support

Received: Consultancy

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Disclosure

Company: UptoDate; PolyNovo; Spectral MD

Role: Royalties; Honorarium; Reimbursement

Received: Author for Surgical Nutrition Tips; Consultancy; Sponsored Research

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Co-Moderators

Lacey N. LaGrone, MD, MPH, MA, FACS

Disclosure

Company: TogetherMADE

Role: 50% equity

Received: Owner

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Resident and Fellow Trauma Paper Competition – Past Winners

Resident and Fellow Trauma Paper Competition

1978

1st Place: **John A. Weigelt**
Runner Up: Mary H. McGrath

1979

Joseph V. Boykin
1st Place: Christopher C. Baker
Runner Up: Frank D. Manart

1980

Robert Tranbaugh
1st Place: Gary M. Gartsman
Runner Up: John B. Moore

1981

Kenneth Kollmeyer
1st Place: Kenneth A. Kudsk
Runner Up: James Hammesfahr

1982

Raj K. Narayan
1st Place: George S. Fortner
Runner Up: Hani Shennib

1983

Mark DeGroot
1st Place: Gregory Luna
Runner Up: Mercedes Dullum

1984

Ronald B. O’Gorman
1st Place: Louis Ostrow
Runner Up: Frederick A. Moore

1985

Lawrence Reed
1st Place: Frank Shannon
Runner Up: M. Rebot

1986

Richard S. Downey
1st Place: Richard Kiplovic
Runner Up: Wiley W. Souba

Basic Laboratory Science

1987

1st Place: **Nicholas B. Vedder**
Runner Up: B. Timothy Baxter

1988

1st Place: **Gary Fantini**
Runner Up: David H. Livingston

1989

1st Place: **David K. Magnuson**
Runner Up: Matthew L. Cooper

1990

1st Place: **William J. Mileski**
Runner Ups: Gary A. Gelfand, Jon C. Walsh

1991

1st Place: **Roy W. Hong**
Runner Up: Benjamin O. Anderson

1992

1st Place: **Michael O’Reilly**
Runner Up: David Bensard

1993

1st Place: **Thomas T. Sato**
Runner Ups : Paul A. Taheri, Alastair C. J. Windsor

1994

1st Place: **James T. Wilson**
Runner Up: Robert F. Noel Jr.

1995

1st Place: **Donald W. Pate**
Runner Up: Carol J. Cornejo

1996

1st Place: **Kenneth E. Drazan**
Runner Up: Carlton C. Barnett Jr.

1997

1st Place: **Randy J. Irwin**
Runner Up: Molly M. Buzdon

1998

1st Place: **Geoffrey Manley**
Runner Up: Gregory J. McKenna

1999

1st Place: **Andrew Kramer**
Runner Up: D. Kirk Lawlor

2000

1st Place: **Philip P. Narini**
Runner Up: George D. Oreopoulos

2001

1st Place: **Deepa Soni**
Runner Up: Daron C. Hitt

2002

1st Place: **Jonas Gopez**
Runner Up: Steven Casha

2003

1st Place: **Eve C. Tsai**
Runner Up: Katherine Barsness

2004

1st Place: **Rachel G. Khadaroo**
Runner Up: Manuel B. Torres

2005

1st Place: **John M. Hwang**
Runner Up: Aaron M. Cheng

2006

1st Place: **Preya Ananthakrishnan**
Runner Up: Jessica Deree

2007

1st Place: **Alexander Q. Ereso**
Runner Up: Sagar S. Damle

2008

1st Place: **Jason M. Seery**
Runner Up: Elizabeth A. Sailhamer

2009

1st Place: **Elizabeth A. Sailhamer**
Runner Up: Reed B. Kuehn

2010

1st Place: **Angela L. F. Gibson** [Reg 5]
Runner Up: Arash Farahvar [Reg 2]

2011

1st Place: **Laura E. White** [Reg 6]
Runner Up: Marlene Mathews [Reg 2]

2012

1st Place: **Laura E. White** [Reg 6]
Runner Up: Alex Cuenca [Reg 4]

2013

1st Place: **Abubaker A. Ali** [Reg 5]
Runners Up: Isaiah R. Turnbull [Reg 7],
Kristin L. Long [Reg 4]

2014

1st Place: **Michaela C. Kollisch-Singule**
[Reg 2]
Runner Up: Matthew W. Ralls [Reg 5]

2015

1st Place: **Simone M. Langness** [Reg 9]
Runner Up: Michaela C. Kollisch-Singule
[Reg 2]

Resident and Fellow Trauma Paper Competition – Past Winners (Cont)

- 2016**
1st Place: **Rachel M. Russo** [Reg 13]
Runner Up: Sarah Ogle [Reg 9]
- 2017**
1st Place: **Teresa C. Rice** [Reg 5]
Runner Up: Theresa Chan [Reg 9]
- 2018**
1st Place: **Michael Valliere** [Reg 7]
Runner Up: Theresa Chan [Reg 9]
- 2019**
1st Place: **Elliott Williams** [Reg 9]
Runner Up: Patricia Martinez-Quinones [Reg 4]
- 2020**
1st Place: **Julia R. Coleman** [Reg 8]
Runner Up: Amanda M. Chipman [Reg 3]
- 2021**
1st Place: **Julia R. Coleman** [Reg 8]
Runner Up: Zachary A. Matthay [Reg 9]
- 2022**
1st Place: **Jessie W. Ho** [Reg 5]
Runner Up: Mark Berry [Reg 9]
- 2023**
1st Place: **Terry (TJ) R. Schaid** [Reg 8]
Runner Up: Jennifer A. Munley [Reg 4]
- 2024**
Overall 1st, 2nd, 3rd Place
1st Place: **Lauren Gallagher** [Reg 8]
Runner Up: Adam D. Price [Reg 5]
3rd place: Sophia Engel [Reg 15], Jennifer A. Munley [Reg 4]
- 2025**
1st Place: **Ashley N. Flinn Patterson** [Reg 13]
Runner Up: Benjamin Stocker [Reg 8]
-
- ### Clinical Research
- 1987**
1st Place: **Eric DeMaria**
Runner Up: John D.S. Reid
- 1988**
1st Place: **Christoph Kaufmann**
Runner Up: Tomasso Bochicchiot
- 1989**
1st Place: **Bradley Reeves**
Runner Up: Danielle Desloges
- 1990**
1st Place: **Miguel Lopez Viego**
- 1991**
1st Place: **Karl Illig**
Runner Up: Carson Agee
- 1992**
1st Place: **William S. Hoff**
Runner Up: Juan Manuel Sarmiento-Martinez
- 1993**
1st Place: **Patricia Yugueros**
- 1994**
1st Place: **Stefan J. Konasiewicz**
Runner Up: Paul J. Gagne
- 1995**
1st Place: **Russell R. Lonser**
Runner Up: John J. Keleman
- 1996**
1st Place: **Peter D. Wearden**
Runner Up: Nicholas Namias
- 1997**
1st Place: **Preston R. Miller**
Runner Up: Katharina Pellegrin
- 1998**
1st Place: **E. Lynne Henderson**
Runner Up: Juan P. Carbonell
- 1999**
1st Place: **Garret Zallen**
Runner Up: Avery B. Nathens
- 2000**
1st Place: **Joseph T. Rabban**
Runner Up: Avery B. Nathens
- 2001**
1st Place: **John-Paul Veri**
Runner Up: Moishe Lieberman
- 2002**
1st Place: **Ram Nirula**
Runner Up: Seong K. Lee
- 2003**
1st Place: **Steven Fox**
Runner Up: David J. Schultz
- 2004**
1st Place: **Matthew Rosengart**
Runner Up: Carlos V. R. Brown
- 2005**
1st Place: **Felicia Ivascu**
Runner Up: Stephanie P. Acierno
- 2006**
1st Place: **Alexander L. Eastman**
Runner Up: David O. Francis
- 2007**
1st Place: **Alexandra Mihailovic**
Runner Up: Heather F. Pidcoke
- 2008**
1st Place: **Joseph F. Golob Jr.**
Runner Up: Sherene Shalhub
- 2009**
1st Place: **Alexios A. Adamides**
Runner Up: Joseph DuBose
- 2010**
1st Place: **Barbara Haas**, [Reg 12]
Runner Up: Thomas M. Schmelzer [Reg 4]
- 2011**
1st Place: **Levi D. Procter** [Reg 4]
Runner Up: Matthew D. Neal [Reg 5]
- 2012**
1st Place: **Kristin Cook** [Reg 2]
Runner Up: Jennifer Roberts [Reg 5]
- 2013**
1st Place: **Eiman Zargarán** [Reg 11]
Runner Up: David A. Hampton [Reg 10]
- 2014**
1st Place: **Hunter B. Moore** [Reg 8]
Runner Up: Vanessa J. Fawcett [Reg 10]
- 2015**
1st Place: **Deepika Nehra** [Reg 10]
Runner Up: Cherisse Berry [Reg 3]
- 2016**
1st Place: **James P. Byrne** [Reg 12]
Runner Up: Lynn Hutchings [Reg 15]

Clinical Research (Cont)

2017

1st Place: **Stephanie A. Mason** [Reg 12]

Runner Up: Sabrina Balakrishnan, MBBS
[Reg 16]

2018

1st Place: **Luke R. Johnson** [Reg 13]

Runner Up: Jarred R. Gallaher [Reg 4]

2019

1st Place: **Hope Villiard** [Reg 7]

Runner Up: Parin Boonthum [Reg 16]

2020

1st Place: **Alexandra Dixon** [Reg 10]

Runner Up: Jetan H. Badhiwala [Reg 12]

2021

1st Place: **Max Marsden** [Reg 15]

Runner Up: Eric Walser [Reg 12]

2022

1st Place: **Luis I. Ruffolo** [Reg 2]

Runners Up: Mary Bokenkamp [Reg 1],
Jeongyoon (Jenny) Moon [Reg 12]

2023

1st Place: **Karan K'Souza** [Reg 11]

Runner Up: Ann Polcari [Reg 5]

2024

No prize awarded

2025

1st Place: **Kajal Mehta** [Reg 10]

Runner Up: **Milandeep** [Reg 16]

Achieving Excellence in Surgery Through Equity

2024

1st Place: **Armaan K. Malhotra** [Reg 12]

2025

1st Place: **Alyscia Severance** [Reg 4]

2026 Regional Winners

Institution and location current at time of paper/abstract submission

Region 1

Olivia Fauver, MD | University of Vermont, Burlington, VT

“Intravital Imaging of Endothelial Calcium Signals in a Surgical Model of Microvascular Trauma”

