Oral #1

COMPARATIVE EVALUATION OF VASOCOLLAR ARTERIAL COUPLING DEVICE AGAINST HANDSEWN ANASTOMOSIS OF MEDIUM- AND LARGE-VESSEL INJURIES: A PILOT STUDY IN SWINE (SUS SCROFA)

Micaela Cuneo, MD; Ania Rogalska, DO; Ashley Flinn-Patterson, MD;
Christian Goei, MD; Stephanie Combs, PhD; Theodore Hart, MD;
Jason Rall, PhD; Marlin Causey, MD
Brooke Army Medical Center

Introduction: The traditional method of vascular repair utilizes a hand-sewn anastomosis, either of two ends of transected vessel or an interposition graft. Microvascular surgeons frequently use vascular coupling devices as hand-sewn anastomoses with fine suture in these small vessels can be tedious. VasoCollar is a novel vascular coupling device that does not utilize a magnetic mechanism and is also designed for use in medium to large vessels.

Methods: Experimental procedures were performed in 6 Sus scrofa swine. Hand-sewn and VasoCollar anastomotic techniques were performed in the bilateral carotid, iliac, and femoral arteries with each animal serving as its own control. Surgeons were timed on vessel exposure, gaining control, and time to anastomosis on both techniques. Each anastomosis was assessed for patency using a handheld Doppler both immediately and at the conclusion of the procedure.

Results: Overall, time to anastomosis completion was significantly faster in the VasoCollar group than the hand-sewn group ($p = 0.02$). When the two groups were compared by location (carotid, iliac, and femoral arteries), the significance remained only in the femoral location ($p = 0.01$). The iliac location approached significance ($p = 0.07$); both locations had several difficulties with successful VasoCollar deployment. There were more successful deployments in the carotid location, but there was no significant difference in the time to anastomosis ($p = 0.99$). There was no significant difference in time to vessel exposure between the groups ($p = 0.12$), and this remained true when each location was examined separately.

Conclusion: The VasoCollar device is a novel vascular coupler that utilizes a mechanical mechanism to anastomose medium to large vessels. The time to anastomosis did not differ significantly in locations that generally have good exposure, such as the carotid artery, but time to anastomosis was faster in the VasoCollar group at the iliac and femoral arteries, which are more difficult to expose in swine. Using a vascular coupling device in these types of exposures could provide an easier alternative for general surgeons who are repairing traumatic vascular injuries.

	Hand-Sewn	VasoCollar	p-value
Exposure	13:55 ± 6:37	14:30 ± 13:35	0.129
Time to Anastomosis	17:12 ± 8:13	8:50 ± 6:14	0.025

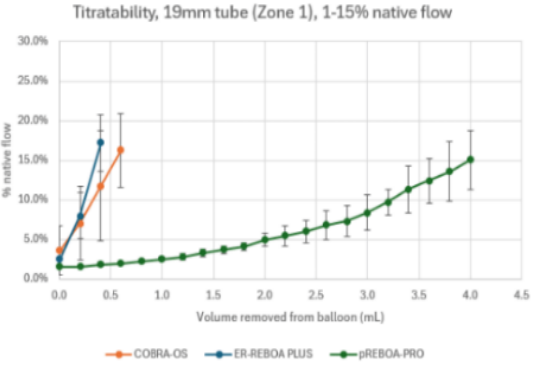
Table 1. Comparison of Time to Exposure and Time to Anastomosis for Hand-Sewn vs. VasoCollar Device

PARTIAL REBOA PERFORMANCE VARIES WIDELY ACROSS AVAILABLE REBOA CATHETERS: A COMPARATIVE ANALYSIS

Elise Fannon, MD, MPP; Shaddy Malik, MD;
Christian Gage, MD; Rachel Russo, MD
UC Davis

Introduction: REBOA is used to manage non-compressible torso hemorrhage, but complete occlusion is limited by ischemic complications. Partial REBOA (pREBOA) aims to preserve distal perfusion and reduce risk. Of the three FDA-cleared REBOA catheters sometimes used for pREBOA—COBRA-OS, ER-REBOA Plus, and P-REBOA Pro—only the P-REBOA Pro is approved for partial occlusion. This study compares their performance in a clinically relevant simulator.

Methods: Devices were tested for complete occlusion (20 mm and 26 mm tubes), titratability (balloon volume vs. distal flow), flow stability (vasodilation and heart rate change), and arterial line accuracy, using FDA-derived testing criteria in a variable flow chamber.
Results: P-REBOA Pro and ER-REBOA Plus occluded both 20 mm and 26 mm tubes; COBRA-OS failed to occlude the 26 mm (Zone 1) tube. For titration to 15% distal flow in Zone 1, P-REBOA Pro required 4.2 mL balloon deflation, compared to 0.7 mL (COBRA-OS) and 0.5 mL (ER-REBOA Plus); full flow restoration required 9.5 mL, 3.6 mL, and 1.6 mL, respectively. P-REBOA Pro showed greater flow stability with vasodilation (67% vs. ~500%) and tachycardia (20% vs. 62–86%). Only P-REBOA Pro and ER-REBOA Plus demonstrated accurate arterial line monitoring; COBRA-OS lacked a proximal line, showed damping distally, and exhibited a false flow artifact.



Conclusion: Only P-REBOA Pro reliably enables safe, titratable partial occlusion with superior flow control and monitoring. These features support its use in trauma and prolonged field care, especially in austere or military environments, where the pREBOA technique may be desirable. The ER-REBOA Plus and COBRA-OS are most suitable for complete occlusion.

