Joint Trauma System

Military Prolonged Field Care and Survival in Iraq and Afghanistan

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Disclaimer

- The opinions or assertions contained herein are the private views of the author and not to be construed as official or as reflecting the views of the Defense Health Agency or the Department of Defense.
- There are no conflicts of interest to disclose.

Background and Significance

Improved approaches to prolonged field care (PFC) are high priority for combat casualty care due to …

- Expected changes in the nature of warfare
- Delayed evacuation

The literature on PFC in US military trauma systems is limited

Definition of prolonged field care?
How long will patients survive without transfusion, surgery?

Journal of Special Operations Medicine Volume 17, Edition 1/Spring 2017

Review of 54 Cases of Prolonged Field Care

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ABSTRACT

Background: Prolonged field care (PFC) is field medical care applied beyond doctrinal planning time-lines. As current and future medical operations must include deliberate and contingency planning for such events, data are lacking to support efforts. A case review was conducted to define the epidemiology, environment, and operational factors that affect PFC outcomes. **Methods:** A sur-

tactical medical providers who must hold and manage patients when transport to higher levels of care is not immediately possible. Much of the first responder medical training over the past decade has focused primarily on the initial stabilization of traumatically wounded casualties in preparation for rapid transport to surgical care.[1,2] As our military forces continue to encounter novel and

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Purpose

To inform the development of PFC improvements, this PI project aimed to

1. Evaluate the association between survival and prehospital time from injury
2. Quantify differences in prehospital care administered to PFC survivors vs non-survivors
3. Identify resources needed for PFC

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Study Design, Population & Data Resources

- Retrospective Cohort Design
- US military and non-US military casualties, Iraq (36%) or Afghanistan (64%) Jan 2007–Dec 2015 with MAIS ≥ 2
- Data Sources
  - DoDTR (primary data source for all)
  - AFMES (AIS/ISS on US military deaths)
  - Original medical records (selected)

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Study Questions

1. How long can evacuation time be safely delayed in US military casualties?
2. Does prehospital care differ comparing survivors of PFC (evacuation delays ≥4-72 hours) with non-survivors (died prehospital), matched on injury mechanism, type, and body regions with AIS ≥3?
3. Are results adjusted for AIS/ISS valid if decedents' scores are assigned without autopsy information?

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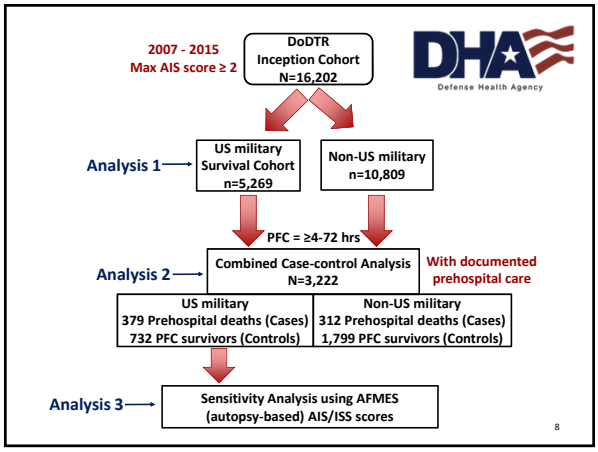

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Prolonged Field Care Study

Analysis 1

How long can evacuation time be safely delayed in US Military casualties?

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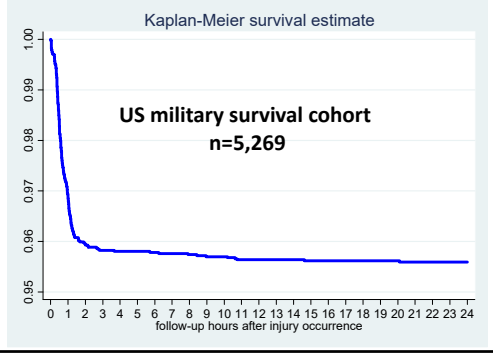
24 hour survival



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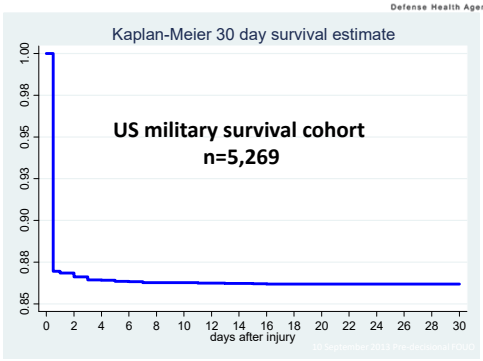
30 day survival



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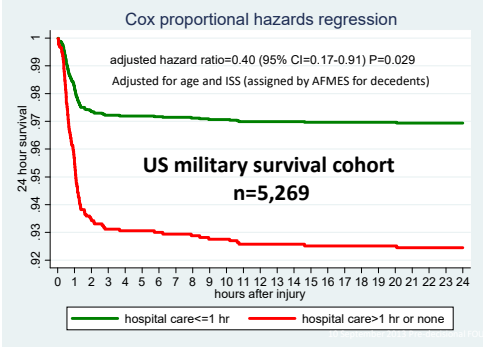
≤ 1 hour delay associated with 24 hour survival



