Reducing Overtriage Without Compromising Outcomes in Trauma Patients

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Hypothesis: Changing category 1 criteria to include primarily physiologic and anatomic indicators of injury, eliminating mechanism of injury criteria, decreases the rate of overtriage without compromising outcomes.

Methods: Retrospective review of our American College of Surgeons-verified level I trauma registry from January 1, 1996, to December 31, 1998, comparing patients before and after trauma alert criteria changes.

Results: There was a significant decrease in category 1 alerts, representing a reduction in overtriage. There was a concomitant increase in injury severity and mortality in category 1 patients. There was no significant change in injury severity or mortality for category 2 patients.

Conclusions: There was a significant reduction in overtriage of trauma patients demonstrated without an appreciable impact on patient outcome. Changing trauma response criteria to more physiologic and anatomic indicators allowed improved triage of trauma patients, which improves resource allocation.

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Since the 1960s, in-field and in-hospital triage systems have become an integral component in providing trauma care. These systems ensure that critically injured patients have an appropriate team of specialists assembled and prepared before their arrival in the emergency department (ED). Appropriate triage has been shown to improve patient care while increasing ED efficiency and reducing operating costs. Appropriateprehospital triage is so important that the American College of Surgeons Committee on Trauma has suggested that a 50% overtriage rate may be necessary to limit potentially life-threatening undertriage. Undertriage refers to missing significant injuries in patients, whereas overtriage refers to unnecessary mobilization of the trauma response team for patients without significant injuries.

The result of overtriage is inefficient use of staff and resources, which results in costly care. DeKeyser et al have documented the significant operating expenses associated with overtriage, which amount to more than half a million dollars annually in their center alone. In addition, diagnosis related groups-based reimbursement has been shown by several authors to be inadequate for both severely and nonseverely injured patients, and this additional burden is shouldered by the treating hospital. With our current goals of health care cost reduction, appropriate triage continues to be a significant financial and quality issue.

Following numerous reports that mechanism of injury indicators may lead to overtriage, in September 1997, we changed our trauma alert criteria to incorporate primarily physiologic and anatomic indicators of injury for our category 1 patients, leaving mechanism of injury as indications for category 2 alerts. We hypothesized that our existing 2-tiered trauma response system could be refined to capture the sickest patients in category 1 and less severely injured patients in category 2, without negatively affecting patient care. This study evaluates what impact these changes had on overtriage rates and outcomes of trauma patients admitted following these changes.

RESULTS

OVERALL

During the study period, there were 3022 trauma evaluations (2174 men and 848 women, with a mean ± SE age of 37.9 ± 0.3 years). Mean patient ISS was 10.8 ± 0.2,
**METHODS**

**STUDY DESIGN**

This retrospective review evaluates triage and outcomes for all trauma patients evaluated in our American College of Surgeons–verified level I trauma center between January 1, 1996, and December 31, 1998. We used a 2-tiered trauma alert/response system, with the sickest patients classified as category 1 traumas and the less injured patients classified as category 2 traumas. Patients not meeting any of the category 1 or 2 triage criteria are considered consultations and, therefore, no trauma alert is activated. Patients who are initially mistriaged can be immediately upgraded or downgraded, when appropriate, following arrival in the ED. For this study, only the original prearrival categorization was used for analysis.

We modified our category 1 trauma alert criteria on September 22, 1997, to include primarily physiologic and anatomic indicators of injury, which shifted mechanism- and scene-related factors into the category 2 trauma alert criteria. Criteria used for trauma team activation and team members responding are shown in Table 1 and Table 2, respectively. We queried our trauma registry (TraumaBase, Denver, Colo), retrieving demographic and post-admission data, which included the following: severity of illness estimated by admission Injury Severity Score (ISS) and Glasgow Coma Scale score (GCS), age, sex, mechanism of injury, ED disposition, length of stay, and survival. The study population was divided into 2 groups: the “before” group, which consists of patients before the criteria changes (January 1, 1996, to September 21, 1997), and the “after” group, which consists of patients following the criteria changes (September 22, 1997, to December 31, 1998).