Oral #3

ASSESSING RETENTION AND CONFIDENCE IN VASCULAR SHUNT PLACEMENT AMONG GENERAL SURGERY RESIDENTS: A SWINE MODEL STUDY

Maria Eugenia Navarro, MD; Anna Rogalska, MD; Micaela Cuneo, MD;
Christopher Goei, MD; Ashley Flinn-Patterson, MD; Stephanie Combs, PhD;
Theodore Hart, MD; Jeremy Bolin, MD; Marlin Causey, MD
Brooke Army Medical Center

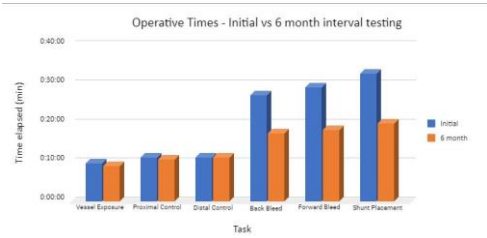
Introduction: Extremity vascular injury and non-compressible torso hemorrhage account for a majority of potentially survivable trauma-related wartime death. Surgical intervention to address hemorrhage before definitive vascular reconstruction in austere and resource-constrained forward-deployed surgical settings rests on the technical competence of general surgeons with limited exposure to shunt placement in residency.

Methods: A 4-stage experimental procedure on *Sus scrofa* animals under general anesthesia was completed to compare vascular shunt (Argyle and Sundt) placement. Initial stages included model development and baseline measurement by vascular surgery staff (average post-residency practice of 5.8 years, n = 7), followed by senior resident-led placement (n = 5) to evaluate baseline competence. After baseline placement at the initial assessment, residents had education with faculty and a subsequent post-education shunt was placed to measure learning impact. After 6 months from the initial competency assessment, residents retested vascular shunt placement to evaluate for retention.

	Initial Assessment		**6 Month Retention**
Variable	Chief Resident, pre-education (minutes:seconds) ±SD	Chief Resident, post-education (minutes:seconds) ±SD	Chief Resident, (minutes:seconds) ±SD
Time to Vessel Exposure	9:44 ± 2:17	9:52 ± 3:41	12:00 ± 4:23
Time to Proximal Control	11:20 ± 2:45	11:03 ± 4:03	14:39 ± 4:32
Time to Distal Control	11:23 ± 2:53	11:36 ± 4:12	15: 48 ± 4:30
Time to Back Bleed	27:15 ± 8:56	17:07 ± 4:47	22:40 ± 5:21
Time to Forward Bleed	29:14 ± 10:08	18:26 ± 4:26	26:33 ± 6:17
Time to Shunt Placement	32:49 ± 7:57	19:54 ± 3:44	26:51 ± 6:03

Results: Surgery residents had faster shunt placement at 6 months when compared to initial assessment pre-education (p=0.08). When comparing shunt placement 6 months post assessment to the initial assessment post-education, resident physicians were slower. (p=0.01). Resident confidence in Argyle (0.4 vs 1.75, p=0.01) and Sundt (0 vs 1.5, p=0.01) shunt placement increased from the initial assessment to retention. Time to shunt placement also decreased from pre-education to retention (32:49 vs 25:01, p=0.08)

Conclusion: The study validates the effectiveness of hands-on education in enhancing senior general surgery resident proficiency in vascular shunt placement. Residents demonstrated retention of shunt placement skills 6 months after initial assessment and education. Resident confidence also correlated with a decrease in shunt placement time. While there was no statistically significant difference in pre-test and 6-month retention times, the results trend toward clinical significance, reflecting increased proficiency compared to the pre-education baseline.



Oral #4

ASSOCIATION BETWEEN SODIUM ADMINISTRATION AND VENTILATOR DAYS IN CRITICALLY ILL TRAUMA PATIENTS

Emily Baird, MD; Louis Boohaker, MD;
Paige Farley, MD; Russell Griffin, PhD; Lindy Reynolds, MS;
John Holcomb, MD; Jan Jansen, MBBS, PhD
University of Alabama at Birmingham

Introduction: Modern resuscitation practices limit crystalloid; however, patients often receive unaccounted for sodium (Na) in their nutritional and medicinal fluids. While some Na is physiologically necessary, excessive quantities of Na has deleterious effects. Guidelines recommend a maximum of 1meq/kg/day (mEq), yet in the intensive care unit (ICU), the total amount of Na routinely received is unknown. The purpose of this study was to assess the association between Na administration and ventilator requirements in patients in either our trauma burn or neuro ICUs (TBICU and NICU respectively).

Methods: We completed a retrospective analysis of ventilated TBICU/NICU patients from 2019 to 2023. We used the electronic health record to determine types and volumes of all infusions and enteral nutrition administered, and calculated the total amount of Na given during the first five days of ICU stay. We used a negative binomial regression adjusted for age, injury mechanism, and injury severity score including an interaction of Na mEq and presence of traumatic brain injury (TBI) (Head AIS >3) to estimate count ratios (CRs) and associated 95% confidence intervals (CIs) for the association between Na administration and ventilator-free days in patients with and without TBI.

Results: 2,943 patients met the inclusion criteria. The median ISS was 21 (IQR 13-29) and median length of ICU stay was 7.5 days (IQR 3.9-15.2). 76.2% (n=2,242) of patients received the recommended amount (≤1mEq/day) of Na, 16.2% (n=478) received >1-2 mEq Na/day and 7.6% (n=223) received >2 mEq Na/day. Patients without a TBI who received ≤1 mEqs had a mean 19.7±9.4 vent-free days, >1-2 mEq of Na had a mean 16.1±10.1 vent-free days (CR 0.84, 95% CI 0.72-0.99, p=0.035), and >2 mEq had a mean 12.5±9.9 vent-free days (CR 0.71, 95% CI 0.57-0.88, p=0.002). Similar patterns of association were observed for TBI patients.

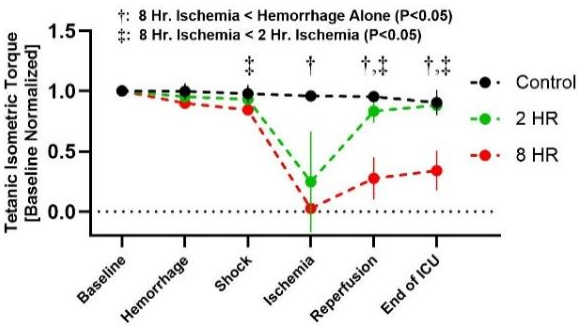
Conclusion: Nearly one-quarter of patients in our ICUs receive almost double the recommended daily amount of Na per day. Higher Na mEqs/day was associated with fewer vent-free days for patients with and without a TBI. Further studies are needed to assess the association between Na administration and outcomes in other populations of critically ill patient.

