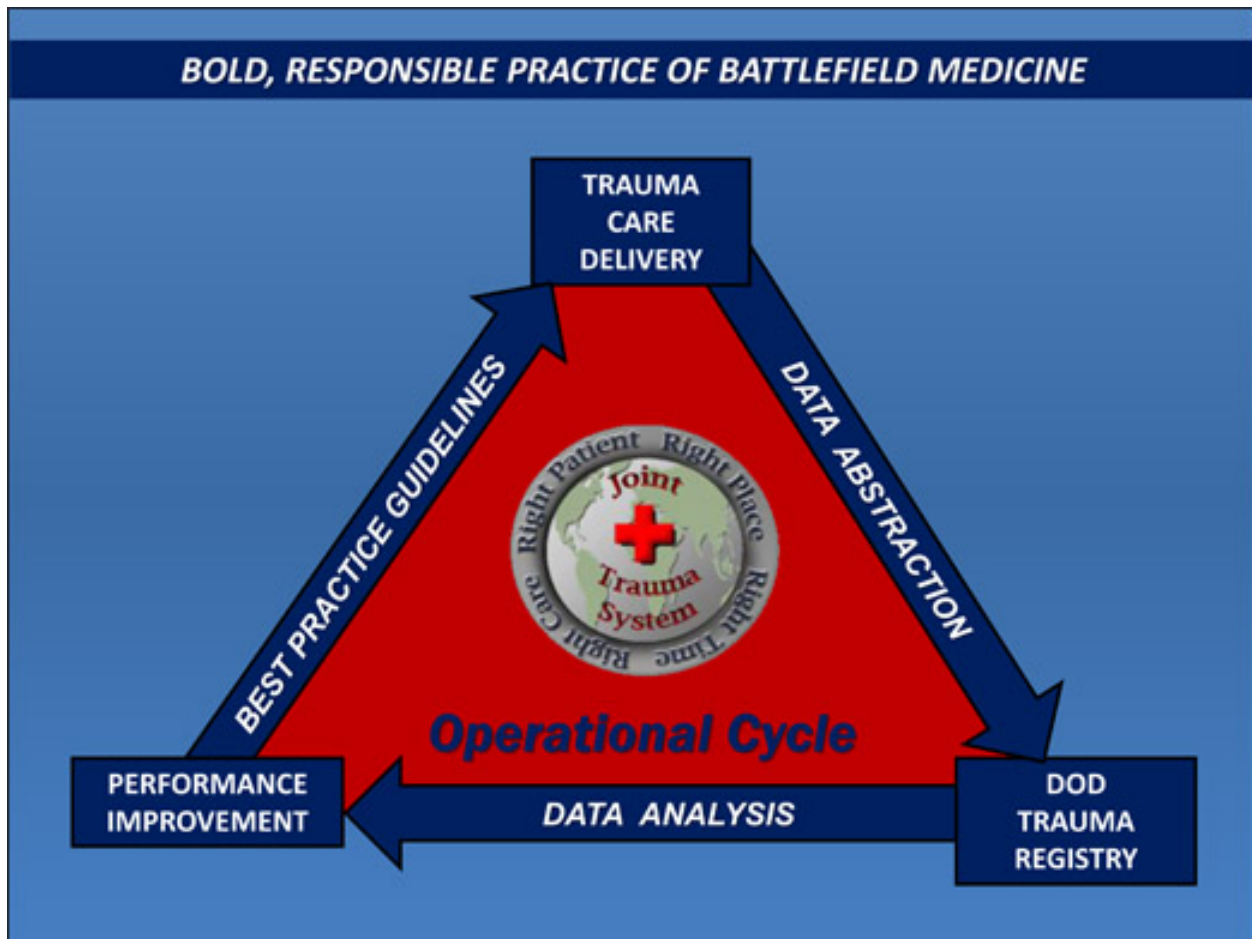


Committee on Surgical Combat Casualty Care  
(CoSCCC)