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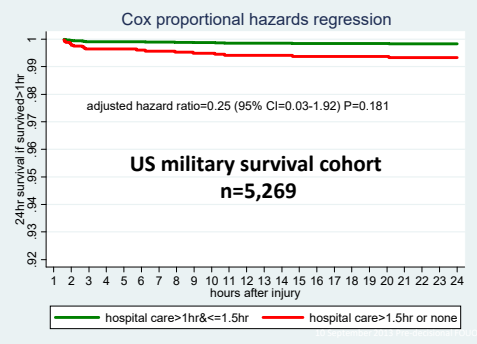
>1-1.5hr delay associated with survival between >1 - 24 hrs



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Prolonged Field Care Study

Analysis 2

Case-control comparison of prehospital care in PFC survivors (≥4-72 hrs) vs. non-survivors (prehospital deaths)

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Table 1. Demographic and Injury Characteristics

Characteristic	Prehospital Deaths N=691	Survived ≥4 hours of Prehospital Care, N=2531
Gender: (% male)	669 (97%)	2361 (94%)
	n=683*	n=2525*
Age in Years: median (IQR)	23 (21, 27)	25 (21, 32)
US military (%)	379 (55%)	732 (29%)
Year of Injury: median (IQR)	2010 (2008, 2011)	2011 (2008, 2011)
Battle-Related Injury (% Yes)	612 (88%)	1617 (64%)
Mechanism of Injury		
Bullet/Gunshot/Firearm	236 (34%)	574 (23%)
Explosives	386 (56%)	1059 (42%)
Motor Vehicle Crash	47 (7%)	305 (12%)
Fall	5 (1%)	231 (9%)
Other (Blunt Object, Fire, etc)	17 (2%)	362 (14%)
Dominant Type of Injury		
Penetrating	584 (85%)	1333 (53%)
Blunt	82 (12%)	1043 (41%)
Burn	22 (3%)	135 (5%)
Other	3 (0.4%)	20 (1%)
Military Operation		
OEF	466 (67%)	1584 (63%)
OIF	219 (32%)	869 (34%)
Other	6 (1%)	78 (3%)
Injury Severity Score (ISS): median (IQR)	18 (9, 27)	9 (5, 17)
Maximum AIS: median (IQR)	4 (3, 5)	3 (2, 3)
Nonsurvivable Injury (% Yes)	117 (17%)	8 (0.3%)
Mode of Transport	n=593*	n=2014*
Air	545 (92%)	1729 (86%)
Ground	48 (8%)	284 (14%)
Sea	0	1 (<0.1%)
Transport Team		
Highest level of care (MERT, PEDRO)	41 (6%)	121 (5%)
MEDEVAC	527 (76%)	1764 (70%)
CASEVAC or Other	123 (18%)	646 (25%)
Transported from POI to Role 3 vs Role 2 MTF (%)**	671 (97%)	2126 (84%)
Evacuation Hours (from POI): median (IQR)	n=297*† 0.8 (0.5, 1.2)	n=2517*‡ 7.25 (5, 13)
Triage classification	n=558*	n=1935*
Delayed	4 (1%)	463 (24%)
Expectant	163 (29%)	10 (1%)
Immediate	391 (70%)	1279 (66%)
Minimal	0	183 (9%)
Evacuation Priority Classification	n=310*	n=775*
A Urgent	207 (67%)	395 (51%)
B Priority	41 (13%)	274 (35%)
C Routine	61 (20%)	106 (14%)

*n=the subgroup of patients with non-missing values available for cross-tabulation.
**Patients transported to a Role 2 MTF who died before transport to a Role 3 MTF were not included in DoDTR until 2015.
†The 394 decedents with missing values were all evacuated within 2 days after the injury date.
‡The 14 survivors with missing values were all evacuated ≥4 hours but within 7 days after injury.

Table 2. Prehospital Care and Outcome (In-hospital Mortality)

