Association between Mode of Transportation and Survival in Adult Trauma Patients with Blunt Injuries: Matched Cohort Study between Police and Ground Ambulance Transport

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Conflicts of interest/funding: This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors. No conflicts of interest declared.

Keywords: blunt trauma; ground ambulance; police transport; survival

Abbreviations:
BTI: blunt traumatic injury
CDC: Centers for Disease Control and Prevention
ED: emergency department
EMS: Emergency Medical Services
GCS: Glasgow Coma Scale
ICD-9-CM: International Classification of Diseases, ninth revision, Clinical Modification
ISS: Injury Severity Score
NTDB: National Trauma Data Bank
PT: police transport
SBP: systolic blood pressure
US: United States

Abstract

Introduction: Early police transport (PT) of penetrating trauma patients has the potential to improve survival rates for trauma patients. There are no well-established guidelines for the transport of blunt trauma patients by PT currently.

Study Objective: This study examines the association between the survival rate of blunt trauma patients and the transport modality (police versus ground ambulance).

Methods: A retrospective, matched cohort study was conducted using the National Trauma Data Bank (NTDB). All blunt trauma patients transported by police to trauma centers were identified and matched (one-to-four) to patients transported by ground Emergency Medical Services (EMS) for analysis. Descriptive analysis was carried out. This was followed by comparing all patients' characteristics and their survival rates in terms of the mode of transportation.

Results: Out of the 2,469 patients with blunt injuries, EMS transported 1,846 patients and police transported 623 patients. Most patients were 16-64 years of age (86.2%) with a male predominance (82.5%). Fall (38.4%) was the most common mechanism of injury with majority of injuries involving the head and neck body part (64.8%). Fractures were the most common nature of injury (62.1%). The overall survival rate of adult blunt trauma patients was similar for both methods of transportation (99.2%; $P = 1.000$).

Conclusion: In this study, adult blunt trauma patients transported by police had similar outcomes to those transported by EMS. As such, PT in trauma should be encouraged and protocolized to improve resource utilization and outcomes further.

Sakr FA, Bachir RH, El Sayed MJ. Association between mode of transportation and survival in adult trauma patients with blunt injuries: matched cohort study between police and ground ambulance transport. *Prehosp Disaster Med.* **2021;36(4):431–439.**

Introduction

Traumatic injury is the principal cause of death in the age population of one year to 45 years of age and contributes to over 42 million emergency department (ED) annual visits in the United States (US).[1,2] The most common cause of severe trauma is blunt traumatic injury (BTI), related mainly to motor vehicle accidents in adults and falls in the elderly.[3–5] To optimize the care for BTI patients and reduce their mortality rate, trauma systems and prehospital triage protocols take into account multiple factors such as trauma center designation, time and distance to ED, type of prehospital care protocols, and other factors.[6,7] However, there are still many controversies pertaining to the transport modes and associated impact on patients' outcomes.[8]

Involvement of police in trauma transport is based on the principle of the golden hour, which pertains to efficient prehospital care and rapid arrival to the hospital.[9,10] As law enforcement, officers usually arrive at the trauma incident location prior to ground ambulance; they are increasingly involved in prehospital care and rapid transport to the ED.[11–14]

Received: December 16, 2020
Revised: February 18, 2021
Accepted: March 7, 2021

doi:10.1017/S1049023X21000510

In Philadelphia (Pennsylvania USA), a well-defined prehospital protocol requires law enforcement officers to transport penetrating trauma patients to the nearest trauma center since 1996.[15–17] Police transport (PT) of trauma patients with penetrating and blunt trauma has been on the rise.[18,19]

Injuries in BTI patients are not easy to recognize by non-health care personnel and may lead to inadequate prehospital care and health outcomes.[18] Prehospital trauma protocols might require extensive training that may involve complex procedures such as endotracheal intubation and spine mobilization for BTI and penetrating trauma patients.[20] In the prehospital setting, these patients may have adverse outcomes in case of improper care delivered by non-medical personnel.[19] Police transports adopting a "scoop and run" approach, which is centered on rapid transport of trauma patients to the ED without prehospital interventions, may be effective.[20] Previous studies examining PT of penetrating trauma patients reported similar health outcomes when compared to ground ambulance in terms of survival rates.[15,18,20–22]

While the focus has been so far on penetrating traumatic injuries, there are currently no well-established prehospital policies regarding PT for BTI patients, and evidence concerning PT for this patient population is lacking. This study examines the association between mode of transport (police versus ground EMS) and survival of BTI patients using a US national trauma registry.