Journal Watch

2nd Quarter

2017

## Journal Watch Key Terminology Searched:

Microcirculation  
Shock  
Human subject research  
Haemorrhagic shock  
Traumatic brain injury  
Plasma  
Transfusion  
RBCs  
Stability  
Blast  
Amputation  
Traumatic Clinical outcomes  
Injury  
Coagulopathy  
Fibrinogen concentrate  
Viscoelastic haemostatic assays  
Guidelines  
fractures  
REBOA  
Orthopaedic trauma  
Wound ballistics  
Cause of injury

Trauma Management  
Sublingual  
IDF  
Multiple trauma  
Coagulopathy  
Pre-hospital  
Trauma  
Resuscitation  
Ultrasound  
Facial trauma  
Multiple  
Clinical parameters  
Pelvic fracture  
Cryoprecipitate  
Massive transfusion  
Angiography  
Internal fixation  
X-ray  
Antibiotic prophylaxis  
Perioperative antibiotics  
Faecal diversion  
Head injuries

Haemorrhage  
Ethics committees  
Institutional review board  
Shock index  
Diagnostic accuracy  
Thrombelastography (TEG)  
Imaging  
Severe trauma  
Afghanistan  
War  
Transfusion  
Damage control  
Trauma  
Fibrinogen  
ABO  
External fixation  
Pelvic ring  
Pre-peritoneal pelvic packing  
Long bone fractures  
Surgical site infection  
Primary repair

# Battlefield pain management: A view of 17 years in Israel Defense Forces

[J Trauma Acute Care Surg.](#) 2017 Jul;83(1 Suppl 1):S150-S155. doi: 10.1097/TA.0000000000001481.

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## Abstract

### Introduction

Pain control in trauma is an integral part of treatment in combat casualty care (CCC). More soldiers injured on the battlefield will need analgesics for pain than those who will need life-saving interventions (LSI). It has been shown that early treatment of pain improves outcomes after traumatic injury, while inadequate treatment leads to higher rates of PTSD. The purpose of this article is to report the Israel Defense Forces Medical Corps (IDF-MC) experience with point of injury (POI) use of analgesia.

### Methods

All cases documented in the IDF Trauma Registry (ITR) between January 1997 and December 2014 were examined. All cases of POI pain medications were extracted. Data collection included mechanism of injury, wound distribution, pain medication administered, mortality, and provid

### Results

Of 8,576 patients, 1,056 (12.3%) patients who had at least one documented pain management treatment were included in this study. Demographics of the study population included 94.2% male and 5.8% female with a median age of 21 years. Injury mechanisms included 40.3% blast injuries (n=426) and 29% gunshot injuries (306). Of 1,513 injured body regions reported, 52% (787) were extremity wounds (upper and lower), 23% (353) were truncal wounds, and 17.7% (268) were head and neck injuries. A total of 1,469 episodes of analgesic treatment were reported. The most common types of analgesics were morphine (74.7%, 1097 episodes), ketamine (9.6%, 141 episodes) and fentanyl (13.6%, 200 episodes). Of the patients, 39% (413) received more than one type of analgesic. In 90.5% of cases, analgesia was administered by a physician or a paramedic. Over the span of the study period (1997-2014), types of analgesics given by providers at POI had changed, as fentanyl was introduced to providers. A total of 801 LSIs were performed on 379 patients (35.9%) receiving analgesia and no adverse events were found in any of the casualties.

### Conclusion

Most casualties at POI did not receive any analgesics while on the battlefield. The most common analgesics administered at POI were opioids and the most common route of administration was intravenously (IV). This study provides evidence that over time analgesic administration has gained acceptance and has been more common place on the battlefield. Increasingly, more casualties are receiving pain management treatment early in CCC along with LSIs. We hope that this shift will impact CCC by reducing PTSD and overall morbidity resulting from inadequate management of acute pain.

