

TRAUMA TRIAGE: CONCEPTS IN PREHOSPITAL TRAUMA CARE

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ABSTRACT

This report examines the efficacy of current trauma triage rules to determine the exigency of field care and transport of severely injured patients from a variety of medical populations. **Key words:** emergency medical services; trauma; triage.

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INTRODUCTION

Effective field triage of trauma victims requires identification of patients at risk of dying and their rapid transport to hospitals capable of treating severe injuries. Identification of these patients at the scene can be difficult because prehospital personnel must rapidly apply structured triage decision making. Precise application of prehospital trauma triage criteria is critical for ensuring that the maximum number of patients with severe injuries is transported to trauma centers. The tradeoff in the prehospital management of trauma balances a perceived need to "stay and play" tempered by the reality of having to "load and go." While the prehospital trauma triage instrument may be helpful in determining the exigency of field care and initiation of transport, the real utility lies in identifying patients warranting transport to the regional trauma center, even if non-trauma centers are bypassed on the way.¹⁻¹³ Online medical direction may be used to enhance triage decisions.⁴

The annual automotive crash distribution in the United States is shown in Table 1. Less than one half of all tow-away crashes involve personal injury. Of those injured, fewer than 9% have serious injury and fewer than 3% have time-critical injury. Rapid identification of patients with serious injury, especially if time critical, is the goal of any prehospital triage scheme. To appropriately conserve resources, such a scheme must have sufficient specificity and not result in excessive overtriage.⁵

While automotive trauma accounts for the larger proportion of patients likely to benefit from treatment at a trauma center, interpersonal violence places substantial demands on trauma systems. The scope of the problem

is immense, with 1.6 million emergency department visits for assault in 2002. While there were more than 42,000 automotive deaths in the United States in 2002, there were more than 17,000 homicides, with a death rate of 6.1 per 100,000. The vast majority of homicides, nearly 12,000, are caused by firearms, with a death rate of 6.1 per 100,000.⁶ The health care burden of caring for the injured is vast and requires that the regional health care system share this burden with minimal overtriage and undertriage. A regional trauma plan is an inclusive model that integrates the resources of hospitals and communities throughout the region in providing care to the severely injured trauma patient.

When the trauma triage rule works well, emergency medical technicians (EMTs) and paramedics get to the scene and apply judgment with explicit triage criteria to determine quickly which hospital to transport patients to and which life-saving interventions to administer at the scene and during transport. Most prehospital trauma triage criteria adopt a combination of physiologic, anatomic, and mechanism of injury components, but this approach still fails to identify a number of patients with severe injuries and often burdens trauma centers with patients with minor injuries.^{7,8}

Physiologic Criteria

Various types of diagnostic and monitoring techniques are available in the prehospital environment, but it is unclear how increasing complexity of diagnostic equipment improves the ability to predict the need for a life-saving intervention. One recent study suggested that a weak radial pulse may be used to triage trauma patients in field conditions with limited instrumentation.⁹ Another study showed that when an abnormal radial pulse character (weak or absent) and abnormal Glasgow Coma Scale (GCS) verbal and motor components were present, the probability of needing a life-saving intervention was >88%. These data show that simple and rapidly acquired manual measurements could be used to effectively triage non-head-injured trauma patients and may provide a more rapid and accurate assessment than more sophisticated techniques.¹⁰

If blood pressure (BP) is to be used as a triage instrument, a manual BP should be obtained. Automated BP determinations are consistently higher than manual BP, particularly in hypotensive patients. Some recommend that automated BP devices should not be used for field or hospital triage decisions. Manual BP determinations should be used until systolic BP is consistently >110 mm Hg.¹¹

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TABLE 1. Annual Automotive Crash Distribution in the United States²⁹

Motor vehicle crashes	11.4 million
Vehicle towed	3.0 million
Treated and released from hospital	1.2 million
Treated at the scene	300,000
Hospitalized	230,000
Vehicles involved in fatalities	47,000

Another predictor of serious trauma is a respiratory rate >25 breaths/min. Respiratory rate may be a useful triage tool for trauma care providers where the scene is chaotic and evacuations long.¹²