Methodology

A retrospective, matched cohort study was carried out using the 2015 dataset of the National Trauma Data Bank (NTDB). The NTDB is considered the largest trauma patient registry in the US gathering data from over 900 facilities released on an annual basis.[23,24] It includes more than six million records of trauma patients[24] and incorporates prehospital reports, patient demographics, injury characteristics, ED and hospital records, diagnosis, outcome, and payment methods.[25] Patients are included in the dataset if they are affected by trauma injuries.[25] Trauma patients (excluding superficial injuries) are determined in accordance with the criteria of the International Classification of Diseases, ninth revision, Clinical Modification (ICD-9-CM) for trauma-related injuries. Patients are included in the NTDB if they sustained at least one of the following diagnosis codes for traumatic injuries: ICD-9-CM: 800-959.9 or ICD-10-CM: S00-S99, T07, T14, T20-T28, T30-T32, and T79.A1-T79.A9.

The injury intentionality, the body region, and the nature of injury in the NTDB are based on the adopted definitions by the Centers for Disease Control and Prevention (CDC; Atlanta, Georgia USA). More specifically, two matrices that can be downloaded from the NTDB manual were used: (1) Barell Injury Diagnosis Matrix: classification by body region and nature of the injury; and (2) ICD-9-CM injury intentionality and trauma type matrix grouping for presenting injury mortality and morbidity data.[23]

Out of the 917,865 patients registered in the NTDB 2015 dataset, 735,494 patients presented to the ED with BTIs and were selected by using a specific variable for the type of injury: "indication of the type (nature) of trauma produced by an injury." Exclusion criteria were patients aged <16 years (n = 119,944), those with unknown age (n = 46,676), those with undetermined ED disposition (unknown = 29,039; left against medical advice [n = 1,305]; transferred to another hospital [n = 25,321]; other such as jail, institutional care facility, or mental health [n = 3,254]), those with unknown hospital disposition (n = 156), and those who had inter-hospital facility transfer (n = 186,837). Further, patients who were transported by a mode other than police or ground ambulance were excluded (n = 111,006). Figure 1 depicts the study sample selection criteria.

After implementing the exclusion criteria, 327,118 patients remained. Out of these patients, 1,422 were transported by police. This group was then matched to ground ambulance group (one-to-four) in order to reduce the risk of significant confounding factors (patient and system-level variables). Matching was done for the following variables: age, gender, race, state designation, geographic region for the hospital, patient's primary method of payment, comorbidity, injury intentionality as defined by the CDC Injury Intentionality Matrix, ICD-9-CM mechanism of injury E-code, ICD-9 body regions as defined by the Barell Injury Diagnosis Matrix (extremities, head and neck, spine and back, torso, unclassifiable), Injury Severity Score (ISS <16, ≥16), Glasgow Coma Scale (GCS) in the ED (severe ≤8, moderate 9-12, mild 13-15), and systolic blood pressure (SBP) at ED (≤90mmHg, ≥91mmHg). The final matched study sample used for the data analysis included 2,469 patients. Out of them, 1,846 patients were transported by ground ambulance and 623 were transported by police.

An exemption was obtained from the Institutional Review Board at the American University of Beirut (Beirut, Lebanon) for the use of this de-identified NTDB dataset.

Validity of NTDB

Since this study was based upon the pre-existing database NTDB, several measures were used to determine its reliability related to data collection and entry.[26] The study investigators read the NTDB manual and dictionary (which are provided with every dataset release) prior to initiating this research study and relied solely on the definitions provided in the NTDB dictionary to interpret the selected data elements. Moreover, the NTDB manual includes a separate section about the limitations of NTDB data including NTDB data quality, convenience samples, selection and information bias, and missing data. These limitations were taken into consideration during the data extraction, cleaning, management, and analysis. More specifically, to assure the validity of the database, potential data entry errors were assessed by conducting descriptive analysis of the variables associated with each other, such as mechanism of injury and trauma type. This method did not reveal any inconsistencies. Furthermore, to determine whether the exclusion of patients with unknown dispositions allowed for selection bias by including only those for whom the dispositions were recorded, the demographic profiles for subjects with complete data and those with missing data were compared to each other. The analysis revealed that there was no difference between the two groups in terms of age, gender, race, and ethnicity (data not shown). Thus, the selection bias is unlikely to occur due to the exclusion of the patients with unknown ED or hospital dispositions or those who had inter-hospital facility transfer. In addition, in the NTDB manual, it is indicated that upon submission of the data files from all contributing hospitals, the validator – NTDB's edit check program – continuously cleaned and standardized the data to improve its quality in terms of validation and error checks. Before NTDB release, all out of range values are replaced by missing values.