Region 2

Conor P. Lynch, MD | SUNY Upstate Medical University, Syracuse, NY

“Single Antibiotic Use with Ceftriaxone for Prophylaxis of All Open Fractures”

Region 3

Anna E. Garcia Whitlock, MD, PhD | University of Pennsylvania, Philadelphia, PA

“Loss of Glucagon Action in the Liver Is Associated with Decreased Stress-Induced Hyperglycemia and Decreased Markers of Inflammation After Trauma and Hemorrhage”

Region 4

Chandler A. Annesi, MD | The University of Alabama at Birmingham, Birmingham, AL

“Reevaluation of Hemodynamic Instability in the Pediatric Trauma Population”

Region 5

Jessica Cao, MD | University of Chicago Medicine, Chicago, IL

“Pathogen-Induced Coagulopathy: The Role of the Gut Microbiota and Pathogen-Derived Virulence Factors in the Development of Clinically Significant Coagulopathy in Critical Illness”

Region 6

Ava K. Mokhtari, MD | Baylor College of Medicine, Houston TX

“HS3ST1 Regulates Pulmonary Inflammation and Is a Determinant of Clinical Outcomes After Trauma and Hemorrhagic Shock”

Region 7

Ricardo A. Fonseca, MD | Washington University in St. Louis, St. Louis, MO

“Determining Current Trends in Prehospital Care of Patients with Penetrating Injuries”

Region 8

Anastasia (Sasha) M. Kahan, MD | University of Utah, Salt Lake City, UT

“Plain Radiograph Utilization in Pediatric Blunt Trauma Patients with Suspicion for Cervical Spine Injury: A Prospective Observational Analysis of the Western Pediatric Cervical Spine Study”

Region 9

Ariyan Tabesh, MD | University of California San Francisco, Oakland, CA

“Therapeutic Limb Hypothermia Preserves Function in a Novel Survival Porcine Model of Acute Hindlimb Ischemia”

Region 10

Hannah Wild, MD | University of Washington, Seattle, WA

“Prehospital Tourniquet Use and Associated Outcomes in a Low-Resource Conflict Setting: Prospective Casualty Data from the Sahel”

Region 11

Vishwathsen Karthikeyan, MD | University of Toronto, Toronto, ON, Canada

“Disparities and Institutional Variation in Time to Surgery for Traumatic Cervical Spinal Cord Injury: A Multicenter Cohort Study”

Region 12

Elliott K. Yee, MD | University of Toronto, Toronto, ON, Canada

“Routine Primary Care Cancer Screening Is Associated with Reduced Long-Term Mortality After Severe Traumatic Injury”

Region 13

Kyle Patterson, MD | Water Reed National Military Medical Center, Bethesda, MD

“Functional and Physiologic Outcomes of Variable Limb Ischemia in a Porcine Model of Hemorrhagic Shock”

Region 14

Maria Agustina Pienovi, MD | Hospital de Clínicas, Montevideo, Uruguay

“Liver Hepatic Packing with Hemostatic Materials in an Animal Model”

Region 15

Rald V. M. Groven, MD, PhD | RWTH Aachen University Hospital, Aachen, Germany

“The RIA System Reduces Systemic Pro-Inflammatory and Pro-Fibrotic MicroRNA Expression in Both Mono and Polytrauma: Results from a Porcine Polytrauma Model”

Region 16

Samman Khalid, MBBS, MRCS | Holy Family Hospital, Rawalpindi Medical University, Rawalpindi, Pakistan

“Artificial Intelligence Tool for Acute Burn Care”

2026 Presentation Order

Institution and location current at time of paper/abstract submission

Region 14

Maria Agustina Pienovi, MD | Hospital de Clínicas, Montevideo, Uruguay

“Liver Hepatic Packing with Hemostatic Materials in an Animal Model” *Discussant: Thomas J. Schroepfel, MD, MS, FACS*

Region 8

Anastasia (Sasha) M. Kahan, MD | University of Utah, Salt Lake City, UT

“Plain Radiograph Utilization in Pediatric Blunt Trauma Patients with Suspicion for Cervical Spine Injury: A Prospective Observational Analysis of the Western Pediatric Cervical Spine Study” *Discussant: Timothy Plackett, DO, MPH, FACS*

Region 1

Olivia Fauver, MD | University of Vermont, Burlington, VT

“Intravital Imaging of Endothelial Calcium Signals in a Surgical Model of Microvascular Trauma” *Discussant: Matthew E. Kutcher, MD, MS, FACS*

Region 16

Samman Khalid, MBBS, MRCS | Holy Family Hospital, Rawalpindi Medical University, Rawalpindi, Pakistan

“Artificial Intelligence Tool for Acute Burn Care” *Discussant: Kathleen S. Romanowski, MD, MAS, FACS*

Region 3

Anna E. Garcia Whitlock, MD, PhD | University of Pennsylvania, Philadelphia, PA

“Loss of Glucagon Action in the Liver Is Associated with Decreased Stress-Induced Hyperglycemia and Decreased Markers of Inflammation After Trauma and Hemorrhage” *Discussant: David P. Blake, MD, MPH, DMCC, FACS*

Region 7

Ricardo A. Fonseca, MD | Washington University in St. Louis, St. Louis, MO

“Determining Current Trends in Prehospital Care of Patients with Penetrating Injuries” *Discussant: David J. Schultz, MD, FACS*

Region 5

Jessica Cao, MD | University of Chicago Medicine, Chicago, IL

“Pathogen-Induced Coagulopathy: The Role of the Gut Microbiota and Pathogen-Derived Virulence Factors in the Development of Clinically Significant Coagulopathy in Critical Illness” *Discussant: Megan T. Quintana, MD, FACS*

Region 11

Vishwathsen Karthikeyan, MD | University of Toronto, Toronto, ON, Canada

“Disparities and Institutional Variation in Time to Surgery for Traumatic Cervical Spinal Cord Injury: A Multicenter Cohort Study” *Discussant: Jared R. Gallaher, MD, MPH, FACS*

Region 15

Rald V. M. Groven, MD, PhD | RWTH Aachen University Hospital, Aachen, Germany

“The RIA System Reduces Systemic Pro-Inflammatory and Pro-Fibrotic MicroRNA Expression in Both Mono and Polytrauma: Results from a Porcine Polytrauma Model” *Discussant: Mary F. Stuever, DO, FACS*

Region 2

Conor P. Lynch, MD | SUNY Upstate Medical University, Syracuse, NY

“Single Antibiotic Use with Ceftriaxone for Prophylaxis of All Open Fractures” *Discussant: Kevin M. Schuster, MD, MPH, FACS*

Region 9

Ariyan Tabesh, MD | University of California San Francisco, Oakland, CA

“Therapeutic Limb Hypothermia Preserves Function in a Novel Survival Porcine Model of Acute Hindlimb Ischemia” *Discussant: D. Roxanne Todor, MD, MBA, FACS*

Region 4

Chandler A. Annesi, MD | The University of Alabama at Birmingham, Birmingham, AL

“Reevaluation of Hemodynamic Instability in the Pediatric Trauma Population” *Discussant: Nicholas Namias, MD, MBA, FACS*

Region 6

Ava K. Mokhtari, MD | Baylor College of Medicine, Houston TX

“HS3ST1 Regulates Pulmonary Inflammation and Is a Determinant of Clinical Outcomes After Trauma and Hemorrhagic Shock” *Discussant: Brian J. Eastridge, MD, FACS*

Region 10

Hannah Wild, MD | University of Washington, Seattle, WA

“Prehospital Tourniquet Use and Associated Outcomes in a Low-Resource Conflict Setting: Prospective Casualty Data from the Sahel” *Discussant: Andrew “Drew” Davis, MD, FACS*

Region 13

Kyle Patterson, MD | Water Reed National Military Medical Center, Bethesda, MD

“Functional and Physiologic Outcomes of Variable Limb Ischemia in a Porcine Model of Hemorrhagic Shock” *Discussant: Elizabeth N. Turner, MD, FACS*

Region 12

Elliott K. Yee, MD | University of Toronto, Toronto, ON, Canada

“Routine Primary Care Cancer Screening Is Associated with Reduced Long-Term Mortality After Severe Traumatic Injury” *Discussant: Kyle W. Cunningham, MD, MPH, FACS*

The afternoon session will run 3:45–6:00 pm (same location).

Competition in 2027

Look Ahead to the 2027 Competition

The deadline for regional submission of first-place region winners is **December 10, 2026**.

Regional first-place winners automatically present at the March COT Annual Meeting.

Second-place regional winners will not be reviewed for presentations in March but will be eligible for a scholarship to attend the Mattox Vegas Trauma, Critical Care & Acute Care Surgery Conference in Las Vegas, Nevada. The scholarship program has previously awarded meeting registration and hotel accommodations.

All selected presenters will be required to **submit a submission-ready manuscript by February 1, 2027**; the manuscript will be considered part of the final winner selection in March.

Prizes to be awarded will recognize the first- and second-place winners in both Basic Science and Clinical Research papers, as well as the “Achieving Excellence in Surgery through Equity” prize.

For detailed information on next year’s competition, please refer to the Resident and Fellow Trauma Paper Competition web page at: <https://www.facs.org/quality-programs/trauma/committee-on-trauma/trauma-papers-competition/>



Region 14 – Basic Science

Liver Hepatic Packing with Hemostatic Materials in an Animal Model

Maria Agustina Pienovi, MD, Edward Delgado, MD, Marcelo Pontillo, MD
 Joaquín Bado, MD, Juan Cossa, MD, Juan Posse, MD

Introduction:

Liver trauma is one of the leading causes of intra-abdominal hemorrhage, associated with high morbidity and mortality. Hepatic packing is a well-known damage control technique, but it presents complications such as rebleeding. Clinical studies have demonstrated the effectiveness of packing in major liver injuries but not exempt from complications. In response, research was done on the use of absorbable hemostatic materials like Surgicel and Hemopatch, which have shown efficacy in both surgery and experimental trauma. In this study, our objective was to evaluate their application in an animal model of liver trauma.

Methods:

We conducted an experimental, prospective and single-blinded study, with the use of 40 *Rattus norvegicus* rats, Sprague Dawley strain. We performed a liver injury: standardized 2 cm laceration on the left hepatic lobe using a cold scalpel. We did a packing with 2 gauze pads - control group -, and in the experimental groups, we interposed a single layer of Surgicel or Hemopatch between the liver and the gauze. Packing was removed after 24 hours

Results:

Group	n	Rebleeding n %	VIBe median (RIQ)	24 h survival
Surgicel	14	2 (14.3%)	0 (0-1)	93 % (13/14)
Hemopatch	13	5 (38.5%)	1 (0-2)	85 % (11/13)
Standard packing	13	9 (69.2%)	2 (1-3)	77 % (10/13)

Surgicel vs control packing $p = 0.003$; Surgicel vs Hemopatch $p = 0.041$; Hemopatch vs control packing $p = 0.087$.