The prehospital GCS score is a reliable physiologic parameter for predicting hospital admission after a motor vehicle crash. When obvious indicators (hypoxemia, multiple long bone fractures, focal neurologic deficits) for trauma team activation are lacking, the prehospital GCS score may be used to reduce overtriage and undertriage rates.¹³

Mechanism Criteria

Investigators from the Royal Melbourne Hospital conducted a study to assess whether prehospital triage guidelines, based on mechanistic criteria alone, accurately identified victims of motor vehicle crashes with major injury. Multivariate logistic regression indicated that prolonged extrication time, passenger compartment intrusion, high speed, and ejection from vehicle were statistically associated with major injury. Vehicle rollover and fatality in the same vehicle were not statistically associated with major injury. These data suggest that existing guidelines for the prehospital triage of motor vehicle crash victims, based on mechanistic criteria alone, may need revision.¹⁴

Paramedic judgment has been identified as an alternative method for the triage of trauma patients but is as of yet unverified.¹⁵ Although there is little evidence to strictly support the rule, scene time should generally be limited to ten minutes unless factors such as delayed extrication supervene.

Are some criteria more sensitive than others? In one study, mechanism of injury was the only reason for trauma center transport in 29 of 112 patients. Neither intubation nor emergent surgery was required in any of these patients, and all survived. Only two had an Injury Severity Score >15. The remaining 83 had an 11% mortality rate. Fourteen (16.9%) had an Injury Severity Score >15. Defining an Injury Severity Score of 16 or greater as severe injury, mechanism of injury alone had a positive predictive value of 7%.¹⁶

For blunt trauma as a result of a motor vehicle crash, select mechanism of injury data such as skid marks, passenger compartment intrusion, and interior deformity will likely be less reliable than location of impact

(side vs. front vs. rear), rollover, restraint use, and bag deployment. In the future, information from car sensors to public safety answering point, crash location, and even voice communication with occupant may be used to predict injury severity. Vehicles equipped with "smart" sensors will be able to relay information to EMTs on change in velocity, vector of impact, and rescue strategies before they arrive at the crash site. Safety measures could include instructions on extrication and disabling of airbags to reduce the chance of inadvertent deployment.¹⁷

Substantial undertriage of serious trauma patients to trauma centers appears to be occurring, especially in older persons and in persons with brain injuries. Efforts to understand why undertriage is occurring so frequently are hampered by fragmentation of the systems of care, inadequate data management systems, and lack of trauma care performance reporting by non-trauma center hospitals.¹⁸

Undertriage of older trauma victims has been a persistent and serious problem. Because of physiologic changes and preexisting disease, blunt trauma in older persons is often covert. Prehospital trauma triage guidelines developed for use with a general adult population may not be sensitive enough to detect covert injuries in elderly trauma patients. In one study, undertriage was 8% for young and middle-aged men, 12% for young and middle-aged women, 18% for older men, and 15% for older women. Overtriage was also present in all age groups, indicating that many motor vehicle crash victims who were admitted to trauma centers could have been admitted to non-trauma center hospitals. Low sensitivity and specificity of trauma triage guidelines result in undertriage and overtriage. Some argue that prehospital triage guidelines should include age as a decision point to avoid placing older persons at risk for undertriage.¹⁹

Conversely, overtriage of younger trauma patients appears to be prevalent. Helicopter transport of pediatric trauma patients in an urban emergency medical services (EMS) system was assessed to identify the appropriateness of using this modality for the young. The majority of pediatric trauma patients transported by helicopter were found to have sustained minor injuries.²⁰

Trauma triage scores, severity of illness measures, and mortality prediction models quantify severity of injury and stratify patients according to a specified outcome. Triage scoring systems are typically used to assist prehospital personnel in determining which patients require trauma center care, but they are not recommended as the sole determinant of triage. To optimize outcome, seriously injured trauma patients should be transported to the nearest trauma center. A recent landmark report showed that the in-hospital mortality rate was significantly lower at trauma centers than at non-trauma centers (7.6% vs. 9.5%), as was the one-year mortality rate (10.4% vs. 13.8%). The effects of treatment at a

trauma center varied according to the severity of injury, with evidence to suggest that differences in mortality rates were primarily confined to patients with more severe injuries.²¹