Statistical Analyses

Statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS, version 24; IBM Corp; Armonk, New York USA). In the univariate analysis, frequencies and percentages

https://doi.org/10.1017/S1049023X21000510 Published online by Cambridge University Press

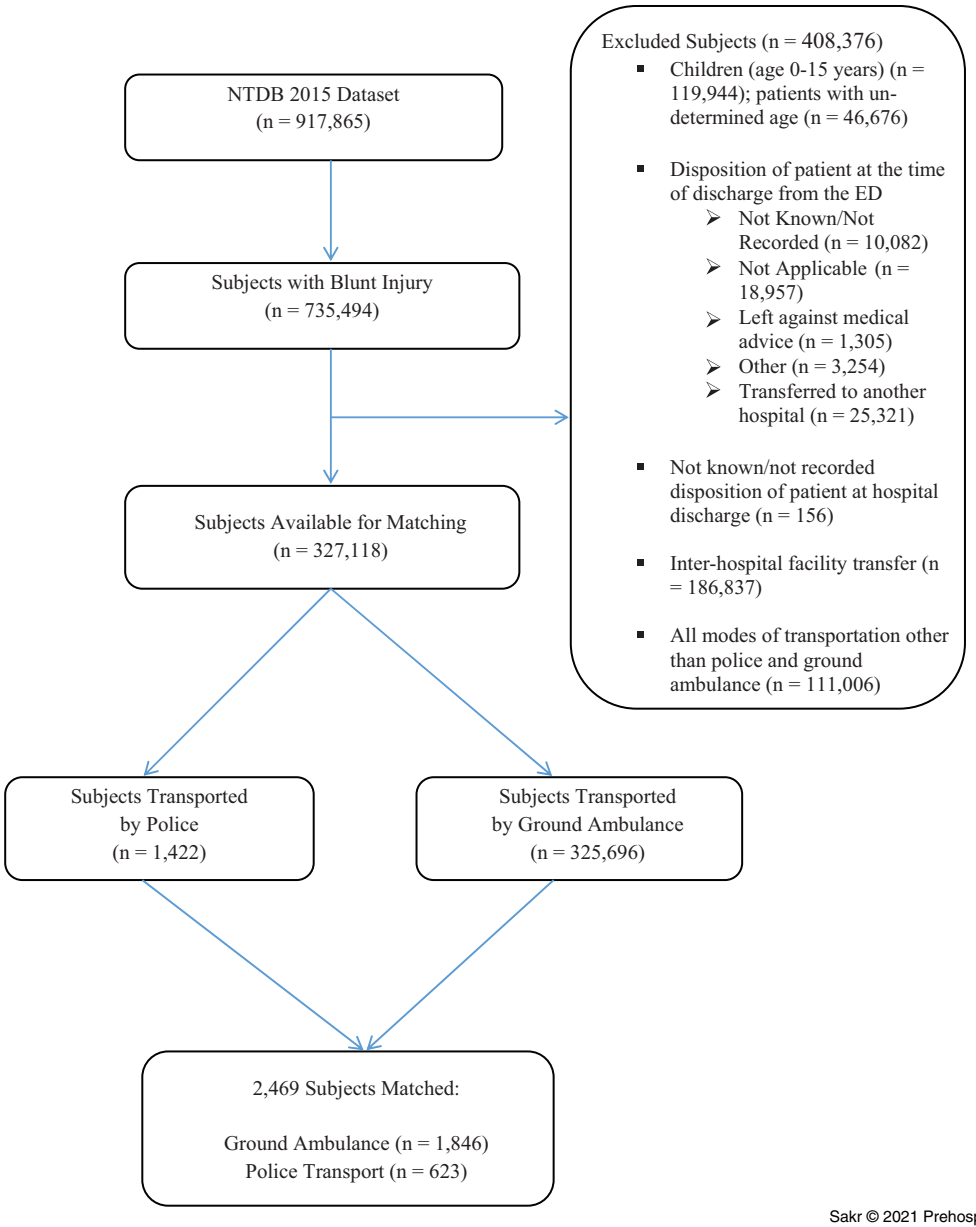

Figure 1. Study Participant Selection from the National Trauma Data Bank (NTDB) 2015.
Abbreviations: ED, emergency department; NTDB, National Trauma Data Bank.
Note: There are overlaps among the categories of the excluded variables. More specifically, some patients who had inter-hospital facility transfer had as ED disposition one of the excluded categories. Also, some patients whose age was not recorded or were 15 years or younger were transferred or had as ED disposition one of the excluded categories. These overlaps explain why the final number on which the data analysis was conducted cannot be calculated just by subtracting the number of excluded patients from the selected sample.