Oral #5

FUNCTIONAL AND PHYSIOLOGIC OUTCOMES OF VARIABLE LIMB ISCHEMIA IN A PORCINE MODEL OF HEMORRHAGIC SHOCK

Kyle Patterson, MD; Meredith Lackie, MD; John Mares, MPH;
Justin Hutzler, BS; Woo Do, MD; Stephen Goldman, PhD;
David Burmeister, PhD; David Schechtman, MD; Joseph Bozzay, MD;
JT Green, MD; Ian Stewart, MD; Jason Radowsky, MD;
Matthew Bradley, MD; Jonathan Morrison, MB, ChB, PhD;
Patrick Walker, MD
Walter Reed National Military Medical Center

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 (1205 ±268 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.



Oral #6

IS INITIAL WHOLE BLOOD TRANSFUSION ASSOCIATED WITH DECREASED ORGAN SPACE SURGICAL SITE INFECTIONS AFTER TRAUMA LAPAROTOMY?

Renee W. Green, MD; William Rieger, MD;
Stephanie Martinez Ugarte, MD; Mokunfayo Fajemisin, MD;
Jan-Michael Van Gent, DO; Thomas Clements, MD;
Lillian Kao, MD; Bryan Cotton, MD, MPH
University of Texas Health Science Center Houston

Introduction: Hemorrhagic shock is associated with greater odds of organ space surgical site infections (OS/SSI) after trauma laparotomy. Given the benefits of whole blood (WB) in resuscitating patients and combat casualties with traumatic hemorrhagic shock, we hypothesized that prehospital or emergency department administration of WB would be associated with reduced OS/SSI rates after trauma laparotomy compared to component-only therapy and those who did not require blood.
Methods: A single-center retrospective review of adult (≥16 years old) patients who underwent exploratory laparotomy at a level-1 trauma center from January 2019 to June 2023 was performed. Patients who died within one hour of arrival were excluded. Patient demographics, vitals, injury and surgical details, and complications were collected from medical records. OS-SSI was recorded per 2024 CDC criteria. Patients were categorized into three groups based on prehospital and emergency department resuscitation method: any WB, component only, and no blood. Univariate and multivariable analyses were performed.
Results: Of 490 included patients, 256 (52.3%) received WB, 105 (21.4%) received components only, and 129 (26.3%) received no blood products. WB patients had higher injury severity scores (ISS) and poorer at-scene vitals, compared to the component and no blood groups. OS/SSI occurred in 18% of WB, 12% of component-only, and 11% of the no blood groups ($p < 0.001$). However, after adjustment for ISS, pre-operative lactate, post-ED pRBC transfusions, arrival shock index, and mode of transport, WB was associated with decreased odds of OS/SSIs when compared with component-only resuscitation (OR 0.54, 95% CI 0.30-0.97, $p=0.04$).
Conclusions: In our single-center analysis, WB administration was associated with decreased odds of OS/SSIs after adjusting for worsened scene physiology. Our study supports the use of WB for severely injured trauma patients for potential reduction in OS/SSIs.

LIMITATIONS OF BLOOD PRODUCT AVAILABILITY AND WALKING BLOOD BANK IMPLEMENTATION ACROSS ROLE 2 SURGICAL TEAMS IN LARGE-SCALE COMBAT OPERATIONS

Jonathan Wang, MD; Mason Remondelli, MD; Benjamin Seamons, BS; Matthew Wang, BS; Kennedy Nye, MD; James Williams, MD; JT Green, MD; Joseph Bozzay, MD; David Schechtman, MD; Ian Stewart, MD; Woo Do, MD; David Burmeister, PhD; Eric Elster, MD; Matthew Bradley, MD; Patrick Walker, MD
Walter Reed National Military Medical Center

Introduction: Hemorrhage is the leading preventable cause of combat death. Large-scale combat operations (LSCO) may overwhelm traditional blood supply chains due to high casualty rates and logistical constraints. This study uses discrete event simulation to assess the resilience of blood supply strategies for Role 2 surgical teams in LSCO.
Methods: Historical data were used to define low (50/day), medium (250/day), and high (500/day) casualty scenarios. A discrete event model simulated variable daily casualties with current resupply strategies based upon blood products estimates set by the Office of the Joint Staff Surgeon, across 30 days. Monte Carlo simulation captured outcome variability and estimated blood supply depletion timelines.
Results: In 10,000 simulations per scenario, existing strategies sustained 30 days of supply in the low-casualty case but failed 25% of the time if continued indefinitely. In medium and high-casualty scenarios, supply was exhausted after 2.1 and 0.8 days on average. A sustained rate of 65 casualties/day yielded a 50% failure risk over 30 days. Supplementation with walking blood banks were inadequate during higher casualty settings.
Conclusions: Current strategies may not meet LSCO blood needs at medium or high casualty rates. Augmentation with walking blood banks is ineffective in these contexts. Expanded resupply or alternative products are needed to close this gap.

NOVEL ECMO-REBOAVC-CRRT CIRCUIT IMPROVES SURVIVAL DURING PROLONGED BALLOON OCCLUSION OF THE AORTA AND VENA CAVA IN A PORCINE HEMORRHAGE MODEL

Bradley Pierce, MD; Obeth Bahena Gutierrez, MD; Cameron Harvey, DO; Catherine Uyehara, PhD; Lee-Ann Murata; Wendy Kurata; Lauren Wong; Sarah Pruitt; Donald Moe, MD; Jason Brill, MD; Lisa Pierce, DSc
TRIPLER ARMY MEDICAL CENTER – TAMC