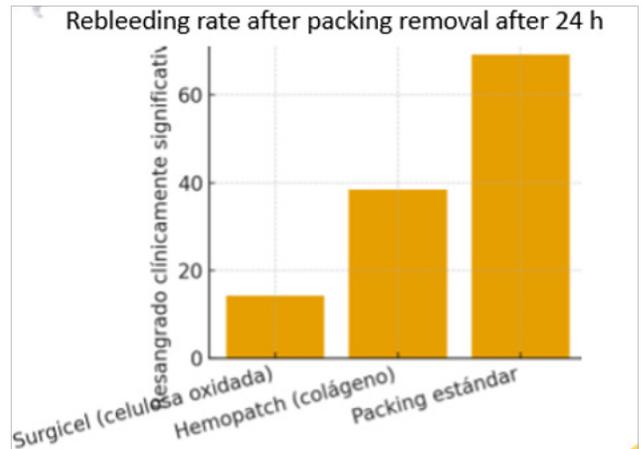


Figure 1. Rebleeding rate (VIBe ≥ 2) by group at 24 h.

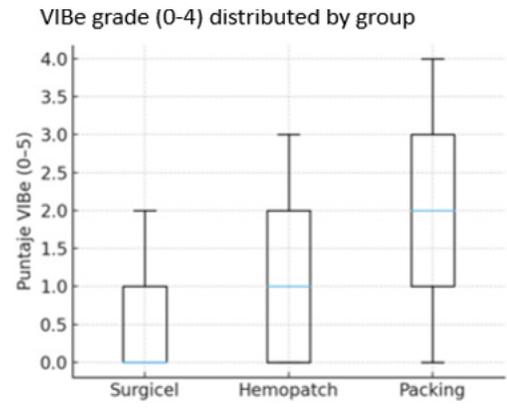


Figure 2. Scores distribution VIBe (0-5) by group.

Conclusions:

We conclude that interposing Surgicel during hepatic packing significantly reduces rebleeding compared to Hemopatch and standard packing. Larger studies and controlled clinical trials are recommended to confirm its usefulness in patients with hepatic trauma.

Region 8 - Clinical Research

Plain Radiograph Utilization in Pediatric Blunt Trauma Patients with Suspicion for Cervical Spine Injury: A Prospective Observational Analysis of the Western Pediatric Cervical Spine Study

Anastasia (Sasha) M. Kahan, MD

Background:

Optimal imaging for cervical spine evaluation following pediatric blunt trauma remains controversial. Although consensus guidelines from the Pediatric Cervical Spine Clearance Working Group support plain radiographs (XR) as an appropriate first-line screening modality in most children, national trends increasingly favor computed tomography (CT), exposing children to substantially higher radiation without clear clinical justification. Importantly, most injured children in the United States receive treatment at adult or mixed trauma centers, where pediatric-specific imaging practices and guideline adherence are variable. We sought to prospectively characterize cervical spine imaging patterns, with particular focus on real-world utilization of XR in asymptomatic, non-obtunded children.

Methods:

The Western Pediatric Cervical Spine Study (WPCSS) is a prospective, multicenter observational cohort of children aged 0-18 years presenting with blunt trauma to 72 pediatric, adult, and mixed trauma centers from 2022-2025. Patients who met national trauma data standard inclusion after blunt mechanism trauma and who underwent any cervical spine imaging (XR, CT, or MRI) within 24 hours of injury were included. The primary outcome was XR utilization in asymptomatic, non-obtunded children (GCS \geq 13, no pain or neurologic deficit on arrival). XR and CT use were compared across trauma center types, and predictors of XR utilization were evaluated using univariate and multivariable logistic regression.

Results:

Of 19,995 enrolled patients, 9.2% were treated at adult centers, 76.1% at pediatric centers, and 14.7% at mixed centers. Pediatric centers evaluated younger patients, more transfers, and more suspected child abuse cases, while adult centers treated the oldest and least severely injured cohort. Overall, only 40% of children underwent XR, with marked variation by center type: pediatric centers used XR in 48% of asymptomatic children, compared with 17% at mixed centers and just 5% at adult centers ($p < 0.001$). CT was used in 61% of the entire cohort and in 95% of children at adult centers, regardless of clinical risk. In multivariable analysis, treatment at a pediatric center was the strongest predictor of XR use (adjusted OR 8.99, 95% CI 7.47-10.82), while older age, ICU admission, and high-risk mechanisms decreased XR likelihood. Nearly 7,600 children received CT without meeting clinical criteria for advanced imaging, suggesting substantial excess radiation exposure.

Conclusions:

Plain radiographs remain significantly underutilized for pediatric cervical spine screening in the United States, with the most pronounced overuse of CT at adult trauma centers and only modestly improved use at pediatric facilities. Despite published pediatric-specific guidelines, real-world practice continues to diverge from evidence-based standards. These findings identify a critical implementation gap and establish a national baseline from which deployment of the PECARN cervical spine prediction rule can be measured. Incorporating pediatric imaging appropriateness into ACS TQIP metrics may provide a path toward reducing unnecessary radiation exposure and aligning national trauma practice with contemporary pediatric guidelines.

Region 1 – Basic Science

Intravital Imaging of Endothelial Calcium Signals in a Surgical Model of Microvascular Trauma

Olivia Fauver, MD, Adrian M. Sackheim, Bryan Walters, Rachel Barba, Grant Hennig, PhD, Mark T. Nelson, PhD, Kalev Freeman, MD, PhD

Background:

Endothelial cell calcium signaling plays a critical role in regulating vascular function, but the mechanisms by which signaling after vascular injury affect clot formation are not well understood. Therefore, we developed novel approaches to study endothelial cell calcium signals produced by a pulsed laser injury in vivo and in vitro using spinning disc confocal microscopy of the externalized mesentery or cultured endothelial cells labeled with calcium indicators.

Objective:

We hypothesize that endothelial calcium signals are produced by laser injury, that these signals propagate both anterograde and retrograde along the vascular wall, and that the rate and extent of signal propagation in vivo model will match what we observe in an endothelial cell culture model. We will also establish the mechanism by which calcium signals propagate between cells using the cell culture model.

Approach:

We used cell culture experiments to quantify calcium signal propagation after photo-stimulation, using pharmacological blockers to block candidate pathways important in endothelial cell calcium signals. Micropoint laser ablation was utilized to injure a single cell through photolysis of the plasma membrane and the ensuing wave propagation and velocity were measured. The spatio-temporal rosetting was captured with coincident mapping. We then developed a method to externalize the mesenteric circulation of anesthetized mice and induce a laser injury to a single blood vessel to measure calcium propagation and thrombus formation in real time.

Results:

1. Mechanism – gap junction for initial rosette, ATP soluble mediator causes release of SOCE in bystander cells. 2. Velocity in cells: Initial radiating velocity is $\sim 30\mu\text{m.s}$, velocity across first line of cells = $\sim 10\mu\text{m.s}^{-1}$, velocity across second line of cells = $\sim 7\mu\text{m.s}^{-1}$, velocity across third line of cells = $\sim 4\mu\text{m.s}^{-1}$. 3. Velocity in blood vessels initial radiating velocity is $\sim 30\mu\text{m.s}$.

Conclusion:

1. Propagation occurs and travels both ways, 2. Velocity matches cell culture, 3. Mechanism involves gap junctions/ ATP/ SOCE.

Region 16 – Clinical Research

Artificial Intelligence Tool for Acute Burn Care

Samman Khalid, MBBS, MRCS

Background:

Burn injuries remain a significant global health burden, causing significant morbidity and mortality. According to the World Health Organization, worldwide, approximately 180,000 deaths occur annually due to burns, with low and middle-income countries like Pakistan disproportionately affected. Early and accurate assessment of burn severity and Total Body Surface Area (TBSA) percentage is essential for guiding fluid resuscitation, surgical interventions, and timely referrals. However, in non-specialist hospitals and rural healthcare facilities across Pakistan, the lack of trained burn specialists necessitates reliance by clinicians on visual inspection, the most widely used method for burn assessment, which remains subjective and yields an accuracy of only 50–70%. This limitation contributes to delays in care, inappropriate treatment, and preventable complications. The objective of this study is to evaluate an Artificial Intelligence-based mobile application to improve early diagnosis of acute burn depth and TBSA, and to guide appropriate resuscitation decisions in such settings.

Patients and Methods:

This study was conducted in the Department of Plastic and Reconstructive Surgery, Holy Family Hospital, Rawalpindi, a tertiary referral burn center that caters to burn patients across the region. Patients older than 12 years presenting with acute burn injuries between January 2022 and December 2022 were included. Exclusion criteria were polytrauma, psychiatric illness, or refusal of consent. Following initial burn resuscitation and stabilization according to ATLS and institutional burn protocols, 2D clinical photographs of burn wounds were captured from mobile phones. Written informed consent was obtained from patients or legal guardians, and ethical approval was secured from the Institutional Review Board. The initial dataset included 2,726 images with 13,490 annotated instances. To address the imbalance between burn categories, targeted augmentation (rotation, flip, crop, scaling) was applied, generating a final balanced training dataset of 6,119 images and 19,552 annotated instances. The dataset was split 70:20:10 into training, validation, and testing sets, with an additional balanced validation set

(2,182 images, 5,196 instances) for performance comparison. Images were manually annotated by burn surgeons into five burn categories (first, second, third, fourth, and mixed-degree burns), and the TBSA was estimated using Wallace's Rule of Nines. The annotated dataset was then processed for model development. Three models were tested: a modified Vision Transformer, a transformer-based semantic segmentation model, and a hybrid Convolutional Neural Networks (CNN)-transformer model. Performance was measured with recall, precision, Dice score, accuracy, and Intersection Over Union. The best-performing model was integrated into a prototype mobile application for real-time burn assessment. Patient care continued per unit protocol, independent of the imaging process.

Results:

Of the included cases, 50.6% were male and 49.4% female, with a mean age of 42.8 years. The mean TBSA involved was 26.9%. Flame burns were the most common mechanism (68%), followed by scalds (22%), electrical injuries (6.4%), chemical burns (1.4%), and miscellaneous causes (2.6%). When tested, the Hybrid CNN-based instance segmentation model demonstrated the best performance, achieving 84.46% accuracy for five-category burn classification, 92.85% accuracy for binary detection of burn presence, and a Dice score of 0.4304, with stable training and no overfitting. Real-time testing through the mobile app confirmed rapid output, with classification, TBSA estimation, and fluid guidance delivered within seconds.

