Trauma surgeon becomes consultant: Evaluation of a protocol for management of intermediate-level trauma patients

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ABSTRACT

Purpose: At our level 1 pediatric trauma center, 9-54 intermediate-level (“level 2”) trauma activations are received per month. Previously, the surgery team was required to respond to and assume responsibility for all patients who had “level 2” trauma activations. In 8/2011, we implemented a protocol where the emergency room (ER) physician primarily manages these patients with trauma consultation for surgical evaluation or admission. The purpose of this study was to prospectively evaluate the effects of the new protocol to ensure that patient safety and quality of care were maintained.

Methods: We compared outcomes of patients treated PRE-implementation (10/2010-7/2011) and POST-implementation (9/2011-5/2012), including surgeon consultation rate, utilization of imaging and laboratory testing, ER length of stay, admission rate, and missed injuries or readmissions. Statistical analysis included chi-square and Student’s t-test.

Results: We identified 472 patients: 179 in the PRE and 293 in the POST period. The populations had similar baseline clinical characteristics. The surgical consultation rate in the POST period was only 42%, with no missed injuries or readmissions. The ER length of stay did not change. However, in the POST period there were significant decreases in the admission rate (73% to 44%) and the mean number of CT scans (1.4 to 1), radiographs (2.4 to 1.7), and laboratory tests (5.1 to 3.3) ordered in the emergency room (all p < 0.001).

Conclusion: Intermediate-level pediatric trauma patients can be efficiently and safely managed by pediatric emergency room physicians, with surgical consultation only as needed. The protocol change improved resource utilization by decreasing testing and admissions and streamlining resident utilization in an era of reduced duty hours.

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1. Background

At Texas Children’s Hospital, a large urban freestanding children’s hospital, trauma is a fairly new concept. Although the hospital has been in existence for over 50 years, we only became a designated level I trauma center in 2010. We established a three-tier system for levels of activation defined by injury mechanism as well as physiologic parameters, which is outlined in Fig. 1. In order to gain experience with trauma resuscitations, the pediatric emergency medicine (PEM) and surgery services worked closely together. The PEM team is involved in all traumas, but patients with the highest level of activation (level 1) require the presence of a surgical fellow or faculty member within 15 minutes, while the lowest severity level (level 3) trauma patients are managed solely by the PEM physicians. The intermediate level (level 2) activations had initially required the presence of a surgical resident, supervised by the surgical attending. These activations (9-54 per month, average 25/month) became increasingly burdensome to the very busy surgical service, especially as resident duty hour restrictions became more stringent. As we refined and evaluated our new trauma program, we identified that a large majority of these level 2 activations were treated with only minor resuscitation and often did not require general surgeon expertise; therefore, awaiting surgical input may be redundant and inefficient.

In order to improve resource utilization and the efficiency of the ER trauma process, we adopted a new protocol where the trauma surgeon became a consultant rather than a primary responder to level 2 resuscitations, based on a previously published model [1,2]. We hypothesized that changing the surgeon response to intermediate-level traumas from a primary responder to a consultant will result in decreased surgeon involvement and length of stay in the emergency...
The purpose of this study was to evaluate the effects of the new protocol on emergency room processes in trauma management, resource utilization, and quality of care.

2. Methods

2.1. Patient population

Patients included all pediatric trauma patients (age <16) who arrived at the emergency room (directly from the scene or via transfer) after being triaged as a level 2 trauma activation. The patients were identified through the hospital trauma registry, which is prospectively maintained. Those who were identified initially as a level 2 but were subsequently downgraded to a level 3 or upgraded to a level 1 upon arrival to the emergency room (ER) remained in the study.

2.2. Study design and analysis

We performed an uncontrolled before and after study to assess the effect of our change in protocol. Comparison groups were the...
Fig. 3. Statistical Process Control charts depicting the time-dependent decrease in radiologic studies (A. CT Scans, B. Radiographs) and laboratory tests (C) ordered in the emergency room.
Table 2

<table>
<thead>
<tr>
<th>Variable</th>
<th>Pre-Implementation (n = 179)</th>
<th>Post-Implementation (n = 293)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discharge from ER</td>
<td>26%</td>
<td>56%</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Surgery Involvement Rate</td>
<td>92%</td>
<td>42%</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Mean # CTs</td>
<td>1.4 (±1.3)</td>
<td>1.0 (±1.2)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Mean # x-rays</td>
<td>2.4 (±1.9)</td>
<td>1.7 (±1.9)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Mean # labs</td>
<td>5.1 (±3.4)</td>
<td>3.3 (±3.3)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Time in ER (mins)</td>
<td>247 (±138)</td>
<td>238 (±145)</td>
<td>0.52</td>
</tr>
</tbody>
</table>

PRE-implementation (10/2010-7/2011) and POST-implementation patients (9/2011-5/2012). Data from one month during the transition period was excluded. Outcome measures assessing adherence to the protocol included the surgical consultation and admission rates. Comparing the ER length of stay until either discharge or admission between the two groups measured the effect of the protocol on ER processes. Resource utilization was evaluated by comparing the number of laboratory tests ordered per patient, the number of plain radiographs ordered and the number of computed tomography (CT) scans ordered per patient. Balance measures included the emergency room length of stay, the number of documented missed injuries, and the number of readmissions. Each intermediate-level trauma patient was reviewed prospectively by a multidisciplinary trauma committee for evidence of a missed injury, delay in diagnosis, readmission within 48 hours, and ER length of stay. Other outcomes were collected via a retrospective chart review.

