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Prehospital interventions for penetrating trauma victims: A prospective comparison between Advanced Life Support and Basic Life Support

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ABSTRACT

Background: Advanced Life Support (ALS) providers may perform more invasive prehospital procedures, while Basic Life Support (BLS) providers offer stabilisation care and often "scoop and run". We hypothesised that prehospital interventions by urban ALS providers prolong prehospital time and decrease survival in penetrating trauma victims.
Study design: We prospectively analysed 236 consecutive ambulance-transported, penetrating trauma patients an our urban Level-1 trauma centre (6/2008–12/2009). Inclusion criteria included ICU admission, length of stay >/=2 days, or in-hospital death. Demographics, clinical characteristics, and outcomes were compared between ALS and BLS patients. Single and multiple variable logistic regression analysis determined predictors of hospital survival.
Results: Of 236 patients, 71% were transported by ALS and 29% by BLS. When ALS and BLS patients were compared, no differences in age, penetrating mechanism, scene GCS score, Injury Severity Score, or need for emergency surgery were detected ($p > 0.05$). Patients transported by ALS units more often underwent prehospital interventions (97% vs. 17%; $p < 0.01$), including endotracheal intubation, needle thoracostomy, cervical collar, IV placement, and crystalloid resuscitation. While ALS ambulance on-scene time was significantly longer than that of BLS ($p < 0.01$), total prehospital time was not ($p = 0.98$) despite these prehospital interventions (1.8 ± 1.0 per ALS patient vs. 0.2 ± 0.5 per BLS patient; $p < 0.01$). Overall, 69.5% ALS patients and 88.4% of BLS patients ($p < 0.01$) survived to hospital discharge.
Conclusion: Prehospital resuscitative interventions by ALS units performed on penetrating trauma patients may lengthen on-scene time but do not significantly increase total prehospital time. Regardless, these interventions did not appear to benefit our rapidly transported, urban penetrating trauma patients.
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Introduction

Since the development of Advanced Life Support (ALS) training for emergency medical technicians (EMT) in the 1970s and 1980s, there has been substantial debate regarding the scope of prehospital trauma care. While Basic Life Support (BLS) personnel are trained to perform essential stabilisation for injury victims (bag-valve-mask ventilation, external defibrillation, spinal immobilisation, etc.), ALS providers receive additional training in more advanced interventions (advanced airway placement, vascular access, etc.) for these patients. Researchers have sought to define the potential benefit of these prehospital procedures as well as the potential risks associated with these procedures, including possible delay in transport to definitive care at a regional trauma centre.

Previous reports suggest that the prehospital transport of urban, penetrating trauma victims by police or private vehicle yields equivalent or superior outcomes to those transported by Emergency Medical Services (EMS).[1–4] These reports have supported the argument that EMTs should minimise prehospital interventions for penetrating trauma patients rather than perform advanced procedures on scene. Few studies have directly compared ALS with BLS prehospital care in penetrating trauma patients.

We hypothesised that prehospital care by ALS providers is associated with prolonged prehospital times and decreased survival in our urban, penetrating trauma population. Our primary study objective was to compare hospital survival in penetrating

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trauma victims transported by ALS and BLS units. Our secondary objectives were to compare prehospital procedures and prehospital times based on the type of EMS unit.

Methods

Temple University Hospital is a Level I trauma centre accredited by the Pennsylvania Trauma Systems Foundation located in the inner city of North Philadelphia. Most trauma patients arrive from within a 2-mile radius of the hospital. The Philadelphia Fire Department (PFD) is the sole provider of Emergency Medical Services for the city. The PFD is a two-tier EMS system utilising 50 ambulances (72% ALS in 2008, 80% ALS at present) augmented by a robust first-responder programme utilising engine and ladder companies. The PFD responded to over 220,000 requests for EMS service in 2009. There are no formal triage criteria to decide EMS tier. Instead, local policy dictates that assignment of ALS or BLS units to the injury scene is determined by geographical proximity.

After institutional review board approval, we conducted a prospective, observational cohort study of all penetrating trauma patients brought by EMS to Temple University Hospital from June 2008 through December 2009. Of 1098 penetrating trauma victims treated during the study period, 494 with minor injuries who were disqualified from the Pennsylvania Trauma Outcome Study (PTOS) were excluded from study analysis. PTOS criteria include all trauma deaths and hospital admissions either to an intensive care unit or lasting greater than 48 h. Further exclusion criteria included absent scene signs of life ($n = 16$) or means of transport other than EMS ($n = 304$), including police ($n = 147$), private vehicle or walk-in ($n = 138$), helicopter ($n = 4$), suburban ambulance ($n = 3$), or unknown ($n = 12$). Patients were also excluded from the study if they sustained injuries caused by a penetrating mechanism other than gun shot wounds or stab wounds (e.g. animal bites, lacerations from shattered glass, etc. [$n = 35$]). Lastly, 13 patients with unavailable EMS trip sheets were excluded from the study analysis, yielding a final study group of 236 injured patients.