Conclusion:

To our knowledge, this is the first validated AI-powered mobile acute burn assessment tool in Pakistan. The application demonstrated reliable performance in burn depth classification and TBSA estimation. By enabling accurate, real-time diagnosis, it addresses a critical gap in burn management and has the potential to reduce treatment delays, support timely referrals, and improve overall patient outcomes.

Region 3 – Basic Science

Loss of Glucagon Action in the Liver Is Associated with Decreased Stress-Induced Hyperglycemia and Decreased Markers of Inflammation After Trauma and Hemorrhage

Anna E. Garcia Whitlock, MD, PhD, Olivia Ong, BS, Matthew Gavin, BA, Niels Martin, MD, FACS
Carrie A. Sims, MD, PhD, FACS, Joseph A. Baur, PhD, Paul M. Titchenell, PhD

Background:

Stress-induced hyperglycemia (SIH) is an acute increase in glucose levels after injury, surgery, or illness that is associated with organ failure and death in the ICU, especially in trauma. SIH is canonically attributed to insulin resistance, however, trauma is accompanied by many metabolic derangements – including elevations in glucagon, a hormone that promotes hyperglycemia via hepatic glucose production. Normally glucagon is suppressed by glucose and insulin, and failure of this i.e. non-suppression is implicated in the pathogenesis of diabetes. Here we investigated the role of glucagon in SIH in patients and mouse models. We hypothesized that trauma patients with SIH exhibit abnormally elevated glucagon, and that loss of glucagon signaling can prevent SIH and improve markers of organ failure in liver.

Study Design:

The first of our two-part study identified 20 nondiabetic penetrating trauma patients who presented them to the bay with SIH (glucose > 200 mg/dL) and compared them to non-SIH controls matched for age and injury-severity score (ISS). Blood collected on arrival was used to measure glucagon and insulin via Luminex. To directly test the role of glucagon in SIH, we used the Cre-loxP inducible knockout system to generate mice acutely lacking the glucagon receptor in the adult liver (L-GcgrKO). The fixed pressure trauma and hemorrhage model was used to recapitulate SIH. Glucose, insulin, and glucagon were measured before injury and 90 minutes later (TH0 vs. TH90). We used radioactive glucose tracer infusions to estimate hepatic glucose production in trauma. We measured serum alanine transaminase (ALT) before and after trauma, and quantified liver tissue inflammatory markers by PCR and mitochondrial function by Oroboros.

Results:

By design, the 20 trauma patients with SIH exhibited high glucose compared to 20 age and ISS-matched controls (Figure 1A, $p < 0.0001$). Insulin was elevated in SIH (Figure 1B, $p < 0.05$). SIH patients exhibited glucagon non-suppression as exhibited by elevated glucagon despite elevated glucose and insulin (Figure 1C).

In mice, glucose, insulin, and glucagon increased at TH90 in controls ($p < 0.001$, $p < 0.05$, and $p < 0.05$) while L-GcgrKO mice were protected from SIH including decreased glucose and insulin at TH90 (Figure 2A-B). Radioactive glucose tracing confirmed reduced hepatic glucose

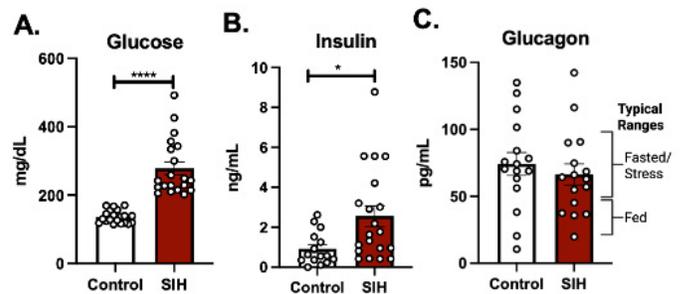


Figure 1. Glucagon is inappropriately elevated in trauma patients with stress-induced hyperglycemia (SIH). A. Mean glucose levels in penetrating trauma patients who presenting with SIH (glucose >200 mg/dL) compared to age and ISS-matched controls without SIH (n=20 each). B. Insulin was elevated in trauma patients with SIH ($p < 0.05$). C. Glucagon was not suppressed in SIH despite increased glucose and insulin. (* $p < 0.05$, **** $p < 0.0001$, typical glucagon ranges in fasted/stress vs. fed states noted).

Conclusion:

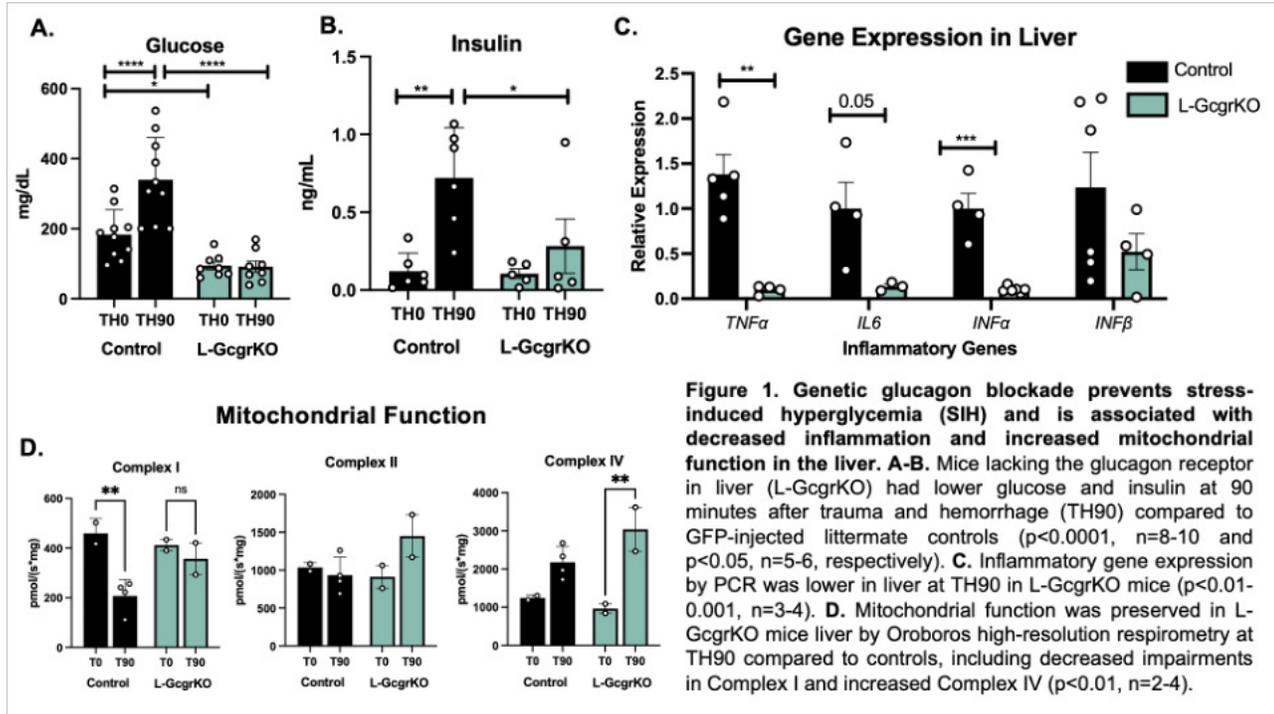


Figure 1. Genetic glucagon blockade prevents stress-induced hyperglycemia (SIH) and is associated with decreased inflammation and increased mitochondrial function in the liver. A-B. Mice lacking the glucagon receptor in liver (L-GcgrKO) had lower glucose and insulin at 90 minutes after trauma and hemorrhage (TH90) compared to GFP-injected littermate controls ($p < 0.0001$, $n = 8-10$ and $p < 0.05$, $n = 5-6$, respectively). C. Inflammatory gene expression by PCR was lower in liver at TH90 in L-GcgrKO mice ($p < 0.01-0.001$, $n = 3-4$). D. Mitochondrial function was preserved in L-GcgrKO mice liver by Oroboros high-resolution respirometry at TH90 compared to controls, including decreased impairments in Complex I and increased Complex IV ($p < 0.01$, $n = 2-4$).

Glucagon is abnormally regulated in trauma patients with SIH and is likely the predominant driver of SIH given loss of glucagon signaling in the liver prevents SIH in mice. This is associated with reduced markers of organ dysfunction in liver. Future work will disassociate the role of glucose versus glucagon in organ dysfunction including if acute pharmacological glucagon blockade can prevent SIH and organ failure after trauma.

Region 7 - Clinical Research

Determining Current Trends in Prehospital Care of Patients with Penetrating Injuries

Ricardo A. Fonseca, MD, Fabiana C. Sanchez, MD, Carolyn Tsung, BS, Marco J. Henriquez, MD
Michael W. Alchaer, MD, Melissa Canas, MD, Lindsay M. Kranker, MD
Grant V. Bochicchio, MD, MPH, Grace M. Niziolek, MD

Introduction:

Current prehospital trauma protocols for Emergency Medical Service (EMS) providers may not include separate protocols for patients with penetrating trauma. As a result, treatment priorities may more closely resemble those for patients with blunt injury, ultimately causing delays in definitive care. This study evaluates current trends in prehospital care for patients with penetrating injuries.

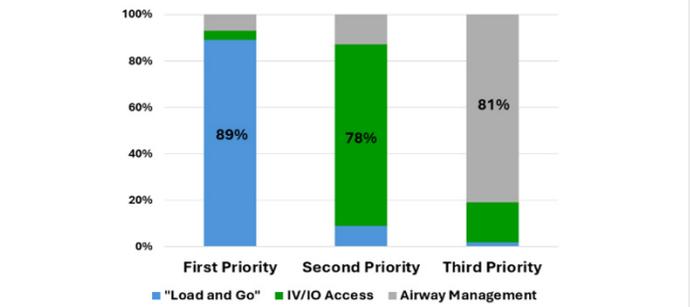
Methods:

We conducted a nationwide cross-sectional survey of EMS medical directors to assess prehospital treatment priorities for penetrating injury. Agency and director demographics were collected. Data were analyzed using descriptive statistics and univariable analysis, stratified by EMS response volume and geographic location.

Results:

A total of 46 directors completed the survey, all physicians with 95.7% specializing in emergency medicine. Most respondents classified their agencies as suburban (50%), followed by 32.6% urban and 17.4% rural. Nearly two thirds (63%) of respondents reported more than 25,000 yearly scene responses. Blood availability was reported by only 30.4% of agencies, though 82.6% had access to tranexamic acid. Separate protocols for penetrating trauma were in place at 17 EMS agencies, this finding was unaffected by location or volume of scene responses. In general, medical directors tended to prioritize quick transport ("Load and Go"), tourniquet placement, and intravenous/intraosseous access over emergent airway access. When advanced airway management was required, 85% preferred ketamine as an induction sedative.