# Early venous thromboembolism chemoprophylaxis in combat-related penetrating brain injury

[J Neurosurg](#). 2017 Apr;126(4):1047-1055. doi: 10.3171/2016.4.JNS16101. Epub 2016 Jun 17.

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## Abstract

### OBJECTIVE

Traumatic brain injury (TBI) is independently associated with deep vein thrombosis (DVT) and pulmonary embolism (PE). Given the numerous studies of civilian closed-head injury, the Brain Trauma Foundation recommends venous thromboembolism chemoprophylaxis (VTC) after severe TBI. No studies have specifically examined this practice in penetrating brain injury (PBI). Therefore, the authors examined the safety and effectiveness of early VTC after PBI with respect to worsening intracranial hemorrhage and DVT or PE.

### METHODS

The Kandahar Airfield neurosurgery service managed 908 consults between January 2010 and March 2013. Eighty of these were US active duty members with PBI, 13 of whom were excluded from analysis because they presented with frankly nonsurvivable CNS injury or they died during initial resuscitation. This is a retrospective analysis of the remaining 67 patients.

### RESULTS

Thirty-two patients received early VTC and 35 did not. Mean time to the first dose was 24 hours. Fifty-two patients had blast-related PBI and 15 had gunshot wounds (GSWs) to the head. The incidence of worsened intracranial hemorrhage was 16% after early VTC and 17% when it was not given, with the relative risk approaching 1 (RR = 0.91). The incidence of DVT or PE was 12% after early VTC and 17% when it was not given (RR = 0.73), though this difference was not statistically significant.

### CONCLUSIONS

Early VTC was safe with regard to the progression of intracranial hemorrhage in this cohort of combat-related PBI patients. Data in this study suggest that this intervention may have been effective for the prevention of DVT or PE but not statistically significantly so. More research is needed to clarify the safety and efficacy of this practice.

# Combat Surgical Workload in OIF/OEF: The Definitive Analysis

[J Trauma Acute Care Surg.](#) 2017 Jul;83(1):77-83. doi: 10.1097/TA.0000000000001496.

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## Abstract

Relatively few publications exist on surgical workload in the deployed military setting. This study analyses U.S. Military combat surgical workload in Iraq and Afghanistan to gain a more thorough understanding of surgical training gaps and personnel requirements.

## Methods

A retrospective analysis of the Department of Defense Trauma Registry (DoDTR) was performed for all Role 2 (R2) and Role 3 (R3) Military Treatment Facilities (MTFs), from January 2001 to May 2016. ICD-9-CM procedure codes were grouped into 19 categories based on functional surgical skill sets. The 189,167 surgical procedures identified were stratified by Role of care, month and year. Percentiles were calculated for the number of procedures for each skill set. A literature search was performed for publications documenting combat surgical workload during the same period.

## Results

A total of 23,548 surgical procedures were performed at R2 facilities while 165,619 surgical procedures were performed at R3 facilities. The most common surgical procedures performed overall were soft tissue (37.5%), orthopedic (13.84%), abdominal (13.01%), and vascular (6.53%). The least common surgical procedures performed overall were cardiac (0.23%), Peripheral Nervous System (0.53%), and spine (0.34%).

## Conclusions

The published literature on combat surgical workload represents the high end of the spectrum of deployed surgical experience. These trends in surgical workload provide vital information that can be used to determine the manpower needs of future conflicts in ever-changing operational tempo environments. Our findings provide surgical types and surgical workload requirements that will be useful in surgical training and placement of medical assets in future conflicts.

## Level of Evidence

Epidemiologic study, level III; Care management, level III.

PMID:28426558 DOI:[10.1097/TA.0000000000001496](https://doi.org/10.1097/TA.0000000000001496)

# Outcomes Associated With Blast Versus Nonblast-Related Traumatic Brain Injury in US Military Service Members and Veterans: A Systematic Review

[J Head Trauma Rehabil.](#) 2017 Apr 18. doi: 10.1097/HTR.0000000000000304. [Epub ahead of print]

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## Abstract

### Objectives

To systematically review the literature on comparative clinical and functional outcomes following blast-related versus nonblast-related traumatic brain injury (TBI) among US service members and Veterans.