were presented to describe the categorical variables, whereas age was summarized through calculating the mean with the standard deviation (SD), median, and interquartile range (IQR). Then, the Kolmogorov-Smirnov Z was used to compare the patients' mean age according to the transport modality. The demographic, injury, events, and clinical characteristics of the study sample were tabulated for the two modes of transportation (police and ground ambulance) and their percentages were compared through conducting the Pearson's Chi-Square or the Fishers' exact tests. P value of $\leq .05$ was used to denote statistical significance.

Results

The overall study population consisted of 2,469 patients including 1,846 transported by EMS and 623 by police. Hospital information and demographic characteristics of the study population are presented in Table 1. Patients had a median age of 40.0 years (IQR 27.0-56.0) and most of them were 16-64 years of age (2,129; 86.2%) with a male predominance (2,038; 82.5%). The majority of patients who presented with blunt injuries were White (n = 1,510; 61.2%), followed by Black/African American (707; 28.6%). Regarding American College of Surgeons (ACS;

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Characteristic	Total, n (%) (N = 2469)	Ground Ambulance, n (%) (N = 1846)	Police, n (%) (N = 623)	*P* Value
Age (years)[a]				.237
16-64	2129 (86.2%)	1583 (85.8%)	546 (87.6%)	
≥ 65	340 (13.8%)	263 (14.2%)	77 (12.4%)	
Mean (SD)	43.1 (18.3)	43.4 (18.5)	42.1 (17.8)	.317[b]
Median (IQR)	40.0 (27.0-56.0)			
Gender [a]				.737
Female	431 (17.5%)	325 (17.6%)	106 (17.0%)	
Male	2038 (82.5%)	1521 (82.4%)	517 (83.0%)	
Race[a]				.314
White	1510 (61.2%)	1145 (62.0%)	365 (58.6%)	
Black/African American	707 (28.6%)	517 (28.0%)	190 (30.5%)	
Other [c]	252 (10.2%)	184 (10.0%)	68 (10.9%)	
Ethnicity				.831
Hispanic or Latino	280 (11.3%)	208 (12.1%)	72 (12.5%)	
Not Hispanic or Latino	2014 (81.6%)	1508 (87.9%)	506 (87.5%)	
Not Known/Not Recorded	175 (7.1%)			
Patient's Primary Method of Payment[a]				.110
Self-Pay	551 (22.3%)	416 (22.5%)	135 (21.7%)	
Medicaid	479 (19.4%)	353 (19.1%)	126 (20.2%)	
Medicare	366 (14.8%)	281 (15.2%)	85 (13.6%)	
Private/Commercial Insurance	659 (26.7%)	506 (27.4%)	153 (24.6%)	
Other Government & Other & Not Billed (for any reason)	414 (16.8%)	290 (15.7%)	124 (19.9%)	
Hospital Teaching Status				<.001
Community	823 (33.3%)	651 (35.3%)	172 (27.6%)	
Non-Teaching	256 (10.4%)	200 (10.8%)	56 (9.0%)	
University	1390 (56.3%)	995 (53.9%)	395 (63.4%)	
ACS Verification Level				.005
Not Applicable	1097 (44.4%)	787 (43.4%)	310 (50.7%)	
I	867 (35.1%)	680 (37.5%)	187 (30.6%)	
II	404 (16.4%)	307 (16.9%)	97 (15.8%)	
III	57 (2.3%)	39 (2.2%)	18 (2.9%)	
Not Known/Not Recorded	44 (1.8%)			
State Designation[a]				.487
Not Applicable	148 (6.0%)	106 (5.7%)	42 (6.7%)	
I	1611 (65.2%)	1209 (65.5%)	402 (64.5%)	
II	589 (23.9%)	446 (24.2%)	143 (23.0%)	
III	121 (4.9%)	85 (4.6%)	36 (5.8%)	
No. of Licensed Beds in Facility				.001
≤ 200	151 (6.1%)	111 (6.0%)	40 (6.4%)	
201-400	579 (23.5%)	433 (23.5%)	146 (23.4%)	
401-600	809 (32.8%)	642 (34.8%)	167 (26.8%)	
> 600	930 (37.7%)	660 (35.8%)	270 (43.3%)	