Figure 1. A patient with gunshot wound to the abdomen has palpable pulses and GCS 7. What should be the provider's prehospital first priority?



Conclusion:

These findings reveal variability in the presence and implementation of EMS protocols for those with penetrating injuries, highlighting a need for standardized guidelines to optimize prehospital care for penetrating injuries.

Region 5 - Basic Science

Pathogen-Induced Coagulopathy: The Role of the Gut Microbiota and Pathogen-Derived Virulence Factors in the Development of Clinically Significant Coagulopathy in Critical Illness

Jessica Cao, MD

Background:

Coagulopathy and bleeding complications are common amongst critically ill trauma patients. While severity of injury, individual patient factors, and trauma-induced coagulopathy influence bleeding complications, the contributions of gut bacteria to coagulopathy remain unknown. Critical illness, traumatic injury, surgery, antibiotics, and prolonged hospitalization predispose patients to colonization by pathogenic bacteria (i.e. *Pseudomonas aeruginosa*, *Pa*). These bacteria are known to secrete virulence factors capable of degrading components of the clotting cascade, but the extent to which these mechanisms contribute to clinically significant coagulopathy and bleeding complications in trauma patients remains unclear.

Hypothesis and Methods:

We hypothesize that *Pa* isolated from the gut of a critically ill patient has the capacity to induce clinically significant coagulopathy via secreted virulence factors.

Pa was isolated from an ICU patient's stool. Gut colonization: Mice were treated with antibiotics and then given enemas of *Pa* (108 CFU/mL) or normal saline (NS). Mice underwent partial hepatectomy. Bleeding time (BT) and percent blood loss were recorded. qPCR was used to assess degree of *Pa* engraftment. Effect of *Pa* exoproducts: *Pa* was grown in liquid culture, and supernatant (*Pa*-Sup) was collected and filtered. In mice, *Pa*-Sup or media control (TSB) was applied to the cut liver edge during hepatectomy, and BT and percent blood loss were measured. In humans, *Pa*-Sup was added to whole blood from healthy volunteers at 1:10 and 1:15 dilutions and compared to the addition of TSB alone. Coagulation profiles were analyzed using the ROTEM sigma (Werfen) and TEG 6s (Haemonetics), functional assays of clotting. *Pa* growth conditions: *Pa* was grown in TSB supplemented with cecal metabolites from antibiotic-treated mice as well as short chain fatty acids to determine the impact of the gut environment on *Pa* coagulation. Exoproduct identification:

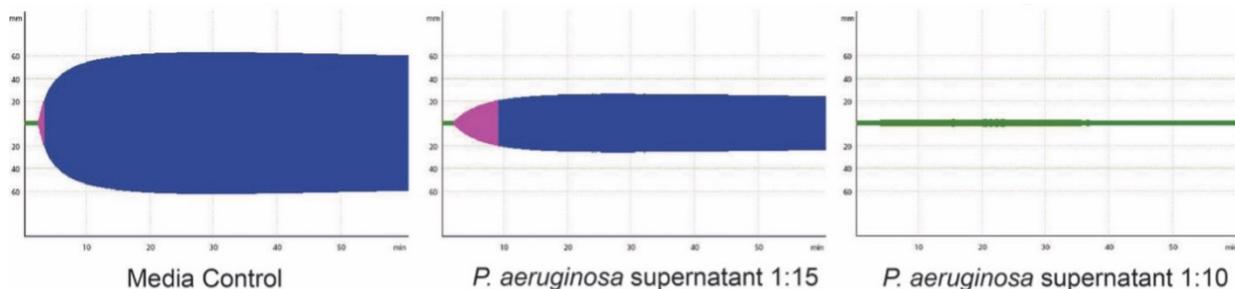
Pa-Sup was subject to fractionation with 10 kDa filters, heat denaturation at 100°C, and protease inhibitor treatment prior to coagulation analysis.

Results:

During partial hepatectomy, *Pa*-colonized mice exhibited a prolonged BT (*Pa* 230s [n=17] vs NS 121s [n=15]; p<0.0015) and increased percent blood loss (*Pa* 12.6% vs NS 9.7%; p=0.008). The degree of *Pa* engraftment correlated with coagulopathy severity. To determine if secreted *Pa* exoproducts were responsible, *Pa*-Sup was applied to the cut edge of the liver during hepatectomy. *Pa*-Sup increased BT (*Pa*-Sup 202s vs TSB 138s; p<0.001) and percent blood loss (*Pa*-Sup 16% [n=13] vs TSB 13.3% [n=12]; p=0.011) compared to TSB alone. The addition of *Pa*-Sup to healthy human blood samples (n=5) led to significant coagulopathy in a dose-dependent manner (Fig). *Pa*-Sup decreased maximum clot firmness (10.2 vs 26.7 vs 53.4; 1:10 vs 1:15 vs TSB; p<0.001) and amplitude at 10 minutes (4.8 vs 24.3 vs 49.1; 1:10 vs 1:15 vs TSB; p<0.001). Additionally, 1:10 *Pa*-Sup caused a significant increase in clotting time (438.2s vs 168.1s TSB; p<0.001). Growing *Pa* in the presence of cecal metabolites from antibiotic-decontaminated mice increased the ability of *Pa*-Sup to cause coagulopathy, whereas growing *Pa* in the presence of 100 mM acetate suppressed the phenotype. Size exclusion, heat denaturation and protease inhibition indicated that the protein is likely a secreted protease >10kDa in size.

Conclusion:

Intestinal colonization with *Pa* can cause coagulopathy in mice undergoing hepatectomy through secreted proteases. These *Pa* exoproducts more than double clotting time and weaken clot strength by almost 50% in humans, and this phenotype seems to be exacerbated in an antibiotic-treated intestinal environment deprived of acetate. Taken together, these data demonstrate that certain pathogens can secrete virulence factors that cause clinically significant coagulopathy.



Region 11 Clinical Research

Disparities and Institutional Variation in Time to Surgery for Traumatic Cervical Spinal Cord Injury: A Multicenter Cohort Study

Vishwathsen Karthikeyan, MD

Background/Objectives:

Early decompression within 24 hours is recommended in traumatic cervical spinal cord injury (SCI), yet real-world adherence remains inconsistent. Emerging evidence highlights those social determinants of health, including race and insurance status, are key contributors to inequities in timely surgical care. In addition, frailty, defined as reduced physiologic reserve, is increasingly recognized as a measurable biologic consequence of lifelong social and economic disadvantage and is associated with adverse healthcare outcomes in surgical cohorts. These intersecting social and biological vulnerabilities may disproportionately affect marginalized groups, compounding disparities in time-sensitive care delivery. Accordingly, this study aimed to (1) evaluate the associations of race, insurance status, and frailty with time to decompressive surgery in traumatic cervical SCI, and (2) quantify between- and within-hospital variation in surgical timing across North American trauma centers.

Methods:

We conducted a multicenter retrospective cohort study using the ACS Trauma Quality Improvement Program (TQIP) from 2010–2020. Adults ≥ 16 years with blunt cervical SCI who underwent surgical decompression within five days were included. Mixed-effects regression models with hospital-level random intercepts were used to identify independent predictors of time to surgery. Variance components from null and adjusted models were compared to quantify proportional change in variance at the hospital (PCVH) and individual (PCVI) levels, and an intraclass correlation coefficient (ICC) measured institutional variation.

Results:

The cohort included 20,566 patients across 503 trauma centers. The mean time to surgery was 30 hours (SD \pm 28), and 57% underwent decompression within 24 hours. Multiple factors were independently associated with surgical delay. Compared with robust patients, prefrail individuals experienced a 1.4-hour delay (MD 1.40, 95% CI 0.46–2.49; $p = 0.005$) and frail patients waited 3.4 hours longer (MD 3.40, 95% CI 2.03–4.63; $p < 0.001$). Uninsured patients waited 1.6 hours longer than privately insured individuals (MD 1.60, 95% CI 0.24–2.94; $p = 0.02$). Black patients experienced a 1.4-hour delay relative to White patients (MD 1.40, 95% CI 0.81–2.80; $p = 0.005$). Across quintiles, mean time to surgery ranged from 21.8 to 43.7 hours, representing a two-fold difference in practice patterns. Institutional variation was substantial: observed hospital- and patient-level variables did not reduce between-hospital variability (PCVH = -5.3%), only 8.6% of within-hospital variability was explained (PCVI = 8.6%), and the adjusted ICC was 8%, indicating meaningful, unexplained center-level differences in surgical timing.

Conclusion:

Delays in surgical decompression for cervical SCI remain common, increasing frailty, uninsured status, and Black race are independently associated with longer wait times. Despite established guidelines, nearly half of patients did not receive surgery within 24 hours, and substantial institutional heterogeneity persisted even after adjusting for patient- and hospital-level variables. This suggests that unmeasured system-level processes, such as OR access, staffing models, triage protocols, and interfacility transfer pathways, may be driving differences in timeliness of care. Targeted, equity-focused quality improvement initiatives and standardized spinal injury pathways may further clarify modifiable factors contributing to surgical delays and ensure consistent, timely, and equitable care across trauma centers.

Region 15 – Basic Science

The RIA System Reduces Systemic Pro-Inflammatory and Pro-Fibrotic MicroRNA Expression in Both Mono and Polytrauma: Results from a Porcine Polytrauma Model

Rald V. M. Groven, MD, PhD

Objectives:

Early triage and timely operative decision-making are critical in the management of polytrauma patients, particularly in high-throughput environments such as mass casualty events or war. Although early definitive fracture fixation is generally preferred to facilitate mobilisation and shorten hospital stays, intramedullary nailing (IMN) can trigger immune activation that contributes to post-traumatic (pulmonary) inflammatory complications. To mitigate these effects, various reaming techniques have been developed; however, their impact on biomolecular immunological homeostasis remains unclear. MicroRNAs (miRNAs), as key post-transcriptional regulators, may play an important role in these inflammatory responses and have shown to be promising biomarker candidates as well as therapeutic tools in several fields of medicine. Over the past years, miRNAs have also gained interest in the field of trauma surgery. Therefore, this study aimed to determine if and how different reaming techniques prior to IMN influence circulating miRNA expression signatures in a translational porcine trauma model of varying injury severity (monotrauma; MT, polytrauma; PT), and to relate these signatures to clinical parameters.