	Prehospital Deaths N=691	Survived ≥4 hours of Prehospital Care, N=2531
Prehospital Assessments		
Documented Shock* (% Yes)	338 (49%)	761 (30%)
Total GCS	n=410**	n=2422**
3 - Intubated	141 (34%)	324 (13%)
3 - no intubation documented	243 (59%)	30 (1%)
4-8	18 (4%)	108 (4%)
9-14	4 (1%)	161 (7%)
15	4 (1%)	1798 (74%)
Documented Prehospital Treatments		
Airway		
Cricothyrotomy	38 (5.5%)	12 (0.5%)†
Intubation (other than Cricothyrotomy)	271 (39%)	484 (19%)†
Adjunct airway only	7 (1%)	2 (0.1%)
Breathing		
Mechanical ventilation	14 (2%)	384 (15%)†
Bag-valve-mask ventilation	140 (20%)	45 (2%)
Supplemental O2	91 (13%)	188 (7%)
Chest		
Needle decompression	34 (5%)	15 (1%)
Tube Thoracostomy/chest tube	20 (3%)	12 (0.5%)
Warming Device		
Blanket or Body Bag only	129 (19%)	782 (31%)†
Chemical or Electric Device/Kit	16 (2%)	75 (3%)†
Hemorrhage Control		
Tourniquet	167 (24%)	114 (4.5%)†
Pelvic binder	7 (1%)	8 (0.3%)
Hemostatic agent	12 (2%)	30 (12%)
Pressure dressing	157 (39%)	405 (16%)
Eye Shield	1 (0.1%)	9 (0.4%)
Circulation		
CPR	316 (46%)	4 (0.2%)†
Peripheral intravenous access	104 (15%)	671 (26%)†
Intraosseous access	164 (24%)	34 (1.5%)†
Crystalloid administered	60 (9%)	367 (14.5%)
Heatend or Colloid administered	10 (1.5%)	8 (0.3%)
Blood products administered	26 (4%)	8 (0.3%)
Transfused red blood cells	26 (4%)	8 (0.3%)
Plasma	12 (2%)	3 (0.1%)
Spine Stabilization (C Collar/Spine Board)	34 (5%)	145 (6%)
Documented Prehospital Medications		
Paralytic	49 (7%)	388 (15%)
Sedative	53 (8%)	543 (21%)†
Vasopressor	30 (4%)	23 (1%)
Pain control narcotic (other than Ketamine)	17 (2.5%)	473 (19%)†
Ketamine	15 (2%)	45 (2%)
Pain control non-narcotic only	0	90 (3.5%)
Atropine	6 (1%)	2 (0.1%)
Lidocaine	2 (0.3%)	8 (0.3%)
Antibiotic	10 (1.5%)	192 (8%)†
Anti-emetic	2 (0.3%)	66 (2.6%)
Tranexamic Acid	9 (1%)	6 (0.2%)
Tetanus prophylaxis (including toxoid, Ig)	1 (0.1%)	54 (2%)
Steroid	0	5 (0.2%)
Anti-seizure medication (Dilantin or NFS)	0	5 (0.2%)
Calcium Chloride	3 (0.4%)	1 (0.04%)
Total Time to Death or In-hospital‡		
Within 24 hours or 1 day of injury	685 (99%)	53 (2%)
Within 30 days of injury	691 (100%)	113 (4%)

*Documented shock required a SBP≤90 or heart rate≥120 or shock index (heart rate/SBP)≥0.9
**n=the subgroup of patients with non-missing values available for cross-tabulation.
†Between-group difference significant at p=0.05 in multivariable mixed model logistic regression adjusted for matching and covariates
‡Patients transported to a Role 2 MTF who died before transport to a Role 3 MTF were not included in DoDTR until 2015.

Prolonged Field Care Analysis 2
Mixed-effects Logistic Regression

- Adjusted for age, US military, shock, GCS, transport team, maximum AIS, ISS, and 41 unique sets of cases/controls matched on injury mechanism, type, and body regions with highest AIS ≥3
- 101/117 non-survivors with MAIS=6 (17% of 691) were excluded due to lack of any matching PFC survivors
- 1,298 PFC survivors (53% of 2,531) were excluded due to less severe injuries with no matching non-survivors

Mixed-effects Logistic Regression
Between-group Differences

Survivors received more

- warming devices
- intravenous fluids
- sedation
- mechanical ventilation
- narcotics
- antibiotics

Non-survivors received more

- intubations
- tourniquets
- intraosseous fluids
- CPR

Prolonged Field Care Study

Analysis 3

Sensitivity analysis in US military casualties:

Matched case-control logistic analyses
were repeated using
AIS/ISS scores assigned by AFMES (autopsy-based)
vs. DoDTR (medical records-based)
for all decedents

Analysis 3: Using AFMES- vs. DoDTR-assigned AIS/ISS scores in the same mixed-effects logistic models

There were **no** significant between-group differences in prehospital care when controls (PFC survivors) were compared with cases (prehospital deaths) matched by their AFMES-assigned AIS scores and adjusting for the other covariates (including MAIS and ISS) using the same logistic models as in Analysis 2.

Prolonged Field Care Analysis 3

AIS assigned to decedents without autopsy information

- significantly underestimated injury severity in 5 body regions (head, face, chest, abdomen, extremities)
- significantly overestimated injury severity in external injuries
- underestimated ISS in a manner inversely correlated with survival time from injury occurrence (Spearman r=-0.28, P<0.0001)
- produced biased effect estimates (between-group differences, measures of association, etc.)

Conclusions

1. Mortality was highest in the first 1 hour after injury emphasizing the importance of prehospital care, rapid transport and timely surgery.
2. Compared with longer delays, only prehospital times ≤ 1 hour were associated with improved survival. Delays between 1-1.5 hours were not since the casualties who required advanced resuscitative and surgical care had already died within the 1st hour.

Conclusions - continued

3. PFC should direct resources, technology and training to prevent death from hemorrhage and promote improvements in airway and ventilator support.
4. Performance improvement and comparative effectiveness studies using AIS or ISS scores assigned to decedents without autopsy information underestimate injury severity; worst in early deaths. Prehospital and early resuscitative care studies are most vulnerable to this bias.

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Questions ?