Table 1. Hospital Information and Demographic Characteristics of Matched Patients Transported via Police or Ground Ambulance (*continued*)

https://doi.org/10.1017/S1049023X21000510 Published online by Cambridge University Press

Characteristic	Total, n (%) (N = 2469)	Ground Ambulance, n (%) (N = 1846)	Police, n (%) (N = 623)	*P* Value
No. of Core Trauma Surgeons at Facility				<.001
1-3	103 (4.2%)	90 (4.9%)	13 (2.1%)	
4-6	1181 (47.8%)	938 (50.8%)	243 (39.0%)	
7-8	660 (26.7%)	398 (21.6%)	262 (42.1%)	
>8	525 (21.3%)	420 (22.8%)	105 (16.9%)	
Geographic Region for Hospital [a]				.640
Northeast	816 (33.0%)	610 (33.0%)	206 (33.1%)	
Midwest	403 (16.3%)	301 (16.3%)	102 (16.4%)	
South	862 (34.9%)	654 (35.4%)	208 (33.4%)	
West	388 (15.7%)	281 (15.2%)	107 (17.2%)	

Table 1. *(continued).* Hospital Information and Demographic Characteristics of Matched Patients Transported via Police or Ground Ambulance

Abbreviation: ACS, American College of Surgeons.

[a] Matched variables for both modalities of transport.

[b] Indicates that the Kolmogorov-Smirnov Z was used instead of the Student's T-test to calculate the exact P value due to the violation of the normality distribution of the age variable.

[c] Other race includes: American Indian & Native Hawaiian or Other Pacific Islander & Other Race.

Chicago, Illinois USA) verification level, most patients were taken to Level I (867; 35.1%). Over one-half of the hospitals (1,390; 56.3%) had university teaching status. The two most common hospital geographic regions were the South (862; 34.9%) and Northeast (816; 33.0%; Table 1).

Most of the injuries were unintentional (1,746; 70.7%) or caused by an assault (717; 29.0%). In terms of mechanism of injury, fall (948; 38.4%) was most common and injuries occurred most commonly in public locations including public building, streets, and recreational areas (1,201; 48.6%). Police were more likely to transport patients from home and residential institution (n = 275; 45.0% versus n = 592; 32.4%) when compared to ground EMS, while the latter were more likely to transport patients from public building, streets, and recreational areas (n = 951; 52.1% versus n = 250; 40.9%) when compared to police. Ground ambulance patients were more likely to drink alcohol (n = 556; 32.3% versus n = 154; 27.3%) compared to police patients, and there was no significant difference observed in terms of drug use (Table 2).

Most patients had previous health comorbidities (1,933; 78.3%). The majority of patients arrived with signs of life (2,465; 99.8%). Injury to head and neck was the most commonly injured body part (1,599; 64.8%). Fractures were the most common nature of injury (1,534; 62.1%). Police-transported patients sustained more fractures (n = 427; 68.5% versus n = 1,107; 60.0%) and less internal organ injuries (n = 209; 33.5% versus n = 785; 42.5%) compared with ground EMS-transported patients. Most patients had an ISS <16 (2,349; 95.1%). Almost all patients had a mild GCS score (2,442; 98.9%) and a SBP ≥91mmHg (2,469; 100.0%) in the ED (Table 3).

Patients transported by police were more likely to be admitted to the floor unit (n = 346; 55.5% [95% CI, 51.6-59.4] versus n = 930; 50.4% [95% CI, 48.1-52.7]), to the intensive care unit (n = 115; 18.5% [95% CI, 15.5-21.5] versus n = 306; 16.6% [95% CI, 14.9-18.3]), or to the operating room (n = 50; 8.0% [95% CI, 5.9-10.1] versus n = 119; 6.4% [95% CI, 5.3-7.5]) compared to their ground EMS patients. Most of the BTI patients were discharged home or to self-care after hospital discharge (n = 1,573; 63.7% [95% CI, 61.8-65.6]) with ground ambulance (n = 1,233; 66.8% [95% CI, 64.7-68.9]) compared to police (n = 340; 54.6% [95% CI, 50.7-58.5]). Transferred to other facilities after hospital discharge was more common for patients transported by police as compared to their ground ambulance counterparts (n = 217; 34.8% [95% CI, 31.1-38.5] versus n = 300; 16.3% [95% CI, 14.6-18.0]). Survival rate of BTI patients transported by police (n = 618; 99.2% [95% CI, 98.5-99.9]) was similar to the rate of patients transported by ground EMS (n = 1,832; 99.2% [95% CI, 98.8-99.6]; P = 1.000; Table 4).