Methods:

In this international collaborative study, 36 Swiss Landrace pigs were randomized into two study groups: monotrauma (MT; n=18; unilateral femur fracture) and polytrauma (PT; n=18; femur fracture, liver laceration, blunt chest trauma, and haemorrhagic shock). Animals were operatively stabilized after a 60-min shock phase and based on the reaming technique, allocated to one of the following subgroups: 1) SynReam, 2) RIA-1, and 3) RIA-2 (all three: DePuy Synthes, Raynham, MA). Serum was collected at the end of the shock phase, and at 2 and 6 h after trauma. Clinical parameters were collected throughout the duration of the experiment. MiRNAs were isolated, transcribed and pooled for qPCR array analyses per reamer subgroup from each trauma severity over time. Subsequently, *in silico* mRNA target prediction and bioinformatic analyses were performed.

Results:

Compared to MT, the circulating miRNA-signature of PT at the end of the shock phase (and before reaming) was more pro-inflammatory in nature, including deregulations of miRNAs linked to shock as well as organ and tissue damage (e.g. miRNAs 93, 99a, and 107). Apart from several overlapping miRNA deregulations among the different reamer subgroups of both MT and PT at the 2 and 6h timepoints, distinct differences were observed. RIA 1 and 2 significantly decreased the systemic expression of pro-inflammatory and pro-fibrotic miRNAs compared to SynReam, which was in line with the obtained clinical parameters. This effect was most prominent in the PT group as compared to the MT group. Overall, in both the MT and PT groups, the RIA 1 and 2 systems exhibited a more regenerative miRNA profile compared to SynReam.

Conclusion:

This study is the first to describe unique circulating miRNA signatures, which were associated with trauma severity and the applied reaming technique. More specifically, our findings imply that the application of SynReam boosts systemic inflammation as compared to RIA 1 and 2, indicating that the application of a system that irrigates and aspirates simultaneously may be preferred in polytraumatized patients to reduce systemic inflammatory load and aid in reducing the risk of inflammatory complications after surgery. The irrigation and aspiration function of the RIA system, combined with the additional cooling of the intramedullary canal during reaming, may reduce osteoinflammation/osteonecrosis, which in part could underlie these observations. These results demonstrate the effect that different types of surgical instruments can have on patient physiology and the potential of microRNAs (miRNAs) as immunological markers for diagnosis and prognosis after trauma. This study warrants further research into the role and involvement of miRNAs in polytrauma.

Region 2 – Clinical Research

Single Antibiotic Use with Ceftriaxone for Prophylaxis of All Open Fractures

Conor P. Lynch, MD, Michael W. Koulopoulos, MD, Alison Buseck, BS, Katherine Lutz, BS
Olivia Brand, BS, Eleanor Sommers, BS, Isaiah Pompo, BS, Andrew Laychur, MD
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Background:

The Gustilo classification has often been used to triage antibiotic choice for prophylaxis of open fractures. In 2018, our institution transitioned to a new antibiotic protocol for open fracture prophylaxis. The current study compares outcomes for open fractures treated with a new prophylactic antibiotic protocol using ceftriaxone for all open fractures regardless of Gustilo classification (CTX) versus a previous protocol utilizing cefazolin for Gustilo I/II fractures and cefazolin plus gentamicin or ceftriaxone monotherapy for Gustilo type III fractures only (classic).

Study Design:

A retrospective review was performed of adult patients at a single level I trauma center who underwent surgery for an open fracture from 2016-2022. Exclusion criteria were fractures of the distal radius or hand, < 3 months of follow up, or an indication for another type of antibiotic such as a farm or freshwater injury. Patients were divided into CTX or classic groups based on which antibiotic protocol they received. Fracture characteristics, demographics, and baseline comorbidities were compared between classic and CTX groups. The outcomes of deep infection, superficial infection, nonunion, and time to antibiotic administration were compared between groups. Subgroup analyses were performed to compare outcomes between groups stratified by Gustilo type. Fisher's exact test and two-sample t-test were used to compare categorical and continuous variables, respectively, between groups.

Results:

A total of 521 patients were included, with 150 in the classic group and 371 in the CTX group. The CTX and classic groups did not significantly differ in distribution of baseline demographics, comorbidities, upper vs lower extremity injury, or rates of gross contamination. The classic group had a significantly greater proportion of type III fractures (p=0.041). No significant differences were noted in rates of deep infection, superficial infection, or nonunion between the CTX and classic groups for all Gustilo types as well as type-specific subgroup analyses. The CTX protocol was associated with significantly shorter time to antibiotic administration (p=0.002).

Conclusions:

The ceftriaxone protocol was associated with non-inferior outcomes in terms of infection and nonunion, as well as shorter time to antibiotic administration. Prophylaxis of all open fractures with ceftriaxone may be a safe and effective method of standardizing and expediting care for orthopedic trauma patients.

Infection and Nonunion Incidence Between Classic and CTX Groups				
Primary Analysis (All Gustilo types, n=521)	Total (n=521)	Classic (n=150)	CTX (n=371)	p-value
Deep Infection	9.2% (48)	12.7% (19)	7.8% (29)	0.095
Superficial Infection	6.3% (33)	4.7% (7)	7.0% (26)	0.427
Nonunion	9.6% (48)	7.9% (11)	10.3% (37)	0.500
Subgroup Analysis (Type I/II only, n=227)	Total (n=227)	Classic (n=56)	CTX (n=171)	p-value
Deep Infection	4.9% (11)	8.9% (5)	3.5% (6)	0.145
Superficial Infection	3.1% (7)	3.6% (2)	2.9% (5)	0.683
Nonunion	2.7% (6)	0% (0)	3.6% (6)	0.340
Subgroup Analysis (Type III only, n=294)	Total (n=294)	Classic (n=94)	CTX (n=200)	p-value
Deep Infection	12.6% (37)	14.9% (14)	11.5% (23)	0.452
Superficial Infection	8.8% (26)	5.3% (5)	10.5% (21)	0.187
Nonunion	15.2% (42)	13.1% (11)	16.2% (31)	0.588

Time to Antibiotic Administration for Classic and CTX Groups

Primary Analysis (All Gustilo types)	Total (n=416)†	Classic (n=124)	CTX (n=292)	p-value
Time to Antibiotic (mins. ± SD)	78.9 ± 147.8	114.1 ± 199.0	63.9 ± 116.9	0.002
Outliers	6.5% (27)	11.3% (14)	4.5% (13)	0.010
Time to Antibiotic with Outliers Removed (mins. ± SD)	47.5 ± 56.8	58.2 ± 62.2	43.2 ± 53.7	0.018

†patients without time to antibiotic administration data available excluded from analysis

Region 9 - Basic Science

Therapeutic Limb Hypothermia Preserves Function in a Novel Survival Porcine Model of Acute Hindlimb Ischemia

Ariyan Tabesh, MD

Introduction:

Acute limb ischemia carries high morbidity and risk of limb loss. Prior models were limited to non-survival designs and biochemical endpoints, precluding assessment of long-term outcomes. We developed a survival porcine-model of ischemia-reperfusion injury to evaluate the efficacy of therapeutic limb hypothermia, allowing for functional, neurophysiologic, and histopathologic assessment.

Methods:

Female Yorkshire pigs underwent anesthesia, vascular access, and baseline angiography. Unilateral hindlimb ischemia was induced by balloon occlusion of the ipsilateral external and internal iliac arteries (Figure 1) for six hours, confirmed by angiography and limb/systemic monitoring. Animals were randomized to hypothermia (5-15°C) vs normothermia; the contralateral limb served as control. Hypothermia was applied using a custom sleeve covering the hindlimb with coolant channels. Postoperatively, were survived to one week with daily Tarlov assessment and underwent terminal neurophysiologic and muscle/nerve biopsy on day 7.

Results:

Hypothermia conferred marked protection compared with controls. Experimental animals achieved near-complete recovery, with Tarlov scores achieving near normalization by day 4, while control remained impaired through day 7 (Figure 2). Neurophysiology showed irreversible motor and sensory loss in controls, whereas experimental limbs preserved motor and sensory conduction (Figures 3). Histology revealed severe ischemic myopathy and nerve edema in controls versus minimal degeneration without necrosis in experimental limbs (Figure 4).

Conclusion:

This survival model shows localized hypothermia accelerates recovery, preserves neurophysiologic function, and minimizes tissue injury. It provides a novel large-animal model for human limb ischemia and reperfusion injury research. The study is ongoing, planning to expand to 12 animals to enhance generalizability.

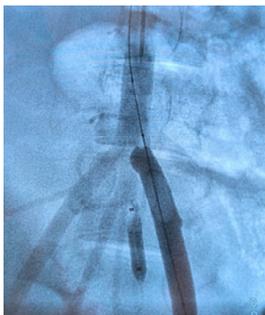


Figure 1. Profound acute unilateral ischemia was achieved by simultaneous balloon occlusion of the ipsilateral external and internal iliac arteries

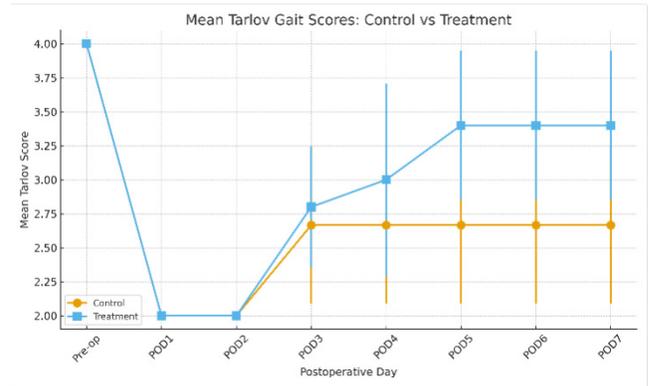


Figure 2. Observed mean Tarlov scores show consistently better functional recovery in the hypothermia group compared with controls across POD1-POD7

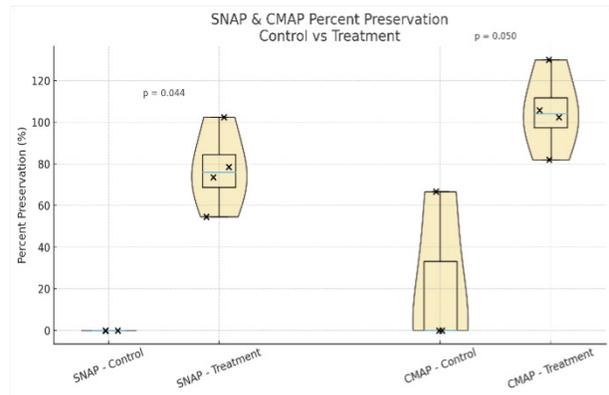


Figure 3. Hypothermia preserved sensory (SNAP) and motor (CMAP) amplitude compared with controls, with significantly higher amplitude percent preservation.

