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Selected Topics: Prehospital Care

THE ASSOCIATION OF PREHOSPITAL INTRAVENOUS FLUIDS AND MORTALITY IN PATIENTS WITH PENETRATING TRAUMA

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Abstract—Background: The optimal approach to prehospital care of trauma patients is controversial, and thought to require balancing advanced field interventions with rapid transport to definitive care. **Objective:** We sought principally to examine any association between the amount of prehospital IV fluid (IVF) administered and mortality. **Methods:** We conducted a retrospective cohort analysis of trauma registry data patients who sustained penetrating trauma between January 2008 and February 2011, as identified in the Pennsylvania Trauma Systems Foundation registry with corresponding prehospital records from the

Philadelphia Fire Department. Analyses were conducted with logistic regression models and instrumental variable analysis, adjusted for injury severity using scene vital signs before the intervention was delivered. **Results:** There were 1966 patients identified. Overall mortality was 22.60%. Approximately two-thirds received fluids and one-third did not. Both cohorts had similar Trauma and Injury Severity Score–predicted mortality. Mortality was similar in those who received IVF (23.43%) and those who did not (21.30%) ($p = 0.212$). Patients who received IVF had longer mean scene times (10.82 min) than those who did not (9.18 min) ($p < 0.0001$), although call times were similar in those who received IVF (24.14 min) and those who did not (23.83 min) ($p = 0.637$). Adjusted analysis of 1722 patients demonstrated no benefit or harm associated with prehospital fluid (odds ratio [OR] 0.905, 95% confidence interval [CI] 0.47–1.75). Instrumental variable analysis utilizing variations in use of IVF across different Emergency Medical Services (EMS) units also found no association between the unit’s percentage of patients that were provided fluids and mortality (OR 1.02, 95% CI 0.96–1.08). **Conclusions:** We found no significant difference in mortality or EMS call time between patients who did or did not receive prehospital IVF after penetrating trauma. Published by Elsevier Inc.

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Disclaimer: Data were provided by the Pennsylvania Trauma Systems Foundation’s Trauma Registry. The foundation specifically disclaims responsibility for any analyses, interpretations, or conclusions.

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Keywords—resuscitation; prehospital care

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INTRODUCTION

There remains considerable, ongoing debate concerning how to provide optimal delivery of prehospital trauma care to victims of penetrating trauma, and whether advanced interventions, such as the administration of intravenous fluid (IVF) should be delivered to these patients before they arrive at the hospital. The impact of the specific intervention of administration of prehospital IVF on patient-centered outcomes has not been studied in a large, urban high-acuity trauma patient population in nearly 25 years. Many prior observational studies are limited by the lack of any prehospital, pre-intervention vital signs, which are of potential benefit for mortality risk stratification.

Penetrating trauma represents a substantial burden of medical care in the United States. In 2012, there were nearly 100 assaults with a firearm or edged weapon per 100,000 persons in the United States, with > 200 per 100,000 persons in large cities (1). Emergency Medical Services (EMS) is actively involved in the care of these patients, with > 2300 ambulance transports for acute injury per 100,000 persons in the United States annually (2,3). For time-sensitive medical conditions, including myocardial infarction, respiratory arrest, and cardiac arrest, a mixed literature exists describing the tradeoffs between rapid transport to definitive care and initiation of treatment in the prehospital setting (4–7). For the injured patients, there is a growing body of evidence demonstrating that increased prehospital interventions and secondary delays in transport to definitive surgical care are associated with increased patient mortality (8–16).

A key intervention that may delay transport to definitive trauma care is the establishment of an IV and administration of IVF in an effort to stabilize hypotensive patients. There are limited data to support the use of prehospital IVF for penetrating trauma patients in urban settings, and several studies have demonstrated either no benefit or harm associated with prehospital IVF (8,17–21). Consequently, the Eastern Association for the Surgery of Trauma published Level II recommendations that prehospital IVF should be omitted for patients with penetrating torso injuries (22). This may facilitate more rapid transport to hospital for definitive trauma care.

Importance

There are two non–mutually exclusive theories to account for the possibility of harm associated with prehospital IVF administered to torso trauma patients in urban systems with short transport times: delayed transport vs. disrupted physiology. Field placement of an IV catheter has been

associated with increased total transport time to the hospital, and delayed transport has been repeatedly associated with increased mortality for patients in hemorrhagic shock (14,15,23–26). Additionally, administration of IVF may reverse the body's innate response to hemorrhage by elevating blood pressure, diluting clotting factors, and disrupting a fragile clot. Such concerns are supported by numerous animal studies and are the basis for resuscitative strategies, including “permissive hypotension” and “damage-control resuscitation” for patients in hemorrhagic shock (27–32). Neither of these theories has been definitively studied in human populations.

In the only prospective randomized controlled trial studying the effects of prehospital IVF in an urban EMS system, Bickell et al., who studied patients with torso trauma only, demonstrated increased mortality associated with early fluid resuscitation before surgery (18). In the largest study to date using the National Trauma Data Bank, Haut et al. demonstrated increased mortality associated with administration of IVF in 30,256 patients who had suffered penetrating trauma (21). This study evaluated a mixed population from urban and rural sites, for which transport times varied more than in the study by Bickell et al. The authors were unable to discriminate between urban and rural populations or control for transport time (8). In contrast, a recent study reported decreased mortality associated with prehospital fluid in trauma patients that required a blood transfusion (33). Urban settings have a high incidence of penetrating trauma and relatively short transport times to trauma centers, and so may benefit from updated, evidence-based management guidelines.

Goals of this Investigation

We looked for any association between the prehospital administration of IVF and mortality in patients with penetrating trauma transported to a trauma center within any of the urban trauma care systems in one city.

PATIENTS AND METHODS

Study Design and Setting

We conducted a retrospective cohort study with a dataset obtained by merging the Pennsylvania Trauma Systems Foundation's (PTSF) Trauma Registry and the Philadelphia Fire Department (PFD)–EMS database. This study was approved by the Institutional Review Board of the affiliated university, the PTSF, and the City of Philadelphia Health Department.

PTSF is the accrediting body for all trauma programs throughout the state of Pennsylvania and oversees the

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