ORIGINAL SCIENTIFIC ARTICLE

911 Emergency Medical Services and Re-Triage to Level I Trauma Centers

Eric Kuncir, MD, MS, FACS, Dean Spencer, BS, Kelly Feldman, MS, Cristobal Barrios Jr, MD, FACS, Kenneth Miller, MD, PhD, Stephanie Lush, MSN, Matthew Dolich, MD, FACS, Michael Lekawa, MD, FACS

BACKGROUND: Interfacility transfer of undertriaged patients to higher-level trauma centers has been found to result in a delay of appropriate care and an increase in mortality. To address this, for the last 10 years our region has used 911 emergency medical services (EMS) paramedics for rapid re-triage of undertriaged patients to our institution's Level I trauma center. We sought to determine whether using 911 EMS for re-triage to our institution was associated with worse outcomes—with mortality as the primary end point—compared with direct EMS transport from point of injury.

STUDY DESIGN: We retrospectively reviewed all trauma activations to our institution during a 16-month period; 3,394 active traumas were analyzed.

RESULTS: Two hundred and seventy patients (8%) arrived via 911 EMS re-triage and 3,124 (92%) arrived via direct EMS transport. Total EMS transport time was significantly longer (122.5 minutes vs 33.7 minutes; $p < 0.001$) between the 2 groups, but there was no significant difference in mortality rates (4.1% vs 3.6%; $p = 0.67$).

CONCLUSIONS: These data show that although using 911 EMS for re-triage is associated with an increase in total transport time, it does not result in an increase in mortality compared with direct EMS transport. We conclude that the use of 911 EMS can be considered a safe method to re-triage patients to higher-level trauma centers. (J Am Coll Surg 2017;■:1−6. © 2017 by the American College of Surgeons. Published by Elsevier Inc. All rights reserved.)

Trauma systems were created with the principle that early identification and subsequent diagnosis and treatment of trauma patients at centers specializing in trauma care could improve outcomes[1,2]; the goal being to send the patient to the trauma facility most capable of dealing with the patient's particular injuries. Within this system, the use of Level I/II trauma centers has long been established to improve patient outcomes, but some critically injured patients are initially triaged to, and receive preliminary care at, outlying hospitals, termed *undertriage*.[3-7] In most instances of undertriage, transfer to definitive care to a higher-level trauma center occurs when the extent of patient injury exceeds the capacities of the receiving facility. There are potential consequences of undertraige, as demonstrated by Haas and colleagues,[8] who reported that initial undertriage to non-trauma centers can result in an increase in mortality up to 30% within the first 48 hours. At least 12% of initially undertriaged patients required transfer to definitive care, as reported by Porter and colleagues.[9]

An ideal system to deal with undertriaged patients would involve rapid patient movement with minimal delays for unnecessary testing or imaging, as espoused in the American College of Surgeon's ATLS course. Delays to definitive care and associated detrimental patient outcomes, could potentially be improved if the substantial investment of time required to coordinate interfacility transfer (IFT) could be reduced.[5,10,11]

To address this, Orange County became the first in California to advocate for the use of fire/paramedic emergency medical services (EMS) to expedite these transfers, a

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From the Division of Trauma and Critical Care Surgery, Department of Surgery, University of California-Irvine, Orange (Kuncir, Barrios, Lush, Dolich, Lekawa) and University of California-Irvine School of Medicine, Irvine (Spencer), Santa Clara County Emergency Medical Services, Santa Jose (Miller), CA, and University of Miami School of Medicine, Miami, FL (Feldman).