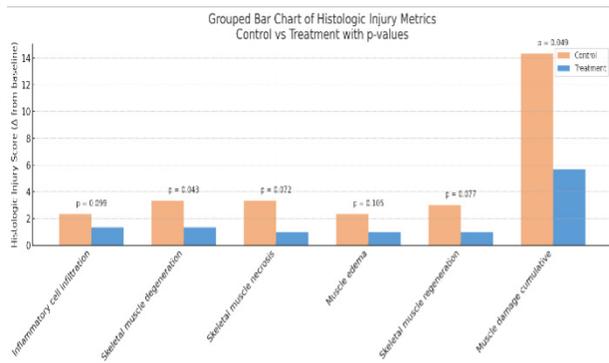


Figure 4. Histology of non-cooled: Histologic injury scores were consistently lower with hypothermia, with a significant reduction in muscle degeneration and cumulative muscle damage.

Region 4 - Clinical Research

Reevaluation of Hemodynamic Instability in the Pediatric Trauma Population

Chandler A. Annesi, MD

Background:

Hemodynamic instability in children is traditionally defined as systolic blood pressure (SBP) <5th percentile or heart rate (HR) >90th percentile. Historically, tachycardia is considered an improved indicator clinically in children compared to hypotension. These traditional definitions and cutoff values were derived from normal reference populations rather than pediatric trauma patients at risk of mortality and therefore may misclassify true hemodynamic instability. The aim of this study was to define age-stratified hemodynamic instability in a cohort of pediatric trauma patients at risk of mortality.

Methods:

We used the American College of Surgeons (ACS) Trauma Quality Improvement Program (TQIP) dataset 2018-2023 including patients aged 1-15. Patients without signs of life on arrival were excluded. SBP, HR, and Shock Index (SI=HR/SBP) were plotted against mortality rate for each age group (1-2y, 3-5y, 6-9y, 10-11y, 12-15y). Area under the receiver operating characteristic curve (AUC) was calculated to evaluate the discriminatory ability of SBP, HR, and SI to predict mortality for each age group. Optimal SBP, HR, and SI cutoffs were determined using Youden's index, which identifies the threshold that maximizes the sum of sensitivity and specificity and compared them to traditional SBP1 and HR2 cutoffs as well as Pediatric Age-adjusted Shock Index (SIPA)³. Subset analysis was completed excluding severe head trauma in patients Abbreviated Injury Scale (AIS) of at least 3.

Results:

There were 233,490 patients included in the analysis (age group 1-2y n=27,871 [11.9%], age group 3-5y n=45,037 [19.3%], age group 6-9y n=56,764 [24.3%], age group 10-11y n=24,731 [10.6%], age group 12-15y n=79,087 [33.9%]). Optimal SBP, HR, and SI cutoffs and AUC for predicting mortality are shown in the Table. Mortality for each age group is also presented. Subset analysis of severe head trauma patients did not show clinically significant changes. Compared to SIPA, SI cutoff is comparable in this cohort of pediatric trauma patients.

Conclusion:

Our data driven findings suggest that mortality occurs at a higher SBP among children post-trauma compared to what is traditionally known and taught. This also validates previously established SIPA values, although with SIPA's less common use in the clinical setting it is important to consider use of blood pressure and tachycardia to allow for earlier identification of pediatric trauma patients at risk for mortality.

Table. Predictive threshold cutoffs for SBP, HR, and SI for all traumas.

Age Group	1-2 years n=27,871	3-5 years n=45,037	6-9 years n=56,764	10-11 years n=24,731	12-15 years n=79,087
Mortality Rate	1.02%	0.64%	0.50%	0.68%	1.31%
SBP cutoff, mmHg (AUC)	104 (0.69)	92 (0.68)	100 (0.65)	104 (0.64)	110 (0.63)
Traditional SBP cutoff¹	72-74	76-80	82-88	90	90
HR cutoff, bpm (AUC)	174 (0.41)	133 (0.56)	125 (0.62)	130 (0.66)	117 (0.69)
Traditional HR cutoff²	146	134-142	120-128	120	112
SI cutoff, mmHg/bpm (AUC)	1.37 (0.59)	1.24 (0.66)	1.09 (0.69)	1.04 (0.70)	0.98 (0.72)
SIPA³	1.2	1.2	1.0-1.2	1.0	0.9

SBP: systolic blood pressure; AUC: area under the receiver operating curve; HR: heart rate; bpm: beats per minute; SI: shock index; SIPA: shock index pediatric age-adjusted; AIS: Abbreviated Injury Scale.

¹Kleinman M, et al. Pediatric Advanced Life Support: 2010 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. 2010. ²Bonafide CP, et al. Development of Heart and Respiratory Rate Percentile Curves for Hospitalized Children. *Pediatrics*. 2013. ³Acker SN, et al. Pediatric specific shock index accurately identifies severely injured children. *J Pediatr Surg*. 2015.

Region 6 – Basic Science

HS3ST1 Regulates Pulmonary Inflammation and Is a Determinant of Clinical Outcomes After Trauma and Hemorrhagic Shock

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Introduction:

Mechanisms that promote organ injury after trauma and hemorrhagic shock (HS) remain poorly defined. Endothelial heparan sulfates are important regulators of microvascular and organ homeostasis and those with a unique 3-O-sulfate (3-OS) modification, enabling their interaction with antithrombin, have anticoagulant and anti-inflammatory properties. The rs16881446 polymorphism in the HS3ST1 gene, which controls endothelial 3-OS HS expression, is associated with acute and chronic inflammation. The objective of this study was to determine if 3-OS HS deficiency, through ablation of or variants in the HS3ST1 gene, is associated with more severe organ injury and poor outcomes after trauma and hemorrhagic shock.

Method:

HS3ST1 -/- and wild-type (WT) littermates were subjected to tissue trauma and fixed pressure HS followed by resuscitation with lactated ringer's (LR) solution or fresh frozen plasma (FFP). Lungs were harvested for histologic injury and transcriptomic analyses. Whole blood was collected upon admission from trauma patients who presented in HS (base excess \leq -4 mmol/L) and required blood products. Thromboinflammatory markers were assessed in plasma. Deoxyribonucleic acid was extracted from peripheral blood mononuclear cells and real-time polymerase chain reaction was used to assess HS3ST1 rs16881446 variant allele expression. Patient demographics, injury characteristics, and outcomes were compared. Multivariable logistic regression analyses were used to determine the independent association between rs16881446 genotype and mortality while controlling for age, sex, and injury severity scores.

Results:

Histologic lung injury was significantly increased in mice that underwent trauma and HS compared to sham and no differences were observed between WT and HS3ST1 -/- mice resuscitated with LR. However, we observed significant increases in histologic lung injury and leukocyte infiltrates in FFP resuscitated HS3ST1 -/- mice compared to FFP resuscitated WT mice (Figure 1). A total of 472 patients met inclusion criteria of which 31 (7%) were homozygous variant for the rs16881446 allele (GG genotype), while 251 (53%) were homozygous for the WT allele (AA) and 190 (40%) carried a single variant allele (AG). There were no differences in demographics, injury mechanism, severity, or transfusion requirements between groups. Compared to AA patients, the number of ventilator free days was lower, and mortality was significantly higher in AG and GG patients. While markers of hypercoagulability were the same, plasma inflammatory mediators were elevated in GG patients compared to matched AA patients. The rs16881446 genotype was an independent predictor of mortality.

Conclusion:

3-OS HS deficiency due to loss of HS3ST1 expression mitigates organ protection from FFP resuscitation and is an independent predictor of mortality after trauma and HS. These findings identify a novel therapeutic target for future interventions and a novel prognostic tool that can be leveraged towards improved risk stratification after trauma.

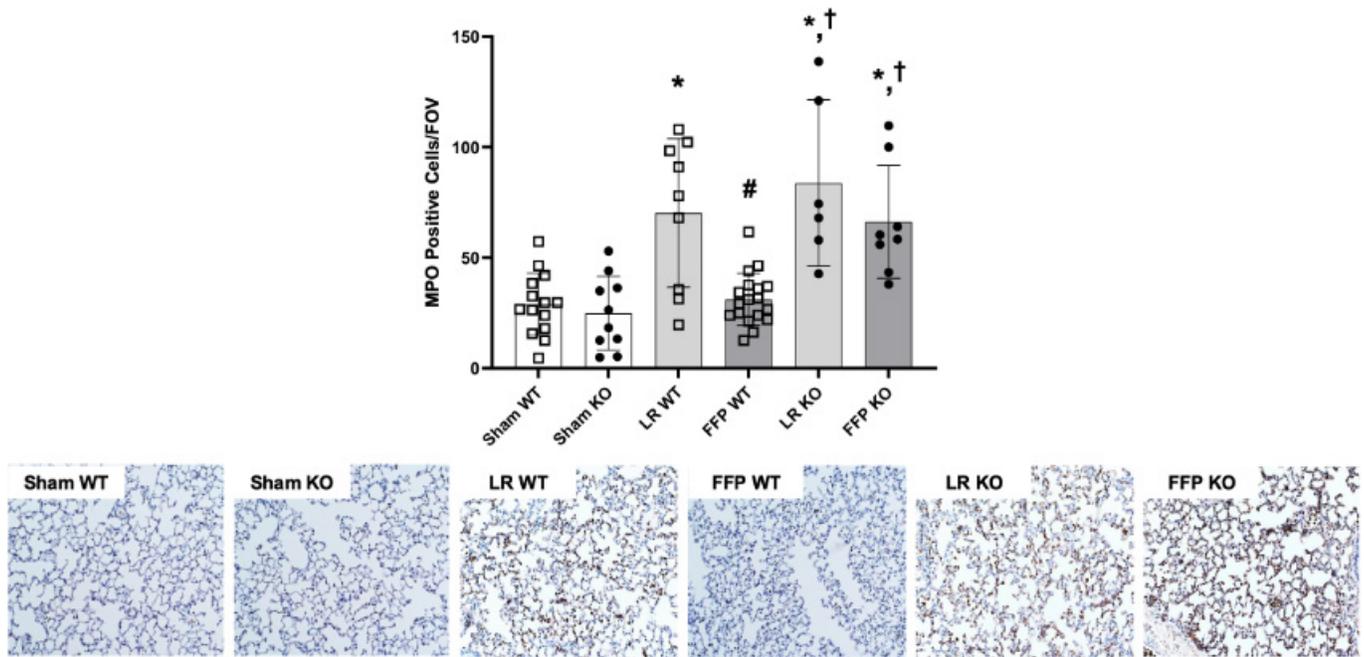


Figure 1. HS3ST1 KO mice exhibit greater pulmonary inflammation after induction of trauma and HS compared to WT mice. Myeloperoxidase (MPO) positive cells per field of view (FOV) were quantified from 3 random images taken per tissue and averaged for each mouse. Representative images at 20x are provided (bottom). N=6-12 per group. Data reported as mean ± standard deviation. * Denotes significance from sham. # denotes significance from LR WT. † denotes significance from FFP WT.