Discussion

This study investigated the association between the survival of BTI patients and the mode of transport (police versus ground EMS) in trauma systems across the US. Survival rates were similar between the two matched groups. This is the first study, to the authors' knowledge, to report on promising results of PT in blunt trauma. Previous studies using older datasets from the NTDB examined impact of PT versus ground EMS on outcomes of patients with penetrating trauma and reported no difference in survival rates for this patient population.[15,18,20–22]

The consistency of these results supplements the data from previous studies in order to encourage implementing PT prehospital protocols in trauma systems. Several state protocols and police regional protocols already allow for the transport of patients with different types of injuries.[27–29] This study clearly showed that the largest category of trauma patients, those with blunt injury, would benefit from PT without significant impact on outcomes.

Most BTI patients in this study had a relatively low ISS (≤15; 95.1%). This finding is surprising since PT is expected to occur in cases where patients are severely injured and for patients who can benefit from rapid transport. Previous studies identified significant

https://doi.org/10.1017/S1049023X21000510 Published online by Cambridge University Press

Characteristic	Total, n (%) (N = 2469)	Ground Ambulance, n (%) (N = 1846)	Police, n (%) (N = 623)	*P* Value
Indication of Type (nature) of Trauma Produced by Injury				-
Blunt	2469 (100.0%)	1846 (100.0%)	623 (100.0%)	
Injury Intentionality as Defined by the CDC Injury Intentionality Matrix [a]				.208[b]
Assault	717 (29.0%)	525 (28.4%)	192 (30.8%)	
Self-Inflicted	2 (0.1%)	1 (0.1%)	1 (0.2%)	
Unintentional	1746 (70.7%)	1318 (71.4%)	428 (68.7%)	
Other	4 (0.2%)	2 (0.1%)	2 (0.3%)	
ICD-9-CM Mechanism of Injury E-Code [a]				.542[b]
Fall	948 (38.4%)	722 (39.1%)	226 (36.3%)	
Machinery	4 (0.2%)	3 (0.2%)	1 (0.2%)	
MVT Motorcyclist	53 (2.1%)	41 (2.2%)	12 (1.9%)	
MVT Occupant & MVT Other & MVT	624 (25.3%)	472 (25.6%)	152 (24.4%)	
Unspecified & Other Specified and				
Classifiable & Transport, Other				
MVT Pedal Cyclist & Pedal Cyclist, Other	16 (0.6%)	11 (0.6%)	5 (0.8%)	
MVT Pedestrian	37 (1.5%)	25 (1.4%)	12 (1.9%)	
Struck by, Against	787 (31.9%)	572 (31.0%)	215 (34.5%)	
Location Where Injury Occurred				<.001
Home & Residential Institution	867 (35.1%)	592 (32.4%)	275 (45.0%)	
Industry & Farm	45 (1.8%)	42 (2.3%)	3 (0.5%)	
Public Building & Street & Recreation	1201 (48.6%)	951 (52.1%)	250 (40.9%)	
Unspecified & Other	324 (13.1%)	241 (13.2%)	83 (13.6%)	
Not Known/Not Recorded	32 (1.3%)			
Whether Patient Used Alcohol				.025
No	1573 (63.7%)	1163 (67.7%)	410 (72.7%)	
Yes	710 (28.8%)	556 (32.3%)	154 (27.3%)	
Not Known/Not Recorded	186 (7.5%)			
Whether Patient Used Drug				.544
No	1757 (71.2%)	1318 (78.6%)	439 (77.4%)	
Yes	486 (19.7%)	358 (21.4%)	128 (22.6%)	
Not Known/Not Recorded	226 (9.2%)			

Table 2. Event and Injury Characteristics of Matched Patients Transported via Police or Ground Ambulance

Abbreviations: CDC, Centers for Disease Control and Prevention; ICD-9-CM, International Classification of Diseases, 9th revision, Clinical Modification; MVT, motor vehicle traffic.