Introduction: Noncompressible torso hemorrhage (NCTH) remains the leading cause of preventable deaths on the battlefield. Endovascular balloon occlusion of the aorta (REBOA) achieves temporary control of NCTH but causes potentially fatal ischemia-reperfusion injury, limiting its applicability to a zone 1 full occlusion time of <30 min. We investigated whether the use of a distal extracorporeal membrane oxygenation (ECMO) perfusion system with endovascular hemorrhage control devices placed in both the aorta and inferior vena cava (REBOAVC) in zone 1 can prolong the duration of survivable occlusion in a porcine hemorrhage model.
Methods: Anesthetized, mechanically ventilated Duroc-cross pigs (52±2 kg) were instrumented to monitor hemodynamics, oxygenation, and systemic markers of tissue injury. Pigs underwent 30% controlled hemorrhage with subsequent REBOAVC in zone 1 (90 min full occlusion) with (n=10) or without (n=3) peripheral veno-arterial ECMO (8Fr/10Fr femoral cannulation). Balloon deflation was followed by immediate transfusion of hemorrhaged blood and a 3-hr reperfusion/critical care period. A subset of ECMO pigs (n=5) underwent continuous renal replacement therapy (CRRT) during reperfusion with an Oxiris filter. Organs were evaluated grossly and histologically for ischemic injuries.
Results: After 3 hr of resuscitation post-occlusion, ECMO pigs showed greater survival (90% vs. 0%), improved lactate clearance (3.7±0.8 vs. 13.7±1.8 mmol/L), decreased norepinephrine requirement (18±5 vs. 56±3 µg/kg), and reduced histologic jejunum and kidney ischemia scores compared to pigs without ECMO ($p<0.05$ for all). Achieved ECMO blood flow rate was inversely correlated with degree of distal end-organ ischemia (jejunum $r=-0.90$, $p<0.001$; kidney $r=-0.7$, $p=0.01$). CRRT successfully managed hyperkalemia and aided in acid-base correction from ischemia-reperfusion injury during resuscitation (K^+ = 4.6±0.4 [CRRT] vs. 5.8±0.6 [ECMO without CRRT] vs. 8.5±0.8 mmol/L [no ECMO]). CRRT resulted in decreased systemic IL-18 (1810±309 vs. 3583±949 pg/ml, $p=0.006$).
Conclusion: Small-bore peripherally placed ECMO cannulas in the femoral artery and vein successfully provided sufficient perfusion to distal organs in a porcine model of hemorrhagic shock and supraceliac/suprahepatic aortic/IVC occlusion. This suggests that an integrated ECMO-REBOAVC-CRRT system has the potential to improve survivability for prolonged aortic occlusion for NCTH.

OPERATIVE VS NONOPERATIVE MANAGEMENT OF MOREL-LAVALLÉE LESIONS: RECURRENCE RATES AND CLINICAL OUTCOMES

Fayrouz F. Abu-Hamdan, MD; Hannah Holland, MD; Carisa Bergner, PhD; Joshua Dilday, DO; Thomas Carver, MD, FACS
Medical College of Wisconsin

Introduction: Morel-Lavallée lesions (MLL) are closed, soft-tissue degloving injuries caused by shearing trauma. Despite their often resource-intensive management, no consensus exists on the optimal treatment approach. We hypothesized that operative management reduces recurrence rates compared to nonoperative strategies.
Methods: A retrospective review was conducted on MLL patients treated at our level-one trauma center and affiliated institutions from 01/01/2010–10/31/2024. Patients with less than one month of follow-up were excluded. Those with MLLs associated with underlying fractures were excluded from primary analysis to prevent confounding, as these patients typically underwent surgical intervention primarily for fracture management rather than specifically for MLL treatment. Data on patient demographics, injury mechanism, time to treatment, MLL characteristics, treatment strategies (operative versus nonoperative: observation, compression, aspiration, or sclerodesis), and outcomes were analyzed.
Results: Among 102 patients with MLLs without underlying fractures, those in the nonoperative cohort (n=52) had a longer median wait time from injury to diagnosis (15.5 vs. 6 days, p=0.008). The median time from injury to treatment was also significantly longer in the nonoperative group (31 days, IQR 0–2,920) compared to the operative group (7 days, IQR 0–4,380). MLL recurrence occurred in 2/50 patients (4%) who underwent operative management alone, while 32/52 patients (61.5%) managed nonoperatively experienced treatment failure or recurrence within three months ($p<0.001$). In the nonoperative cohort, 23/52 patients (44%) required subsequent operative management.
Conclusion: Operative management is associated with significantly lower recurrence rates compared to nonoperative strategies in patients with MLLs without associated fractures. Nonoperative care often led to delayed treatment, higher failure rates, and frequent need for delayed surgery. These findings support early operative intervention. The impact of delayed diagnosis and treatment on outcomes warrants further study to refine treatment algorithms and optimize management strategies.

Oral #10

THE IMPACT OF RAPID INFUSERS ON THE HEMOSTATIC POTENTIAL OF CRYOPRECIPITATE PRODUCTS

Connor Purvis, MD; Samantha Redden, MD; Andrew Jacobson, MD; Yao-Wei Wang, PhD; Jessica Cardenas, PhD; Bryan Cotton, MD, MPH
McGovern Medical School

Introduction: As rapid infusion devices are not approved for cryoprecipitate, we examined the impact of different transfusion methods on the hemostatic activity of two available products.
Methods: Ten bags of cryoprecipitate (CRYO) and 10 bags pathogen-reduced cryoprecipitate (IFC) were obtained. Each unit was infused with one unit of whole blood by three techniques: (1) gravity infusion with filter, (3) rapid infuser at 70 mL/min, and (3) pressure bag and filter. Hemostatic potential was measured by thrombelastography (TEG), thrombin generation (CAT), and factor levels.
Results: Compared to standard and pressure delivery, both CRYO and IFC demonstrated stable or improved TEG, CAT, and factor values via rapid transfuser device (Table).
Conclusions: Hemostatic potential of cryo appears intact after infusion via rapid transfusers. Restriction of cryo infusion should be reconsidered.