The baseline characteristics of the patients, including age, mechanism, and severity of injury, were compared between each group. Statistical analysis was performed using SPSS (version 20, Chicago, IL), and included chi-square for categorical variables and student’s T-test for continuous variables. Statistical process control charts were made using the X-bar method with the data grouped by month (ChartRunner Version 3.6.70 by PQ Systems). Mean, upper, and lower controls were calculated separately for pre- and post-implementation groups.

3. Results

3.1. Patient characteristics

We identified 472 patients: 179 in the PRE period and 293 in the POST period. The populations had similar baseline clinical characteristics including gender, age, and injury severity (Table 1). While the injury severity score (ISS) is statistically higher in the PRE-implementation group, the clinical significance of 2 points on the ISS is likely minimal. The mechanism of injury was also consistent between the two comparison groups (Fig. 2).

3.2. Clinical outcomes

The surgical consultation rate in the POST period was only 42%, compared to 92% surgeon involvement PRE-implementation (8% of patients were transferred and not treated as trauma resuscitations, with no surgery notification). During the POST period, no patients were found to have missed injuries discovered after their triage from the ER (to either an admitting service or discharge to home), there were no unplanned readmissions for inadequate treatment, and there were no noted delays in care resulting in an adverse patient event.

3.3. Resource utilization

When we examined the resource utilization dedicated to the treatment of these patients, we found a number of encouraging trends. The discharge rate from the emergency room doubled from in the POST-implementation period. Additionally, the mean number of CT scans, laboratory tests, and radiographs ordered while in the emergency room all decreased in the POST-implementation group by approximately 40% (Fig. 3a, b, and c, respectively). The ER length of stay from the time of entry into the ER until either discharge or admission to the hospital was unchanged between the two groups (Table 2).

4. Discussion

The management of pediatric trauma continues to be an evolving field. Investigation into the management of specific injuries, comparison of outcomes between dedicated children’s and adult trauma centers, and discussion of minimizing radiation in pediatric trauma are often presented in the literature [3–6]. However, few studies report the details of the process of managing these children, specifically with regards to the leader of their care (ER or the surgeon). The group at Nationwide Children’s hospital has demonstrated that “minor resuscitation” trauma patients can be managed by the pediatric EM physician, as opposed to the surgeon, without an increase in adverse events [1,2,7].

At our institution, we noted that a large proportion of patients with the intermediate-level activations had only minor injuries and could be directly discharged from the ER, or had isolated trauma that...
required surgical subspecialty treatment only. Our protocol change sought to decrease redundancy by removing the surgeon’s involvement in these minor cases without causing adverse effects. This was aided by the activation of multiple safety-net guidelines, which focused on early notification of the trauma surgeon when required and safe evaluation of blunt abdominal trauma (Figs. 4, 5). These guidelines have worked well, as we have noted with prospective weekly reviews of every case.

The results after implementation of this quality improvement initiative are encouraging. The protocol successfully reduced the number of intermediate level trauma patients receiving a trauma surgical initiative are encouraging. The protocol successfully reduced the number of intermediate level trauma patients receiving a trauma surgical consultation by 50%. When evaluating our balance measures of missed injuries, readmissions, and delays in care, we did not find that this decrease in surgeon involvement caused unintended adverse effects.

Similar to the results reported by Groner et al., we found that the number of discharges from the ER significantly increased following protocol implementation [1]. This is probably due to the fact that pediatric EM physicians are more comfortable with discharging children with minor injuries rather than admitting them for observation as a surgical resident might be inclined to do.

Despite similar demographics, injury severity, and injury mechanisms between the pre and post-implementation groups, we found that overall resource utilization with respect to imaging and laboratory tests decreased. Explanations for this difference may include the inexperienced surgical residents’ predilection for imaging in trauma and laboratory work as compared to experienced pediatric EM faculty or decreased reliance on these tests as our experience as a trauma center broadens. There has also been a general increased awareness recently in limiting unnecessary CT scans in children, which may account for this decrease. Furthermore, provider consistency by following the abdominal trauma management guidelines may have contributed to the decrease in excessive imaging and laboratory work.