Region 10 – Clinical Research

Prehospital Tourniquet Use and Associated Outcomes in a Low-Resource Conflict Setting: Prospective Casualty Data from the Sahel

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Background:

Tourniquet (TQ) application is a key component of extremity hemorrhage control in high-resource military and civilian trauma systems. The widespread use of TQs in such settings depends on rapid evacuation to surgical care and rarely causes permanent harm even if not medically indicated or inappropriately applied. In contrast, when left in place for prolonged periods TQs can cause severe complications including unnecessary limb loss, rhabdomyolysis, or death. TQ guidance developed in high-resource trauma systems can therefore cause harm in low-resource settings where the “golden hour” does not apply. “Tourniquet syndrome” has been described in Ukraine and other low-resource conflict settings, yet limited data exist on the scope and epidemiology of this problem. To address this evidence gap, we conducted data collection on casualties with conflict-related injuries undergoing prehospital TQ application at a military hospital in the Sahel.

Study Design:

We conducted a single-center prospective observational analysis at the largest military hospital in Burkina Faso to describe injury epidemiology, TQ characteristics, and early outcomes among casualties that underwent prehospital TQ application from January-July 2025. Burkina Faso is a low-income country in the Sahel region of West Africa severely affected by terrorism-related violence. Eligible casualties included military personnel and *Volontaires pour la défense de la patrie* (VDP or “country defense volunteers”) with conflict-related injuries who underwent TQ application in the prehospital setting. We created a TQ registry including demographics, injury characteristics, TQ characteristics, care processes and early outcomes. Data were collected using Kobo Toolbox. Descriptive analysis was performed in SPSS (v. 30.0) and Microsoft Excel.

Results:

One hundred casualties (N) were included in analysis, 99% (n=99) of which were men with a mean age of 27.2 years. The average time to treatment was 11.9 hours. The most common mechanisms of injury were gunshot wound (63%, n=63), followed by improvised explosive devices (35%, n=35). The majority (81%) of casualties had a single TQ placed; 17% had two TQs, and 2% had three TQs. Lower extremity injuries were more frequent than upper (n=129 vs n=23; n>N due to multiple injuries per casualty). Nine TQs were improvised (10.5%) using clothing, belts, or AK-47 slings. Overall, only 4% of TQs were both medically necessary and appropriately placed (Table 1). Nineteen casualties (19%) underwent a single amputation and six underwent double amputations, totaling 31 amputations. Of these, 67.7% (n=21) underwent amputation more proximally than otherwise indicated due to TQ application. Mortality was 5% (n=5), three of which were attributable to TQ complications (e.g., rhabdomyolysis, cardiac arrest).

Conclusion:

TQs play an important role in reducing preventable death from extremity hemorrhage. TQ guidance developed during the US-led wars in Afghanistan and Iraq depends on rapid evacuation yet is applied in conflict settings globally. In contexts with prolonged evacuation, TQs can have harmful consequences. In our sample from the Sahel, prehospital TQ use was associated with significant limb loss, morbidity, and mortality. The development of context-specific clinical algorithms and training programs emphasizing alternative hemorrhage control modalities and principles of TQ conversion could help mitigate these complications while upholding the role of appropriate TQ use in the management of conflict-related trauma.

Table 1. Tourniquet (TQ) characteristics

	TQ medically necessary – Yes (n, %)	TQ medically necessary – No (n, %)	Total (n, %)
TQ appropriately placed – Yes (n, %)	4 (4%)	32 (32%)	36 (36%)
TQ appropriately placed – No (n, %)	17 (17%)	47 (47%)	64 (64%)
Total (n, %)	21 (21%)	79 (79%)	100 (100%)

Region 13 – Basic Science

Functional and Physiologic Outcomes of Variable Limb Ischemia in a Porcine Model of Hemorrhagic Shock

Kyle Patterson, MD

Introduction:

Extended ischemia during large scale combat operations may threaten limb salvage rates. This study describes recovery of isometric limb function following variable ischemic durations in a porcine model of hemorrhagic shock and ischemia-reperfusion injury (IRI).

Methods:

Yorkshire swine (n=4/group) underwent a controlled hemorrhage of 25% blood volume followed by 30 minutes of shock prior to surgical occlusion of the left common iliac artery and vein (0 vs. 2 vs. 8 hr ischemia). After reperfusion, isometric neuromuscular function of the hindlimb dorsiflexor was tested every 15 minutes for 7 hours. Secondary outcomes included parameters of post-tourniquet syndrome (compartment pressures, vasopressor requirement, urine output, creatinine).

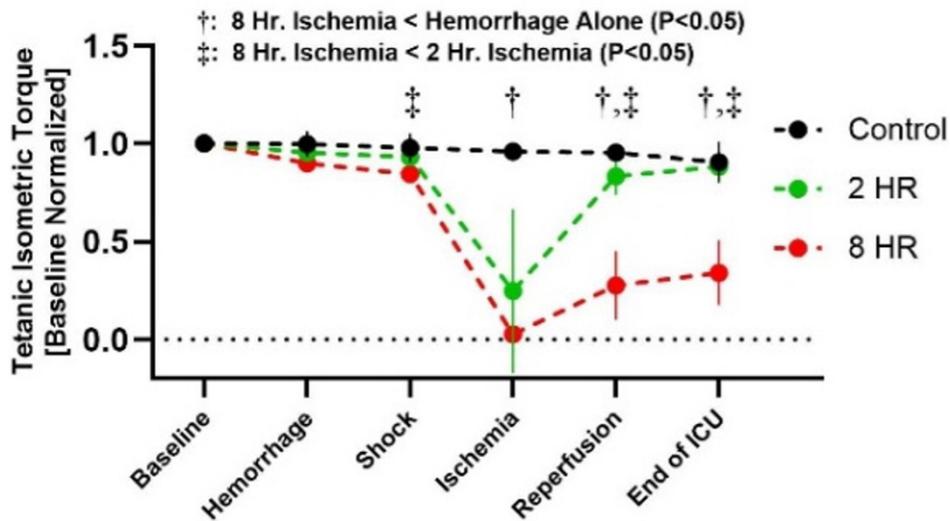
Results:

Figure 1 shows recovery of limb function (tetanic isometric torque) after 2 hrs ischemia but not 8 hrs ($p<0.05$). 8 hr ischemia impaired recovery of muscle contraction (43%) and relaxation (32%) rates vs. 2 hr (83%, 79%) and controls (78%, 73%; $p=0.005, <0.001$). IRI after 8 hrs was associated with higher

compartment pressure during reperfusion (22 ± 2 vs. 11 ± 2 vs. 9 ± 2 mmHg, $p<0.05$) (vs. 2 hrs vs. 0 hrs) and higher norepinephrine requirement (1025 ± 725 vs. 0 vs. 0 mcg, $p<0.01$). No differences were seen across groups for urine output or serum creatinine ($p=NS$).

Conclusion:

This porcine model of hemorrhagic shock with limb ischemia-reperfusion demonstrated a difference in functional limb recovery after prolonged ischemia. This model will facilitate preclinical evaluation of novel therapeutics to improve limb salvage and post-tourniquet syndrome.



Region 12 – Clinical Research

Routine Primary Care Cancer Screening Is Associated with Reduced Long-Term Mortality After Severe Traumatic Injury

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Background:

Patients who survive severe injury experience a high burden of long-term morbidity, including serious physical and psychological sequelae. Injury survivorship is also associated with an increased risk of premature death, not only from reinjury but from chronic health conditions such as heart disease and cancer. Strategies to reduce adverse outcomes among injury survivors, including premature death, are not well studied. At the population level, primary care access is associated with improved chronic disease management. We therefore hypothesized that primary care access is also associated with improved long-term outcomes among injury survivors. The objective of this study was to evaluate whether completion of routine cancer screening (a marker of engagement with high-quality primary care) in the years after injury is associated with reduced long-term mortality among survivors of severe injury.

Study Design:

We performed a retrospective, population-based cohort study of community-dwelling adults discharged alive from hospital (2010–2022) after severe injury (Injury Severity Score > 15) in a large regional trauma system. In this population, we identified three non-mutually exclusive cohorts of individuals eligible for guideline-concordant breast, cervical, and colorectal cancer screening based on sex and age. Patients with contraindications to routine screening (e.g., cancer, surgical history) were excluded. The exposure of interest was being up to date for indicated cancer screening in the 5 years after injury hospitalization, measured as a time-varying exposure. The primary outcome was 5-year all-cause mortality (time to death) after discharge. The association between screening and death within each cohort was evaluated with time-varying multivariable Cox regression models. Models were adjusted for potential confounders including baseline socioeconomic status, pre-injury primary care access, comorbidity, and injury characteristics.

Results:

We identified 25,713 severe injury survivors. From this population we derived three cohorts based on eligibility for cervical (n=4,106), breast (n=3,083), and colorectal (n=10,785) cancer screening. In the 5 years after injury hospitalization, the proportions of eligible patients up to date for screening in each cohort ranged from 55–57% for cervical cancer, 54–57% for breast cancer, and 60–62% for colorectal cancer. Overall, 5-year mortality was 4.4% in the cervical cohort, 8.6% in the breast cohort, and 8.8% in the colorectal cohort. Adjusted for patient characteristics, being up to date with screening was associated with significantly reduced mortality compared to being not up to date: cervical cancer screening HR 0.49 (95% CI 0.34–0.70), breast cancer screening HR 0.43 (95% CI 0.32–0.58), and colorectal cancer screening HR 0.62 (95% CI 0.54–0.70). Among patients who died during follow-up, most deaths (83–86%) were not due to cancer.

Conclusion:

Among survivors of severe injury, being up to date with routine cancer screening was associated with a 38–57% reduction in the hazard of all-cause mortality in the 5 years after discharge. Since non-cancer deaths were the main driver of mortality, it is unlikely that the observed mortality reductions were due to cancer prevention alone. Rather, injury survivors without engagement with high-quality primary care (as measured by cancer screening) represent a population at high risk of death in the years following hospital discharge. These findings support the hypothesis that interventions to help injury survivors engage meaningfully with long-term, high-quality primary and preventive care could improve long-term survival after severe injury. Trauma systems should consider strategies to facilitate longitudinal continuity of care between injury survivors and community primary care providers in the years after injury.



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