### Design

MEDLINE search (January 2001 to June 2016) supplemented with hand search of reference lists and input from peer reviewers.

### Results

Thirty-one studies (in 33 articles) reported on health outcomes; only 2 were rated low risk of bias.

There was variation in outcomes reported and methods of assessment. Blast and nonblast TBI groups had similar rates of depression, sleep disorders, alcohol misuse, vision loss, vestibular dysfunction, and functional status. Comparative outcomes were inconsistent with regard to posttraumatic stress disorder diagnosis or symptoms, headache, hearing loss, and neurocognitive function. Mortality, burn, limb loss, and quality of life were each reported in few studies, most with small sample sizes. Only 4 studies reported outcomes by blast injury mechanism.

### Conclusions

Most clinical and functional outcomes appeared comparable in military service members and Veterans with TBI, regardless of blast exposure. Inconsistent findings and limited outcomes reporting indicate that more research is needed to determine whether there is a distinct pattern of impairments and comorbidities associated with blast-related TBI.

PMID: 28422897 DOI:[10.1097/HTR.0000000000000304](https://doi.org/10.1097/HTR.0000000000000304)

# Aggressive medical management of acute traumatic subdural hematomas before emergency craniotomy in patients presenting with bilateral unreactive pupils. A cohort study.

[Acta Neurochir \(Wien\)](#). 2017 Aug;159(8):1553-1559. doi: 10.1007/s00701-017-3190-4. Epub 2017 Apr 24.

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## Abstract

### BACKGROUND:

The outcome of patients with severe traumatic brain injury (TBI) and acute traumatic subdural hematoma (aSDH) admitted to the emergency room with bilaterally dilated, unreactive pupils (bilateral mydriasis) is notoriously poor.

### METHODS:

Of 2074 TBI patients consecutively admitted to our facility between 1997 and 2012, 115 had a first CT scan with aSDH, unreactive bilateral mydriasis, and a Glasgow Coma Score of 3 or 4. Sixty-two patients were unoperated and died within hours or a few days. The remaining 53 patients (2.5% of the 2074 consecutive patients) were scheduled for emergent evacuation of the aSDH. We compared three different dosages of mannitol to landmark different comprehensive levels of treatment: (1) a "basic" level of treatment characterized by a single conventional dose (18 to 36 g), (2) "reinforced" treatment landmarked by a single high dose (54 to 72 g), and (3) "aggressive" treatment landmarked by a single high dose (90 to 106 g). Doses above 36 g were administered intravenously over a period of 5 min.

### RESULTS:

Of the 53 selected patients, 7 were aggressively managed (13.2%) and 24 (45.3%) received reinforced treatment. Rates of hyperventilation and barbiturate bolus administration were appropriately associated with increasing doses of mannitol. After adjustment for age, aggressive management was significantly associated with a lower risk of death and persistent vegetative state [adjusted OR 0.016 (95% 0.001-0.405)]. Patients surviving after aggressive management suffered more severe disability at 1 year.

### CONCLUSION:

The study shows an association between reduced mortality and persistent vegetative state, albeit at the cost of increased long-term severe disability in survivors, and aggressive medical preoperative management of mydriatic patients with aSDH following TBI.

PMID: 28435989 DOI:[10.1007/s00701-017-3190-4](https://doi.org/10.1007/s00701-017-3190-4)

# Multicenter retrospective study of non-compressible torso hemorrhage: anatomic locations of bleeding and comparison of endovascular versus open approach.

[J Trauma Acute Care Surg.](#) 2017 Jul;83(1):11-18. doi: 10.1097/TA.0000000000001530.

Chang R1, Fox EE, Greene TJ, Eastridge BJ, Gilani R, Chung KK, DeSantis SM, DuBose JJ, Tomasek JS, Fortuna GR Jr, Sams VG, Todd SR, Podbielski JM, Wade CE, Holcomb JB; NCTH Study Group.