[a] Indicates the matched variables for both modalities of transport.

[b] Indicates that the Fisher's exact was used to calculate the P value.

https://doi.org/10.1017/S1049023X21000510 Published online by Cambridge University Press

Characteristic	Total, n (%) (N = 2469)	Ground Ambulance, n (%) (N = 1846)	Police, n (%) (N = 623)	*P* Value
Comorbidity				.187
No	536 (21.7%)	389 (21.1%)	147 (23.6%)	
Yes	1933 (78.3%)	1457 (78.9%)	476 (76.4%)	
Signs of Life				.266[a]
Arrived with No Signs of Life	4 (0.2%)	2 (0.1%)	2 (0.3%)	
Arrived with Signs of Life	2465 (99.8%)	1844 (99.9%)	621 (99.7%)	
Nature of Injury as Defined by the Barell Injury Diagnosis Matrix				
Fractures	1534 (62.1%)	1107 (60.0%)	427 (68.5%)	<.001
Internal Organ	994 (40.3%)	785 (42.5%)	209 (33.5%)	<.001
Open Wounds	894 (36.2%)	684 (37.1%)	210 (33.7%)	.133
Other	375 (15.2%)	284 (15.4%)	91 (14.6%)	.640
Region 1: ICD-9 Body Region as Defined by the Barell Injury Diagnosis Matrix [b]				
Extremities	735 (29.8%)	545 (29.5%)	190 (30.5%)	.646
Head & Neck	1599 (64.8%)	1195 (64.7%)	404 (64.8%)	.959
Spine & Back		163 (8.8%)	58 (9.3%)	.717
Torso	221 (9.0%)	246 (13.3%)	93 (14.9%)	.315
Unclassifiable by Site	339 (13.7%) 3 (0.1%)	2 (0.1%)	1 (0.2%)	1.000[a]
Injury Severity Score [b]				.148
≤ 15	2349 (95.1%)	1763 (95.5%)	586 (94.1%)	
≥ 16	120 (4.9%)	83 (4.5%)	37 (5.9%)	
GCS (ED)[b]				.243[a]
Severe ≤ 8	11 (0.4%)	6 (0.3%)	5 (0.8%)	
Moderate 9-12	16 (0.6%)	11 (0.6%)	5 (0.8%)	
Mild 13-15	2442 (98.9%)	1829 (99.1%)	613 (98.4%)	
SBP (ED) [b] ≥ 91	2469 (100.0%)	1846 (100.0%)	623 (100.0%)	–

Table 3. Clinical Characteristics of Matched Patients Transported via Police or Ground Ambulance
Abbreviations: ICD-9, International Classification of Diseases, 9th revision, GCS, Glasgow Coma Scale; ED, emergency department; SBP, systolic blood pressure.

[a] Indicates that the Fisher's exact was used to calculate the P value.

[b] Indicates the matched variables for both modalities of transport.

improvement in terms of survival rates when PTs involved penetrating trauma patients with ISS score ≥15.[15,20] This reported benefit, however, was not significant after adjusting for injury severity.[15,20]

The current study did not assess, beyond survival rates, the benefit of transport by police for patients with relatively low ISS and whether this mode of transport is consistent with appropriate resource utilization. Additional studies are needed to examine potential benefits of PT of blunt trauma patients on patients with low ISS.

The overall survival rate of the patients transported by police and ground ambulance in this study was high (99.2%). Different studies using the NTDB dataset found a similar high survival rates (>90.0%) for blunt trauma patients for ground and air ambulance transport.[8,30] Significant differences in terms of survival are reported when studies take into consideration variation in prehospital times.[8,9,31] Factors associated with survival in patients transported by police were previously examined,[10] and blunt trauma mainly from motor vehicle traffic was identified to be a significant positive predictor of survival.

This study also described different injury characteristics that are useful to guide development of future protocols for police involvement in trauma transport. Beyond life-saving interventions such as hemorrhage control, training on initial assessment, immobilization, and other interventions may be needed. In fact, police transported more patients with fractures compared to ground ambulance (68.5% versus 60.0%). Additionally, such practices may have implications on medical equipment needed in police vehicles to meet the needs of trauma patients during transport.