Differences by transfusion method of standard cryoprecipitate				
	Filter only	Rapid infuser	Press. bag	p-value
TEG angle	70 (61, 75)	78 (76, 81)	79 (76, 81)	0.003
Time-peak	12 (10, 13)	10 (9, 11)	13 (12,15)	<0.001
Fibrinogen	243 (171, 326)	532 (463, 632)	644 (572, 749)	<0.001
Factor II	71 (57, 77)	95 (91, 103)	100 (94, 108)	<0.001
Factor VII	60 (43, 75)	89 (74, 105)	101 (80, 152)	<0.001
Factor X	71 (60, 81)	102 (92, 104)	112 (97, 129)	<0.001
vWF	79 (53, 107)	308 (267, 365)	273 (180, 351)	<0.001
Differences by transfusion method of IFC				
TEG angle	72 (66, 75)	74 (72, 79)	77 (73, 82)	0.044
Time-peak	13 (11, 16)	13 (10, 14)	14 (13, 20)	0.211
Fibrinogen	221 (186, 242)	310 (262, 358)	379 (330, 428)	<0.001
Factor II	65 (60, 78)	75 (68, 84)	84 (74, 87)	0.047
Factor VII	64 (55, 68)	73 (64, 76)	81 (74, 86)	0.004
Factor X	78 (63, 84)	86 (79, 87)	92 (87, 97)	0.013
vWF	83 (74, 85)	129 (107, 172)	202 (169, 222)	<0.001

Oral #11

USE OF COMPOSITE LACTATE METRICS IN ECMO PATIENTS

Pranav Singh, MD; Seth Lawson, BS; Julie Rizzo, MD;
Jason Thomas, MD; Ellynor Herico, RN; Marla Gutierez, MPH
Brooke Army Medical Center

Introduction: Composite lactate-based metrics, arterial lactate x bicarbonate (HCO3) & lactate gradient (venous – arterial), may enhance prognostics by reflecting dynamic physiologic states in ECMO patients. These metrics incorporate metabolic acidosis, compensatory responses to maintain homeostasis, & clearance capacity potentially providing superior mortality predictions compared to single point lactate metrics. Our objective was to evaluate whether composite metrics, arterial lactate × HCO3 or the lactate gradient, are superior mortality predictors than arterial or venous lactate alone in patients on ECMO.
Methods: A retrospective cohort study of 99 ECMO cases (2022–2024) at a Level 1 Trauma Center analyzed arterial & venous lactate levels, as well as composite lactate metrics. Statistical comparisons between survivors and non-survivors were conducted using t-tests & Kolmogorov-Smirnov (KS) tests, followed by multivariate regression and random forest modeling.
Results: For VA ECMO (n= 29), arterial lactate was significantly higher in non-survivors than survivors (p= 0.007), while venous lactate was insignificant. VV ECMO demonstrated similar trends with arterial and venous lactate. The composite metric of arterial lactate × HCO3 demonstrated similar findings in VA ECMO but with stronger predictive significance (p= 0.002). The differential lactate gradient had greater variability, trending toward negative values in non-survivors, but was less predictive than individual lactate values or the arterial lactate x HCO3.
Conclusion: Lactate as a metric for mortality can be improved to provide assessment of the body's compensatory and clearance function using composite metrics. Composite metrics better stratify survival than the traditional differential lactate gradients in ECMO patients. These findings support the integration of lactate-based composite metrics into prognostic assessments to improve ECMO management strategies.

USE OF IMMUNOADSORPTION FILTER FOR CONVERSION OF HIGH-TITER TO LOW-TITER TYPE O WHOLE BLOOD

Jonathan Lutgens, MD; Zachary Riggenbach, MD;
Abigail Kelly, MD; Brooklyn Williams, DO;
James Williams, MD; Daniel Lammers, MD; Jason Bingham, MD;
John Kuckelman, DO; Luke Pumiglia, MD
US Army - MADIGAN ARMY MEDICAL CENTER

Introduction: Whole blood transfusion is critical in trauma resuscitation, but high antibody titers in donor blood can cause potentially lethal transfusion reactions. Low titer Type-O whole blood (LTOWB) is preferred, yet its availability remains limited. Immunoadsorption has successfully reduced antibody levels in plasma, but its use in whole blood is not well studied. This proof-of-concept study tested whether proprietary immunoadsorption columns can lower antibody titers in whole blood using a single-stage process.
Methods: Eight units of Type O whole blood were stored at 4 °C and filtered using the experimental immunoadsorption columns. Filtration was gravity-driven using standard transfusion tubing. Two types of columns were used: 4 mL columns (flow rate 1–2 mL/min) and 60 mL columns (flow rate 50–100 mL/min). Blood samples were collected before and after filtration to assess antibody titers, complete blood count (CBC), basic metabolic panel (BMP), coagulation studies (PT/INR, PTT), lactate dehydrogenase (LDH), haptoglobin, and thromboelastography (TEG) parameters.
Results: Complete data was available for 5 experiments (N=3 for 4ml, N=2 for 60ml). Conversion to LTOWB was observed in all (100%) completed experiments with an average decrease in anti-A titers from 1:106 to 1:15 ($p=0.016$) and 1:85 to 1:14 ($p=0.01$) in anti-B titers. Pre- and post-column analyses revealed no statistically significant differences in hematologic or coagulation parameters. Hemoglobin increased from 7.6 g/dL to 12 g/dL ($p = .07$) and hematocrit from 25% to 40% ($p = .07$). Coagulation indices showed minimal change, including platelets (57×10^9/L to 40×10^9/L, $p = .24$), protime (24s to 27s, $p = .07$), prothrombin time (80s to 88s, $p = .8$), INR (2.3 to 2.6, $p = .7$), fibrinogen (224 mg/dL to 176 mg/dL, $p = .2$), R-time (6.7 to 11.2, $p = .1$), and thromboelastography measures including max amplitude and LY30 ($p = .9$ for both). Markers of hemolysis were also unchanged, with haptoglobin decreasing from 54 mg/dL to 39 mg/dL ($p = .2$), LDH increasing from 173 IU/L to 577 IU/L ($p = .08$), and potassium decreasing from 21 mEq/L to 19 mEq/L ($p = .2$). The average filtration time for a single unit of blood using the 60 mL columns was 7 minutes, while the 4 mL columns were unable to filter a complete unit.
Conclusion: This proof-of-concept study supports the feasibility of using immunoadsorption columns to reduce anti-A and anti-B titers in whole blood while maintaining the value of whole blood for resuscitation and stabilizing coagulopathy without creating significant hemolysis.