**SETTING**

The Ohio State University Medical Center, Columbus, is a tertiary care facility in central Ohio, which serves a population of approximately 1.25 million. Our trauma program is supported by both an accredited general surgery and emergency medicine program. Our ED is staffed 24 hours a day by board-certified and advanced trauma life support (ATLS)–certified emergency medicine physicians. After the field emergency medical services personnel determine the patient’s destination, our ED physician evaluates and triages by radio communication all trauma patients before ED arrival and activates the appropriate trauma alert response. All residents are ATLS trained before their trauma experience. All trauma attending surgeons are ATLS certified, board certified in general surgery, and present for all category 1 trauma alerts. Our surgical intensive care unit is directed and managed by physicians with added qualifications in surgical critical care.

**STATISTICAL ANALYSIS**

All statistics were performed on a personal computer using Minitab software (Minitab, State College, Pa). Continuous variables are reported as means±SEs. Categorical variables are presented as percentage of frequency of occurrence. Comparison of continuous variables was by unpaired t test with 95% confidence intervals. Discrete variables were compared using χ² analysis. P<.05 was considered significant.

mean patient GCS was 13.4±0.1, and the overall mortality was 5.8%. The breakdown of trauma by mechanism was 77.4% blunt, 8.9% penetrating, and 13.7% other (burns, drowning). There was an overall increase during the study period in numbers of patients evaluated per week.

**“BEFORE” AND “AFTER” GROUP COMPARABILITY**

In the 21-month “before” group there were 1518 admissions; in the 15-month “after” group there were 1504 admissions. These groups were evaluated to ensure comparability, and results are shown in Table 3. There was no significant difference in mean age, mean ISS, or mean GCS between the groups, and there was a comparable incidence of patients with ISSs greater than 15 in both groups. The incidence of blunt and penetrating trauma was not significantly different, nor was the ratio of stabs to gunshot wounds. The sex distribution was slightly different, with fewer women in the “before” group than in the “after” group.

**TRAUMA ALERTS AND MORTALITY**

Following changes in triage criteria, there was a significant decrease in category 1 trauma alerts from 24% to 13% (Table 3). Concomitantly, there was a significant increase in category 2 trauma alerts from 14% to 19% after changes. Results of mortality analyses stratified by category are shown in Table 4. There was a statistically significant increase in the mortality of category 1 patients after changes in triage criteria, with no increase in category 2 patient mortality.

**INJURY SEVERITY**

“Before” and “after” groups were compared for injury severity as estimated by the ISS and GCS, and results are illustrated in Table 4. Category 1 patients had significantly higher mean ISSs after changes in triage criteria. There was no significant change in mean ISSs for category 2 patients after triage criteria changes. Category 1 patients had significantly lower mean GCSs after triage criteria changes, with no significant change in mean GCSs for category 2 patients.

To evaluate whether patients were inappropriately triaged, we analyzed the distribution of ISSs by trauma category (Table 5). Category 1 trauma patients with ISSs of 0 to 15 significantly decreased from 57% to 38% after changes in triage criteria. Concomitantly, there was a statistically significant increase in category 1 trauma patients with ISSs of greater than 25 from 23% to 36%. There were no statistically significant changes in injury severity distribution among category 2 patients after criteria changes.
This study demonstrates that an existing 2-tiered trauma triage system can be refined to reduce overtriage without significantly influencing outcomes. Like many modern trauma centers, we use an in-hospital trauma triage/response team as an adjunct to field triage, which is activated subsequent to patient entry into our trauma system. Ultimately, the purpose of our category 1 response team is to ensure immediate management of airway, breathing, and circulation problems and to facilitate an orderly and timely evaluation and disposition of definitive therapy. The purpose of our category 2 response team is to rapidly screen and assess the physiologically stable patient, with a known mechanism of injury, who may have occult injuries. After using our initial triage system for many years and following several studies that suggest that mechanism of injury criteria was not highly predictive of severe injury, we modified our category 1 triage criteria to include only physiologic and anatomic variables. Our goal was to reduce overtriage and provide a response appropriate to the level of patient injury.