## Collaborators (32)

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## Abstract

### OBJECTIVE

Rational development of technology for rapid control of non-compressible torso hemorrhage (NCTH) requires detailed understanding of what is bleeding. Our objectives were to describe the anatomic location of truncal bleeding in patients presenting with NCTH and compare endovascular (ENDO) versus open (OPEN) management.

### METHODS

Retrospective study of adult trauma patients with NCTH admitted to 4 urban level 1 trauma centers in the Houston and San Antonio metropolitan areas in 2008-2012.

### INCLUSION CRITERIA

named axial torso vessel disruption, AIS chest or abdomen  $\geq 3$  with shock (base excess  $< -4$ ) or truncal operation in  $\leq 90$  minutes, or pelvic fracture with ring disruption.

### EXCLUSION CRITERIA

isolated hip fractures, falls from standing, or prehospital CPR. After dichotomizing into OPEN, ENDO, and resuscitative thoracotomy (RT) groups based on the initial approach to control NCTH, a mixed-effects Poisson regression with robust error variance (controlling for age, mechanism, ISS, shock, hypotension, and severe head injury as fixed effects and site as a random effect) was used to test the hypothesis that ENDO was associated with reduced in-hospital mortality in NCTH patients.

### RESULTS

543 patients with NCTH underwent ENDO (n=166, 31%), OPEN (n=309, 57%), or RT (n=68, 12%). Anatomic bleeding locations were 25% chest, 41% abdomen, and 31% pelvis. ENDO



was used to treat relatively few types of vascular injuries, while OPEN and RT injuries were more diverse. ENDO patients had more blunt trauma (95% vs 34% vs 32%); severe injuries (median ISS 34 vs 27 vs 21), and increased time to intervention (median 298 vs 92 vs 51 min), compared to OPEN and RT. Mortality was 15% vs 20% vs 79%. ENDO was associated with decreased mortality compared to OPEN (RR 0.58, 95% CI 0.46-0.73).

#### CONCLUSION

Although ENDO may reduce mortality in NCTH patients, significant group differences limit the generalizability of this finding.

LEVEL OF EVIDENCE Level V (Prognostic and Epidemiologic).

PMCID:[PMC5484539](#) [Available on 2018-07-01] DOI:[10.1097/TA.0000000000001530](#)

# The Effect of REBOA, Partial Aortic Occlusion and Aggressive Blood Transfusion on Traumatic Brain Injury in a Swine Polytrauma Model.

[J Trauma Acute Care Surg.](#) 2017 Apr 27. doi: 10.1097/TA.0000000000001518. [Epub ahead of print]

Johnson MA1, Williams TK, Ferencz SE, Davidson AJ, Russo RM, O'Brien WT Sr, Galante JM, Grayson JK, Neff LP.

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## Abstract

### OBJECTIVES

Despite clinical reports of poor outcomes, the degree to which REBOA exacerbates traumatic brain injury (TBI) is not known. We hypothesized that combined effects of increased proximal mean arterial pressure (pMAP), carotid blood flow (Q<sub>carotid</sub>), and intracranial pressure (ICP) from REBOA would lead to TBI progression compared to partial aortic occlusion (PAO) or no intervention.

### METHODS

21 swine underwent a standardized TBI via computer Controlled cortical impact followed by 25% total blood volume rapid hemorrhage. After 30 minutes of hypotension, animals were randomized to 60 minutes of continued hypotension (Control), REBOA, or PAO. REBOA and PAO animals were then weaned from occlusion. All animals were resuscitated with shed blood via a rapid blood infuser. Physiologic parameters were recorded continuously and brain computed tomography obtained at specified intervals.