Trauma Centers

The extent to which severely injured patients receive definitive care at trauma centers is determined by the accuracy of prehospital major trauma criteria in predicting severe injuries and by the level of compliance with these triage instructions by prehospital providers. The majority of patients meeting prehospital major trauma criteria are transported to designated trauma centers. Patients meeting only physiologic criteria, however, are much less likely to be transported to trauma centers, and there was a differentially low compliance for elderly trauma patients meeting physiologic criteria alone.²²

A trauma center is a hospital with a current American College of Surgeons verification certificate, but this varies across states. The attending surgeon is expected to be present in the emergency department upon arrival of all patients to assure that hospital-specific guidelines are met and to define major resuscitation when given sufficient advance notification from the field, within 15 minutes of trauma team activation when the advance notification is short. Documentation of compliance with this expectation must be 80% or greater to be verified. Online medical direction is encouraged for difficult cases. Prearrival notification of the receiving facility is essential.²³

Only 56% of seriously injured patients in California were treated at trauma centers, despite most of the injuries occurring in the catchment areas of designated trauma care systems. There are several barriers to an optimal emergency medical system: 1) 75% of the United States is not covered by a trauma system; 2) regionalization of care, which would provide services without duplicating resources, is not common; and 3) some mechanisms criteria are not useful and those that are useful should be used in the emergency department and in patient care as needed. Additionally, there is a failure to document elements and a failure to act on those elements.¹⁸

Do EMS charts selectively report trauma triage criteria? Most mechanism of injury criteria noted on the data instrument were infrequently documented on the standard EMS report. Patients who had mechanism criteria noted on the EMS report were more likely to be admitted to the hospital, to require major operative procedures, and to have prolonged lengths of stay than were patients who had mechanism criteria documented only on the structured data instrument.²⁴

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In the simplest of all triage schemes, investigators sought to determine whether EMT judgment is adequate in identifying patients at high risk for death or the need for immediate operative intervention. The EMTs rated the patient's overall severity on a four-point scale and estimated the probability of patient mortality. The investigators found that the EMT prediction of mortality was as accurate as the various scores. The investigators concluded that EMT judgment is as accurate as these three scoring systems in identifying patients who were seriously injured.²⁶

A rapid surgical response is predicated on adequate communication from prehospital providers. While on-line medical direction is encouraged to assist in the management of difficult cases, prearrival notification of the receiving facility allows for the trauma center to amass the resources necessary to expedite the accurate management of the trauma patient. Radio contact has a number of additional benefits. For example, ambulance call report documentation is better with online medical oversight. In addition, medical oversight helps reduce the number of refusals by incompetent patients, may help convince patients who are competent but appear ill to accept transport, and overall assists paramedics with other difficult or unusual circumstances.²⁷

What happens after EMS arrives at the hospital with the injured patient? In one study, the verbal communication between EMT-paramedics and physicians in an emergency department trauma room was measured before and after an educational intervention. Physicians appear to recall paramedic verbal reports about trauma patients poorly. Recall is better with less injured patients. Failed recall may have a negative impact on patient care.²⁸

CONCLUSIONS

The success of a trauma system relies on transfer of patients from the field to the most appropriate hospital for definitive care. Effective field triage of trauma victims requires early identification of patients to hospitals capable of treating their level of injury. Identification of these patients at the scene requires that prehospital personnel rapidly apply structured triage decision making. Precise application of prehospital trauma triage criteria is critical but not uniform. Excessive overtriage and undertriage place significant burdens on the system and require that prehospital triage criteria maximize sensitivity balanced with optimal specificity. While a variety of triage criteria have been tested, most prehospital trauma triage criteria adopt a combination of physiologic, anatomic, and mechanism of injury components. It is recommended that EMS systems develop,

apply, and validate a system for the triage of prehospital trauma patients.

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