2025 UPDATE TO COMMITTEE ON TACTICAL COMBAT CASUALTY CARE RESEARCH GAP ANALYSIS- TOP 10 RESEARCH AND DEVELOPMENT PRIORITIES FOR BATTLEFIELD SURGICAL CARE

Laura Kraemer, MD; Dylan Griffiths, MD; Dominick Sestitio, MBA; Caryn Stern, MPH; Matthew Martin, MD; Marty Schreiber, MD; Matthew Tadlock, MD; Jan Michael Vangent, DO; Jennifer Gurney, MD; Christian McEvoy, MD; Travis Polk, MD; John Holcomb, MD; James Wallace, MD
Naval Medical Center San Diego

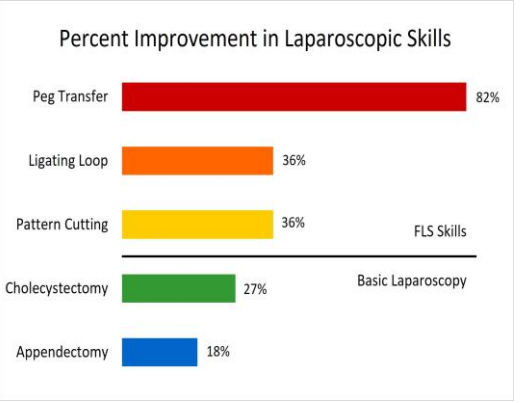
Introduction: The Committee on Tactical Combat Casualty Care (CoSCCC) completed its last gap analysis and top 10 research and development priorities for battlefield surgical care 5 years ago. Since then, operational focus has turned to large-scale combat operations in Eastern Europe and South East Asia. It is anticipated that combat injuries, fatalities, and resource limitations will be greater due to decreased air superiority and ability to move patients quickly. As a result, operational needs and limitations will likely force us to change practice and explore new research and development priorities.
Methods: We created an update to the 2019 CoSCCC survey-based gap analysis. All previous questions from 5 years ago were revisited along with additional questions based on group consensus that addressed new anticipated threats. A web-based survey ranked topics on a Likert scale from 1 (low) to 10 (high priority). The survey was distributed to the CoSCCC, as well as select trauma and CCC providers. Demographics, descriptives, univariate statistics, and inter-rater correlation analysis were performed.
Results: There was a 66% survey response rate. 94.5% of the respondents were military. There was high inter-rater agreement between questions (inter-rater correlation coefficient = 0.91, CI:0.88-0.93). The top 5 focus areas were Personnel/Staffing (7.36), Resuscitation and Hemorrhage Management (7.07), CBRNE Events and Patients (6.87), Pain/Sedation/Anxiety Management (6.81), and Burn Injuries (6.67). CBRNE Events and Patients had the largest positive mean score change (0.41). The top 10 questions with the largest decreased importance centered on Resuscitative Endovascular Balloon Occlusion of the Aorta (REBOA), nonoperative intervention for non-compressible truncal hemorrhage, and point of care ultrasound. Top research priorities were creating dried or otherwise shelf stable blood products/bio-artificial blood substitutes (9.12) as well as optimization of blood products and their storage for transfusion (8.99). All top 10 research priorities were identified on the previous survey and with seven of them arising from the identified top 5 focus groups.
Conclusion: Similar to the previous findings, nearly all of the top 10 research priorities arose from 3 main focus groups- Resuscitation and Hemorrhage, Operative Management, and Personnel/Staffing. It is likely that these research gaps have yet to be sufficiently addressed and still pose a major threat. With that being said new research priorities were also identified within these focus areas and likely reflect gaps due to new threats. REBOA, intercavitary foams and point of care ultrasound were noted to have decreased relevance compared to optimization and storage of blood products and the development of shelf stable blood products/bio-artificial blood substitutes. This change is likely secondary new literature and the anticipated needs in future conflict. These findings should be used to guide the DoD’s research programs and help prioritize funding for future research to ensure optimal medical readiness in the next conflict.

Oral #14

ARMED AND LAPAR-READY: LAPAROSCOPIC TRAINING FOR MILITARY SURGICAL READINESS

Margaret Mericle, MD; Tiffany Cox, MD;
Alexandra Rooney, MPH; Andrea Krzyzaniak, MA;
Michael Sise, MD; Vishal Bansal, MD; Michael Krzyzaniak, MD
Scripps Mercy Hospital

Introduction: Formal laparoscopic curricula remain limited within military residency programs. These programs face unique challenges in education for surgeon readiness due to frequent deployments and relocation of attending surgeons. As minimally invasive surgery (MIS) becomes more prevalent, structured laparoscopic training can bolster resident confidence and ensure military surgeons meet readiness standards.
Methods: We developed a three-part module to introduce laparoscopy: didactics, operating room (OR), and simulation. This structured curriculum, delivered with faculty guidance, was implemented for all postgraduate year 1 (PGY1) residents from a single military training facility during protected academic time. Residents participated in the module and completed pre- and post-module self-evaluation surveys, rating their ability to perform laparoscopic skills and complete basic laparoscopy procedures of appendectomy and cholecystectomy on a 5-point Likert scale.
Results: Among the 11 PGY1 residents, we observed increased confidence in performing basic laparoscopic appendectomy and cholecystectomy after module completion, with 18% and 27% improvement, respectively (Fig. 1). Residents reported improvements in specific laparoscopic skills: 82% improvement in peg transfer, 36% improvement in pattern cutting and ligating loop. All residents reported the module as useful and more than half cited skill development as a key reason for simulation use.
Conclusion: Our data demonstrate increasing self-reported confidence among PGY1 residents in performing laparoscopic skills and basic procedures. Early skill enhancement may advance junior residents along the laparoscopic learning curve and support surgical readiness. Integrating structured laparoscopic training into military residency programs may help sustain competency in MIS.