### RESULTS

There were no differences in baseline physiology or during the initial 30 minutes of hypotension. During the 60-minute intervention period, REBOA resulted in higher maximal pMAP (REBOA 105.3±8.8; PAO 92.7±9.2; Control 48.9±7.7, p=0.02) and higher Q<sub>carotid</sub> (REBOA 673.1±57.9; PAO 464.2±53.0; Control 170.3±29.4, p<0.01). Increases in ICP were greatest during blood resuscitation, with Control animals demonstrating the largest peak ICP (Control 12.8±1.2; REBOA 5.1±0.6; PAO 9.4±1.1, p<0.01). There were no differences in the percentage of animals with hemorrhage progression on CT (Control 14.3%, 95%CI 3.6-57.9; REBOA 28.6%, 95%CI 3.7-71.0; and PAO 28.6%, 95%CI 3.7-71.0).

### CONCLUSIONS

In an animal model of TBI and shock, REBOA increased carotid flow and pMAP, but did not exacerbate TBI progression. PAO resulted in physiology closer to baseline with smaller increases in ICP and pMAP. Rapid blood resuscitation, not REBOA, resulted in the largest increase in ICP after intervention, which occurred in Control animals. Continued studies of the

cerebral hemodynamics of aortic occlusion and blood transfusion are required to determine optimal resuscitation strategies for multi-injured patients.

LEVEL OF EVIDENCE Level IV.

PMID: 28452884 DOI:[10.1097/TA.0000000000001518](https://doi.org/10.1097/TA.0000000000001518)

# Efficacy and Safety of Tranexamic Acid in Prehospital Traumatic Hemorrhagic Shock: Outcomes of the Cal-PAT Study.

[West J Emerg Med.](#) 2017 Jun;18(4):673-683. doi: 10.5811/westjem.2017.2.32044. Epub 2017 Apr 19.

Neeki MM1,2, Dong F3, Toy J3, Vaezazizi R4, Powell J5, Jabourian N1, Jabourian A1, Wong D6,2, Vara R6, Seiler K1, Pennington TW1,2, Powell J5, Yoshida-McMath C4, Kissel S7, Schulz-Costello K6, Mistry J1, Surrusco MS8, O'Bosky KR8, Van Stralen D9, Ludi D7, Sporer K10, Benson P7, Kwong E1,2, Pitts R1,2, Culhane JT6,2, Borger R1,2.

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## Abstract

### INTRODUCTION

The California Prehospital Antifibrinolytic Therapy (Cal-PAT) study seeks to assess the safety and impact on patient mortality of tranexamic acid (TXA) administration in cases of trauma-induced hemorrhagic shock. The current study further aimed to assess the feasibility of prehospital TXA administration by paramedics within the framework of North American emergency medicine standards and protocols.

### METHODS

This is an ongoing multi-centered, prospective, observational cohort study with a retrospective chart-review comparison. Trauma patients identified in the prehospital setting with signs of hemorrhagic shock by first responders were administered one gram of TXA followed by an optional second one-gram dose upon arrival to the hospital, if the patient still met inclusion criteria. Patients administered TXA make up the prehospital intervention group. Control group patients met the same inclusion criteria as TXA candidates and were matched with the prehospital intervention patients based on mechanism of injury, injury severity score, and age. The primary outcomes were mortality, measured at 24 hours, 48 hours, and 28 days. Secondary outcomes measured included the total blood products transfused and any known adverse events associated with TXA administration.

### RESULTS:

We included 128 patients in the prehospital intervention group and 125 in the control group. Although not statistically significant, the prehospital intervention group trended toward a lower 24-hour mortality rate (3.9% vs 7.2% for intervention and control, respectively,  $p=0.25$ ), 48-hour mortality rate (6.3% vs 7.2% for intervention and control, respectively,  $p=0.76$ ), and 28-day mortality rate (6.3% vs 10.4% for intervention and control, respectively,  $p=0.23$ ). There was no significant difference observed in known adverse events associated with TXA administration in the prehospital intervention group and control group. A reduction in total blood product usage was observed following the administration of TXA (control: 6.95 units; intervention: 4.09 units;  $p=0.01$ ).