The use of physiologic and anatomic data is certainly not a new idea and is well supported in the literature. There are also good data confirming the inaccuracy of mechanism of injury to reliably predict significant injury. Our data support these concepts, as one of the
most significant impacts of changing our trauma triage criteria was to significantly decrease overtriage in the “after” group. There was a substantial decrease in category 1 trauma from 24% to 13% after criteria revision (P = .001), with a concomitant increase in category 2 trauma alerts from 14% to 19% after criteria changes (P = .001). By definition, a decrease in category 1 activations can be considered a reduction in overtriage.

Since reducing overtriage in category 1 patients should appropriately divert less injured patients into category 2, the “after” group should show a significant increase in severity of illness for category 1 patients. There was indeed a significant increase in mean ISS (P < .001) and a significant decrease in mean GCS (P = .02) in category 1 patients after triage criteria changes. Not surprisingly, with this increased injury severity came a significant increase in mortality from 16% to 24% (P = .03) for category 1 patients. The most convincing data for increased acuity in category 1 emerged when patients were stratified by ISS before and after criteria changes (Table 5). This showed a significant decrease in incidence of category 1 patients with ISSs of less than 15, with a concomitant increased incidence of patients with ISSs of more than 25. By definition, an increase in acuity of category 1 patients with a concomitant decrease in frequency is a reduction in overtriage.

The most important question answered was whether this reduction in overtriage was at the expense of diverting sicker patients inappropriately into category 2. When category 2 patients were similarly analyzed, there were no significant changes in ISSs or GCSs for either the “before” or “after” group (Table 4). Mortality in category 2 patients remained the same, and when stratified by ISS (Table 5), they showed almost identical patterns of distribution after triage criteria changes, suggesting no significant impact on injury severity. There was a slight increase in moderately injured patients (ISS, 16–25) in category 2 patients from 11% to 17%, but this did not reach statistical significance (P = .07). Overall, modifying triage criteria did not seem to influence outcome in less severely injured category 2 patients.

There is little dispute that overtriage of trauma patients is expensive for the treating hospital, and appropriate triage has been repeatedly shown to improve patient care and increase ED efficiency. Reduction of overtriage rates without worsening outcomes should, therefore, have favorable economic effects for a hospital. Although this study does not specifically address cost, there are sufficient data available corroborating this concept to allow generalizations to be made. Certainly, an overall decrease in category 1 trauma activations frees up faculty, resident, nursing, and other ancillary personnel to care for patients elsewhere in the hospital. In addition, several hospital resources (eg, operating rooms, computed tomography scanners, blood bank), which are traditionally put “on hold” on arrival of a category 1 patient, will be less often monopolized, which again should improve patient care elsewhere. An added bonus has been an improvement in surgery faculty morale at category 1 trauma team activations, since patients are now more severely injured, requiring their presence and expertise for resuscitation and definitive management.

A cavalier interpretation of these data might suggest that patients without physiologic or anatomic indicators of injury can be safely taken to nontrauma centers. Despite the very low mortality rates seen in category 2 patients, it is impossible to ascertain from these data whether their outcome would have been as excellent if taken to a nontrauma center. We believe very strongly that care should be taken not to overgeneralize our results. These changes should be applicable to trauma systems with a similar 2-tiered structure and may not translate appropriately in other systems.

Shortcomings of the study stem mainly from its retrospective nature, although a prospective randomized trial would not be possible. It is possible that referral patterns in the prehospital setting changed following changes in criteria, but we have no reason to believe that this happened. There were slight differences in the “before” and “after” groups in ratio of male to female patients, with slightly more female patients injured in the “after” group (Table 3, P = .04). There were also significantly more “other” trauma in the “after” group, which is primarily attributable to a higher incidence of burn admissions during that period. Despite these slight differences, there did not seem to be any significant difference between groups, particularly in age, ISS, GCS, ratio of penetrating to blunt trauma, ratio of stabs to gunshot wounds, and the overall distribution of mechanism.
In summary, a properly applied 2-tiered trauma triage system that focuses on physiologic and anatomic criteria for category 1 patients can successfully decrease rates of overtriage, without noticeably compromising outcomes. This is undoubtedly more cost-effective, freeing up both highly trained personnel and a number of expensive hospital resources. We conclude that physiologic and anatomic triage of trauma patients improves resource utilization without compromising outcomes.

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REFERENCES