COMPARATIVE OUTCOMES BETWEEN MILITARY AND CIVILIAN CHILDREN AFTER NON-ACCIDENTAL TRAUMA: A MULTICENTER RETROSPECTIVE STUDY

Utsav M. Patwardhan, MD; Katie Joskowitz, MPH; Mauricio A. Escobar, MD; Margaret Gallagher, MD; Kylie Scallon, BAN; Katherine Davenport, MD; Shannon N. Acker, MD; Sage Vincent, MD; Luke Pumiglia, MD; Cameron Harvey, DO; Christina Colosimo, DO, MS; Patrick Thomas, MD; Russell Woo, MD; Shalon Nienow, MD; Romeo C. Ignacio, Jr., MD, MS
Naval Medical Center San Diego

Introduction: Non-accidental trauma (NAT) is associated with many social factors including low socioeconomic status, mental health difficulties, and substance use. Military families are uniquely vulnerable to experiencing abuse, and NAT in military children has been linked to periods of increased stress, including deployments. NAT outcome data in military-dependent children are limited to a single-center study showing longer length of stay (LOS), higher mortality, and more complications.
Methods: A retrospective review was conducted of children (≤18 years) at 8 US children's hospitals from 2018-2023 with NAT diagnosed by a multi-disciplinary child abuse team. Exclusion criteria included sexual abuse and neglect. Military affiliation was determined by insurance coverage or caregiver self-identification. The primary outcome was mortality and LOS. Secondary outcomes included the number of specialty consultations, need for operations, and 30-day readmissions. Comparisons were made between military and civilian patients.
Results: A total of 907 patients were diagnosed with NAT (112 [12.3%] were military-affiliated and 62% were male). Military patients were younger, more likely to be the first child, and lived in less disadvantaged areas (Table). Mechanism of injury, median Glasgow Coma Scale (GCS), and injury severity score (ISS) did not vary. However, military children had higher median abbreviated injury scores (AIS) of the face and chest. Military children were more likely to need ENT evaluation. 30-day readmission and ED visits were equivalent. Military children had a higher median LOS than civilian patients (4 vs. 3 days, p=.05).
Conclusion: In a large, multicenter study, military children affected by NAT were younger and had a longer LOS, despite equivalent ISS. Although the mechanism of injury was similar, military patients had more severe facial and chest injuries. Military families were less likely to have some common risk factors for NAT including law enforcement involvement and substance use. Notably, military children were more likely to be the only child in the household. This is the first multicenter study performed to characterize a high-risk population and identify opportunities for greater support and early intervention for military families.

	Civ. Patients (n=795)	Mil. Patients (n=112)	p
Age, median months (IQR)	4.6 (2.3-17.0)	3.7 (1.8-6.6)	<.01
ADI national percentile, median (IQR)	55 (32-77)	38 (29-52.25)	<.01
Only child in household, n (%)	312 (39.2)	60 (53.6)	.01
ISS, median (IQR)	10 (5-22)	11 (5-18)	.69
AIS, median face (IQR)	1 (0-1)	1 (0-1)	.04
AIS, median chest (IQR)	0 (0-1)	0 (0-2)	.04
# of specialty consults, median (IQR)	1.98 (1.490)	2.11 (1.504)	.44
Need for Otolaryngology (ENT), n (%)	27 (3.4)	10 (8.9)	.02
In-hospital mortality, n (%)	77 (9.7)	7 (6.3)	.24
Total length of stay, median days (IQR)	3 (1-7)	4 (2-7)	.05
30-day readmission, n (%)	25 (3.1)	4 (3.6)	.77

ENHANCING BATTLEFIELD READINESS: A CADAVER-BASED SURGICAL SKILLS CURRICULUM FOR ROLE 1 (R1) PROVIDERS

Dylan Griffiths, MD; Laura Kraemer, MD;
Bailey Grimsley, MD; Jack Brandau, DO
Naval Medical Center San Diego

Introduction: In future global conflicts, distributed maritime operations and contested airspace may delay casualty evacuation and require prolonged field care. This highlights the need for adequately trained frontline medical personnel, known as R1 providers. These providers are often general medical providers without surgical subspecialty training, yet they must be prepared to perform critical life- and limb-saving interventions in austere environments. To address this training gap, we developed a cadaver-based curriculum to improve procedural confidence and capability among Navy R1 providers.
Methods: A prospective, observational study was conducted at Naval Medical Center San Diego. Eligible participants included Active-duty Navy personnel serving as R1 providers. The participants completed a pre- and post-course confidence survey measuring all trained skills on a 5-point Likert scale. Hands-on training included 12 procedures identified as being important for R1 providers to have experience with, including tube thoracostomy, cricothyroidotomy, and advanced vascular access. Self-assessment surveys were analyzed to assess procedural confidence using Wilcoxon signed-rank test with an alpha of 0.05. Additionally, a post-course debrief was recorded and analyzed for qualitative themes to assess content relevance, instructional quality, and areas for improvement.
Results: There were 10 total participants, including physicians, physician assistants, and independent duty corpsmen. Statistically significant improvements in procedural confidence were observed across all surveyed skills ($p < 0.05$). The greatest gains were noted in fasciotomy (mean increase 1.5 to 3.4), saphenous vein cutdown (1.0 to 3.9), blood vessel ligation (1.7 to 3.6), and evisceration management (1.9 to 3.5). Qualitative analysis revealed three dominant themes: high perceived relevance to deployed settings, appreciation for hands-on learning and small-group instruction, and a desire for scenario-based integration of procedural and tactical skills.
Conclusions: A cadaver-based training curriculum significantly improved R1 providers' procedural confidence. These findings support expanding training models to strengthen frontline trauma care capabilities in future austere conflict settings. Moving forward, tailoring instruction to combat-relevant scenarios and allowing increased hands-on time may further enhance competence and preparedness. We plan to iteratively improve this course in response to participant feedback, as well as to quantitatively evaluate technical skill acquisition.