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Characteristic	Total (N = 2469)		Ground Ambulance (N = 1846)		Police (N = 623)		
	N	Percent (95% CI)	N	Percent (95% CI)	N	Percent (95% CI)	*P* Value
Disposition of Patient at Time of Discharge from ED							.001[a]
Deceased/Expired	1	0.0 (0.0-0.0)	1	0.1 (0.0-0.2)	0	0.0 (0.0-0.0)	
Floor Bed (General Admission, Non-Specialty Unit Bed)	127	51.7 (49.7-53.7)	93	50.4 (48.1-52.7)	346	55.5 (51.6-59.4)	
Home with Services	6	0.4 (0.2-0.6)	0	0.4 (0.1-0.7)	2	0.3 (-0.1-0.7)	
Home without Services	9	11.5 (10.2-12.8)	7	13.0 (11.5-14.5)	44	7.1 (5.1-9.1)	
Intensive Care Unit	284	17.1 (15.6-18.6)	240	16.6 (14.9-18.3)	115	18.5 (15.5-21.5)	
Observation Unit (Unit that Provides 24-hour Stays)	421	5.4 (4.5-6.3)	306	5.5 (4.5-6.5)	33	5.3 (3.5-7.1)	
Operating Room	134	6.8 (5.8-7.8)	101	6.4 (5.3-7.5)	50	8.0 (5.9-10.1)	
Telemetry/Step-Down	169	7.1 (6.1-8.1)	119	7.7 (6.5-8.9)	33	5.3 (3.5-7.1)	
Unit (Less Acuity than ICU)	175		142				
Disposition of Patient at Hospital Discharge							<.001[a]
Not Applicable	294	11.9 (10.6-13.2)	248	13.4 (11.8-15.0)	46	7.4 (5.3-9.5)	
Deceased/Expired	18	0.7 (0.4-1.0)	13	0.7 (0.3-1.1)	5	0.8 (0.1-1.5)	
Discharged to Home or Self-Care (Routine Discharge)	1573	63.7 (61.8-65.6)	1233	66.8 (64.7-68.9)	340	54.6 (50.7-58.5)	
Transferred to Other Destination	517	20.9 (19.3-22.5)	300	16.3 (14.6-18.0)	217	34.8 (31.1-38.5)	
Left Against Medical	67	2.7 (2.1-3.3)	52	2.8 (2.0-3.6)	15	2.4 (1.2-3.6)	
Advice or Discontinued Care							
Died in ED/Hospital							1.000[a]
No	2450	99.2 (98.8-99.6)	1832	99.2 (98.8-99.6)	618	99.2 (98.5-99.9)	
Yes	19	0.8 (0.4-1.2)	14	0.8 (0.4-1.2)	5	0.8 (0.1-1.5)	

Table 4. Emergency Department and Hospital Characteristics of Matched Patients Transported via Police or Ground Ambulance
Abbreviations: ED, emergency department; ICU, intensive care unit.
[a] Indicates that the Fisher's exact was used to calculate the P value.

Challenges may also be faced when transporting patients with mechanically unstable injuries.[19]

Limitations

This study has few limitations related to its retrospective nature and to the dataset used. Survival rates of BTI patients may have been over-estimated since the dataset excludes patients who died on scene and who were transported to the ED. The quality of data shared and the involvement with the NTDB may also vary across participating hospitals.

Many variables reflecting the trauma system complexity, general characteristics, injury characteristics, and clinical severity were matched for BTI patients transported to ED via the two transport modalities. Some variables may not be obtainable for matching in the NTDB, such as clinical care during transport and prehospital transport time, which may be confounding factors in terms of patient survival outcomes. Additionally, information about other important outcomes such as assessment of disability are not available in the NTDB database.

The group of patients with ISS≥16 was relatively small in this study population. Additional studies examining outcomes in this specific group may be needed.

Despite these limitations, the NTDB remains the largest trauma dataset in the US and the results of this study are generalizable to the national trauma settings where police are involved in transport of trauma patients.

Conclusion

The survival rates for trauma patients transported by police and by ground EMS were similarly high. Findings of this study can help

https://doi.org/10.1017/S1049023X21000510 Published online by Cambridge University Press

guide further development and implementation of police protocols for the transport and treatment of trauma patients. Additional research is needed to examine other benefits of PT and to improve training of police officers and to standardize transport and treatment protocols of trauma patients by police.

Author Contributions

FS, RB, and ME acquired, analyzed, and drafted the work. ME conceived, designed, and substantively revised the study. FS, RB, and ME approve the submitted version and agree to be personally accountable.

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