## CONCLUSION

Preliminary evidence from the Cal-PAT study suggests that TXA administration may be safe in the prehospital setting with no significant change in adverse events observed and an associated decreased use of blood products in cases of trauma-induced hemorrhagic shock. Given the current sample size, a statistically significant decrease in mortality was not observed. Additionally, this study demonstrates that it may be feasible for paramedics to identify and safely administer TXA in the prehospital setting.

PMID: 28611888 PMCID: [PMC5468073](#) DOI: [10.5811/westjem.2017.2.32044](#)

# Timing of femoral shaft fracture fixation following major trauma: A retrospective cohort study of United States trauma centers.

[PLoS Med.](#) 2017 Jul 5;14(7):e1002336. doi: 10.1371/journal.pmed.1002336. eCollection 2017 Jul.

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6 Division of Orthopaedic Surgery, University of Toronto, Ontario, Canada. Abstract

## Abstract

### BACKGROUND

Femoral shaft fractures are common in major trauma. Early definitive fixation, within 24 hours, is feasible in most patients and is associated with improved outcomes. Nonetheless, variability might exist between trauma centers in timeliness of fixation. Such variability could impact outcomes and would therefore represent a target for quality improvement. We evaluated variability in delayed fixation ( $\geq 24$  hours) between trauma centers participating in the American College of Surgeons (ACS) Trauma Quality Improvement Program (TQIP) and measured the resultant association with important clinical outcomes at the hospital level.

### METHODS AND FINDINGS

A retrospective cohort study was performed using data derived from the ACS TQIP database. Adults with severe injury who underwent definitive fixation of a femoral shaft fracture at a level I or II trauma center participating in ACS TQIP (2012-2015) were included. Patient baseline and injury characteristics that might affect timing of fixation were considered. A hierarchical logistic regression model was used to identify predictors of delayed fixation. Hospital variability in delayed fixation was measured using 2 approaches. First, the random effects output of the hierarchical model was used to identify outlier hospitals where the odds of delayed fixation were significantly higher or lower than average. Second, the median odds ratio (MOR) was calculated to quantify heterogeneity in delayed fixation between hospitals. Finally, complications (pulmonary embolism, deep vein thrombosis, acute respiratory distress syndrome, pneumonia, decubitus ulcer, and death) and hospital length of stay were compared across quartiles of risk-adjusted delayed fixation. We identified 17,993 patients who underwent definitive fixation at 216 trauma centers. The median injury severity score (ISS) was 13 (interquartile range [IQR] 9-22). Median time to fixation was 15 hours (IQR 7-24 hours) and delayed fixation was performed in 26% of patients. After adjusting for patient characteristics, 57 hospitals (26%) were identified as outliers, reflecting significant practice variation unexplained by patient case mix. The MOR was 1.84, reflecting heterogeneity in delayed fixation across centers. Compared to hospitals in the lowest quartile of delayed fixation, patients treated at hospitals in the highest quartile of delayed fixation suffered 2-fold higher rates of pulmonary embolism (2.6% versus 1.3%; rate ratio [RR] 2.0; 95% CI 1.2-3.2;  $P = 0.005$ ) and required greater length of stay (7 versus 6 days; RR 1.15;

95% CI 1.1-1.19;  $P < 0.001$ ). There was no significant difference with respect to mortality (1.3% versus 0.8%; RR 1.6; 95% CI 1.0-2.8;  $P = 0.066$ ). The main limitations of this study include the inability to classify fractures by severity, challenges related to the heterogeneity of the study population, and the potential for residual confounding due to unmeasured factors.

## CONCLUSIONS

In this large cohort study of 216 trauma centers, significant practice variability was observed in delayed fixation of femoral shaft fractures, which could not be explained by differences in patient case mix. Patients treated at centers where delayed fixation was most common were at significantly greater risk of pulmonary embolism and required longer hospital stay. Trauma centers should strive to minimize delays in fixation, and quality improvement initiatives should emphasize this recommendation in best practice guidelines.

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