The overall ER process did not appear to be affected significantly by the protocol, as the length of stay did not change. We hypothesized that the length of stay would decrease, as the number of providers evaluating and managing this patient population would be reduced. Main drivers of the ER length of stay may not be related to the managing provider, but rather the availability of imaging, the time for the specialist consult to be completed, and the necessary observation period prior to discharge. Thus, decreased provider involvement did not affect this particular outcome measure at our hospital.

Limitations to this study include the fact that the two comparison groups are non-randomized, as differences in the patient population may confound our results. Additionally, we did not contact patients following discharge to ensure that there were no missed injuries; rather, we relied on the fact that they did not present back to the ER within 48 hours of discharge. It is possible that we may have underestimated patients with missed injuries as they presented to a different hospital.

In conclusion, this study was able to demonstrate that intermediate-level pediatric trauma patients may be successfully and perhaps more efficiently managed primarily by a pediatric emergency medicine physician, with the trauma surgeon as a consultant as opposed to a primary responder. Decreasing redundancy in patient care, particularly as hospital reimbursement moves to models of bundled payment, will become an area of increasing importance. Additionally, as resident duty hours face continued restriction, reducing the scope of the resident’s responsibilities may allow for higher yield educational experiences. Continued assessments of hospital-level quality improvement initiatives are necessary to determine both the benefits and the possible unintended adverse consequences, and to identify areas for further improvement.

References


Discussion

Discussant: Dr. STEVEN STYLIANOS (New Hyde Park, NY): Very nicely done and very valuable information for all of us. I’m sure the room is processing this and wondering how they are going to respond when they go home. One of the things that you pointed out is that after a full workout by an ED team there may be a phone call to the surgical team, please come down and admit this patient, we’re all finished evaluating him/her. That will emphasize the hand-offs that have to

**Fig. 5. Abdominal trauma management guidelines (Abbreviated version depicted).**
occur. Can you amplify how that transition of care occurs from the ED who did all the work to the surgical resident/team that has to now accept the patient?

*Response: Dr. SARA FALLON:* All of the surgery team still receives the code 2 page so the surgery team is aware that a code 2 patient is in the ER and may require their attention. At that point the same paging system goes out to the entire team that a surgical consultation is needed and there is a required 30-min response time, so hopefully some of the hand-offs with regards to a lag time in surgeon ability to evaluate the patient are decreased. We also have a dedicated trauma nurse practitioner who comes down with the residents to facilitate a consistent interaction between the trauma team and all of our ER providers. We have had good experience thus far with that.

*Discussant: ANDREAS MEIER (SUNY Upstate Syracuse, NY):* When I look at your slide regarding the levels, it seems that trauma score for the activation has gone down after the implementation. Did you see an over-triage of level 1’s? Do you see an increase in level 1 traumas during that time period? If so, do you think those were appropriately leveled or was there an upgrade that was basically just done because of increased nervousness in the emergency room?

*Response: Dr. SARA FALLON:* We have had an increase in level 1 trauma patients over the time period. Whether that is an effect of the protocol or just over time our trauma center becomes more known to the EMS and we have a higher volume of patients is unknown. I did not specifically look at the number of upgrades or downgrades of our codes in this study but I think that is a good point and something I should review.

*Discussant: PETER ERHLICH (Ann Arbor, MI):* Why didn’t you just rewrite your level 2 and level 1 criteria? When we looked at this, our level 2 criteria, we found the same thing. We just rewrote them so that the ones that were always being sent home were now not level 2 criteria. Don’t you think that’s really what you did?

*Response: Dr. SARA FALLON:* I think that’s partially what occurs. As part of our criteria for the level 2, it is really mechanistically based and I think you can have such a broad range of injuries with the same mechanism. It is partially physiologically based. I think the majority of our code 2’s are not hemodynamically unstable. Those are actually our level 1 patients, so the code 2’s are really stratified by what their injury is within a certain set of mechanisms. I do think it is worth sort of drilling down on which mechanism predisposes our patients at a local level to worse versus more minor injuries and then maybe rewriting our protocol that way. I do think it is a point that is worth exploring with our own institutional data.

*Trauma Surgeon Becomes Consultant: Outcomes After Implementation of a New Protocol:* Presented by Sara C. Fallon, Houston, TX.

*(MONFORD) DANNY CUSTER (Temple, TX):* We’re in the process of applying for a trauma level designation in our institution. We get cited for trauma patients who are admitted to a nonsurgical service, so for the level 2 trauma patients that did not get a surgical consultation, which service would they be admitted to if they needed admission?

*SARA FALLON:* All patients that are level 2’s that require admission are seen by the surgery team. Even if they have an isolated orthopedic injury, they are admitted to the surgery team for a 23-h observation period and a tertiary survey. At that time, if they still require additional orthopedic or say neurosurgical treatment, they are then transferred to that service once we feel as though the initial acute trauma evaluation has been completed.