Correspondence address: Eric Kuncir, MD, Department of Surgery, University of California-Irvine School of Medicine, 333 City Blvd West, Suite 1600, Orange, CA 92868. email: ekuncir@uci.edu

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Abbreviations and Acronyms

ED = emergency department
EMS = emergency medical services
IFT = interfacility transfer
ISS = Injury Severity Score
911 RT = 911 re-triage

process locally referred to as "911 re-triage" (911 RT). This process reduces potential transfer times by allowing lower-level hospitals to rapidly transfer an undertriaged patient to a higher-level trauma center by using local EMS resources to move the patient by simply dialing 911 and thereby eliminating the need to contact the receiving trauma surgeon or center to gain approval for the transfer, other than to get the name of an accepting ED physician and to provide notification of an incoming 911 RT patient. For the last 10 years, our region has used 911 RT exclusively to provide rapid re-triage of patients to our institution's Level I trauma center, and no patients were transported not using 911 RT. Other regions, such as Los Angeles County, have also adopted 911 RT as a method of IFT of trauma patients, albeit on a smaller scale, and data on this practice were published in an emergency medicine-based report, however, the report lacked hospital outcomes data.[10] Lacking previous reports of outcomes using 911 RT, we sought to determine whether using 911 EMS for re-triage to our institution's Level I trauma center would be associated with an increase in mortality compared with direct EMS transport from point of injury.

METHODS

After IRB approval, we retrospectively reviewed all trauma activations from the University of California-Irvine Medical Center's internal trauma registry from January 1, 2014 to April 30, 2015. Two groups of patients were identified: those transported directly to University of California-Irvine Medical Center via EMS and those transferred by 911 RT. Patients identified as a re-triage to our institution were also identified in the Orange County EMS Agency database and EMS transport data for these individuals was merged into a single data set. Data points of age, sex, mechanism of injury, Injury Severity Score (ISS), Glasgow Coma Scale, total EMS transit time, hospital length of stay, ICU length of stay, emergency department (ED) disposition, and mortality were analyzed.

The EMS transit data for patients who underwent 911 RT were collected and confirmed by contacting the transferring hospitals initiating re-triage and, in addition, all patients were cross-referenced with the Orange County EMS database to verify they indeed arrived via 911 RT and were not transported directly from the scene of injury. For patients undergoing 911 RT, EMS transport time is defined as the time of arrival at the transferring hospital to the time of arrival to our institution. For patients transported directly from point of injury, transport time is defined as the time of EMS arrival on scene to time of arrival at our institution. The variation in defining EMS transport time between 911 RT and direct transport was due to the high number of incomplete EMS transit records from point of injury at base hospitals who initiated 911 RT. Mortality was considered during the index hospital admission for that trauma activation.

Patients were stratified by ISS range: 0 to 8, 9 to 16, 17 to 24, and $\geq$25, and 320 patients with no ISS data available were excluded from analysis. Analysis of demographic data was performed using Student's *t*-test and comparison of mortality rates was performed with chi-square. The effect of 911 RT on mortality for each stratified cohort was also analyzed as a relative risk with 95% CI. Total mean EMS transportation time for 911 RT was compared between all ISS cohorts by a 1-way ANOVA. Finally, a pooled analysis of all patients for mortality rate and relative risk was performed. Relative risk for the pooled population was calculated using the Mantel-Haenszel method to account for variations of strata size contributing to the pooled result.

RESULTS

A total of 3,394 active traumas with ISS data available presented to our institution from January 1, 2014 to April 30, 2015. Two hundred and seventy (8%) patients arrived via 911 RT and 3,124 (92%) arrived via direct EMS transport.

Injury Severity Score 0 to 8 cohort

The majority of patients (n = 2,318 [68.3%]) had less-severe injury with an ISS between 0 and 8. Of the patients in this ISS range, 134 (5.8%) arrived via 911 RT and 2,184 (94.2%) were transported directly from point of injury. Table 1 demonstrates there was a higher percentage of penetrating injury for 911 RT vs direct transport.

Patients were more likely to be admitted if arriving via 911 RT (Table 2). Patients undergoing 911 RT had a higher mean ISS, longer EMS transport time (109.1 minutes vs 29.3 minutes; $p < 0.001$), longer hospital length of stay, and longer ICU length of stay (Table 2). There was no significant difference in mortality (0.7% vs 0.2%; $p = 0.240$) between the 2 groups (Table 3).