Oral #17

EXPEDITIONARY SURGERY AT SEA: 1-YEAR OUTCOMES OF EMERGENCY SURGICAL PROCEDURES PERFORMED ON U.S. NAVY WARSHIPS

Sophia Schermerhorn, MD; Matthew Tadlock, MD;
Kathleen Cannon, MD; Katherine Wrenn-Maresh, MD;
Benedict Capacio, MD; Caleb Adkins, DO;
Lindsey Sawczuk, MD; Eleanor Harding, MD
Naval Medical Center San Diego

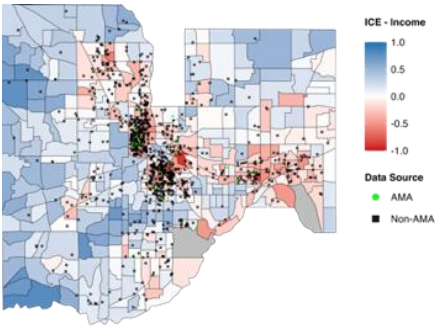
Introduction: Naval surgeons routinely deploy with single surgeon teams on warships with limited surgical and diagnostic capabilities. Implemented in 2021, the Maritime Surgery Quality Improvement (MSQI) program tracks surgical care at sea. In this first analysis of the MSQI database, we report 1-year outcomes of major operations performed at sea.
Methods: The MSQI database was retrospectively reviewed from July 2021-December 2024. Encounters involving a major operation, endoscopy or medical evacuation (MEDEVAC) were reviewed via the military electronic medical record (EMR) for demographics, operative documentation, and 1-year postoperative outcomes.
Results: Of 839 encounters, 817 procedures were performed and 35% (n=344) met inclusion criteria. Of these, 20% would typically be managed by another surgical specialty on shore, including ENT (4), urology (3), GI (17), gynecology (13), and orthopedics (27). Intra-operative, 30-day, and 1-year complication rates were 0.7%, 11% and 2.1% respectively. Of minor cases, 86 involved managing hand and finger injuries using local anesthetic. There were 72 MEDEVACs, and 2 blood transfusions. Two deaths were included that received resuscitative procedures for medical diagnoses.
Conclusion: This is the first study to report short- and long-term outcomes of surgical care aboard U.S. warships, showing the breath of surgical care and low complication rates associated with appropriately selected cases. Our findings demonstrate the need for supplemental subspecialty training. This data can also facilitate informed decision making for patients, deployed surgeons and the non-physician warship Commanders who make the final determination if an operation is performed in expeditionary the maritime environment.

Oral #18

SPATIAL AND SOCIOECONOMIC INSIGHTS INTO AGAINST MEDICAL ADVICE DISCHARGE AFTER FIREARM INJURY

Ted Chung, DO; Sara Hammouri; Zoe Randall; Charly Vang;
Rachel Nygaard, PhD; Derek Lumbard, MD
Hennepin County Medical Center

Introduction: Patients who discharge (DC) against medical advice (AMA) often leave the hospital before completing their recommended treatment, placing them at increased risk for complications and subsequent readmission. The aim of this study was to assess the rate of AMA discharge following assault-related firearm injury. The secondary aim was to determine whether patients who discharged AMA were from under-resourced areas to identify opportunities for targeted intervention.
Methods: This study utilizes data from a level 1 trauma center spanning 2014-2023. Demographic and injury characteristics related to assault-related firearm injuries were gathered for patients with AMA and non-AMA discharge. Home locations were linked to census tracts and paired with Index of Concentration at the Extremes (ICE) values calculated from socioeconomic data in the American Community Survey 5-year estimates.
Results: A total of 1,450 assault-related firearm injuries were treated and 3.4% (45/1319) of surviving patients discharged AMA. Post-DC mortality did not differ significantly (AMA 4.4% and non-AMA 2.9%). AMA DC had significantly higher readmission rates (17.8% vs 7.7%, p = 0.029). While not statistically significant, patients discharged AMA had a shorter median time to readmission (10.5 vs. 33 days, p = 0.371). Home location ICE showed no significant spatial clustering among AMA patients (Moran's I = 0.053, p = 0.153) and was not a significant predictor of AMA DC. However, non-AMA patients exhibited strong spatial clustering (Moran's I = 0.765, p < 0.001), suggesting they tend to reside in socioeconomically under-resourced areas.



Conclusion: After assault-related firearm injury, those who discharged AMA were significantly more likely to be readmitted; Moran's I showed no spatial clustering among AMA patients, while non-AMA patients clustered in socioeconomically homogenous areas.

Oral #19

UNDERSTANDING PEDIATRIC MORTALITY IN CONFLICT ZONES: A TWENTY-YEAR ANALYSIS OF TRAUMA CARE

Sara Bibbens, DO; Margaret Shields, MD
Walter Reed National Military Medical Center

Introduction: Pediatric mortality from conflict-related injuries exceeds adult mortality. Understanding pediatric-specific injury patterns and their impact on outcomes is critical for resource allocation and training. This study aims to characterize pediatric injuries in conflict zones and examine the relationships between injury patterns, resource allocation, and survival.
Methods: A retrospective cohort analysis of the Department of Defense Trauma Registry from 2001 to 2022 was conducted for children less than 18 years old treated at a deployed military treatment facility in a conflict zone with a documented injury and discharge status. The primary outcome was survival to hospital discharge.
Results: 5,680 children met the inclusion criteria with an overall mortality rate of 9.4%. Non-survivors had higher illness severity scores (25 vs 9, $p < 0.001$), burn injury (18% vs 9.4%, $p < 0.001$), were younger, and had greater median [IQR] blood loss (12.1 [3.6, 24.8] mL/kg vs 2.9 [1.2, 8.3] mL/kg, $p < 0.001$). Acute respiratory failure (2.3% vs 0.5%, $p < 0.001$) and fluid and electrolyte imbalances (6.8% vs. 2.9%, $p < 0.001$) were significantly more common in non-survivors.
Conclusion: This large epidemiologic study of pediatric injuries in a conflict zone is the first to examine injury patterns and resource utilization through a mortality-focused lens. This study provides key insight into complex injury patterns and complications likely to result in conflict-related death and underscores the need for pediatric-specific training and resources for improved outcomes in austere environments.