EMS prehospital "trip sheets" were used to provide prehospital data regarding transport method, signs of life, cardiac rhythm, blood pressure, GCS score, prehospital time intervals, and the type and number of prehospital procedures performed. Total prehospital time was defined as the time from the initial request to 911 for assistance until arrival in the emergency department (ED). Total prehospital time was comprised of time from the initial call until arrival at scene (response time), time from arrival at scene until departure from scene (on-scene time), and time from scene departure until arrival in the ED (transport time). Prehospital procedures recorded included placement of an intravenous (IV) catheter, needle thoracostomy, endotracheal intubation, and cervical collar immobilisation. Failed procedure attempts were included as a prehospital "procedure". The approximate volume of prehospital intravenous fluid administered was recorded when available.

Demographic and clinical characteristics collected in the ED record included patient age, ethnicity, gender, injury mechanism, initial signs of life, initial cardiac rhythm, initial vital signs, initial GCS (Glasgow Coma Scale) score, and procedures performed in the ED. Procedures included tube thoracostomy, central venous catheter (CVC) placement, venous cutdown, local wound exploration, cricothyroidotomy, and emergency thoracotomy. Time from ED arrival until the operating room was calculated for all patients requiring an emergent operation. Emergent surgery was defined as any procedure performed in the operating room immediately following the initial trauma resuscitation. The Injury Severity Score (ISS) was calculated for all patients.

Study patients were compared on the basis of prehospital transportation mode (ALS or BLS) for the primary outcome of survival to hospital discharge and the secondary outcomes of prehospital times and procedures performed. Descriptive statistics and post hoc analysis of all numeric variables were applied (two-sided Fisher's exact test, Wilcoxon rank sum test). Continuous data were expressed as means with accompanying standard deviations (SD) and categorical data were expressed as proportions (%). The variables that were significantly associated with survival until hospital discharge ($p < 0.05$) in the univariate analysis were retained for the multiple variable regression model. Odds ratios (ORs) with 95% confidence intervals (CIs) for survival and prehospital times were calculated for each measured variable. A p value less than or equal to 0.05 was considered statistically significant.

Table 1
Prehospital demographics and clinical characteristics by advanced life support and basic life support transport method.

Patient characteristics	All patients ($n = 236$)	ALS ($n = 167$)	BLS ($n = 69$)	p-Value
Age (years)	31.1 (11.5)[a]	30.9 (11.5)	31.5 (11.5)	0.72
Gender				
Male	217 (92%)	153 (92%)	64 (93%)	1.00
Mechanism of injury				0.12
Gun shot wounds	165 (70%)	122 (73%)	43 (62%)	
Stab wounds	71 (30%)	45 (27%)	26 (38%)	
Scene cardiac rhythm				<0.01
Asystole	2 (1%)	1 (1%)	1 (1%)	
Pulseless electrical activity	31 (13%)	28 (17%)	3 (4%)	
Sinus rhythms	203 (86%)	138 (83%)	65 (94%)	
Scene systolic blood pressure (mmHg)	100.9 (50.8)[a]	95.3 (53.5)	118.1 (36.9)	0.01
Scene Glasgow Coma Scale	12.1 (4.8)[a]	11.7 (5.0)	13.2 (4.0)	0.11
Prehospital IV fluid (mL)	154.7 (252.3)[a]	210.8 (275.8)	18.8 (89.2)	<0.01
Prehospital procedures (yes/no)	174 (74%)	162 (97%)	12 (17%)	<0.01
Successful IV placement	158 (67%)	154 (92%)	4 (6%)	<0.01
Failed IV placement	15 (6%)	15 (9%)	0	<0.01
Endotracheal intubation	31 (13%)	31 (19%)	0	<0.01
Failed endotracheal intubation	9 (4%)	9 (5%)	0	0.06
Needle thoracostomy	5 (2%)	4 (2%)	1 (1%)	1.00
Cervical collar	50 (21%)	41 (25%)	9 (13%)	0.06
Prehospital procedures per patient	1.3 (1.2)[a]	1.8 (1.0)	0.2 (0.5)	<0.01
Response time (min)	5.1 (3.6)[a]	4.7 (2.6)	5.9 (5.1)	0.40
On-scene time (min)	8.9 (3.7)[a]	9.4 (3.2)	7.7 (4.3)	<0.01
Transport time (min)	7.4 (3.7)[a]	7.2 (3.6)	7.9 (3.9)	0.08
Total prehospital time (min)	21.3 (6.2)[a]	21.1 (5.4)	21.7 (8.0)	0.98

[a] Mean ± standard deviation.

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