Midwest Surgical Association

Starting the clock: defining nonoperative management of blunt splenic injury by time

Elan Jeremitsky, M.D.\textsuperscript{a,}\textsuperscript{*}, R. Stephen Smith, M.D.\textsuperscript{b}, Adrian W. Ong, M.D.\textsuperscript{a}

\textsuperscript{a}Department of Trauma, Allegheny General Hospital, 320 East North Avenue, Pittsburgh, PA 15212, USA; \textsuperscript{b}Department of Surgery, University of South Carolina School of Medicine, Columbia, SC, USA

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Abstract

BACKGROUND: There is no consensus when the designation of nonoperative management (NOM) for splenic injury (BSI) should start. We evaluated NOM success rates based on different time points after admission.

METHODS: The National Trauma Data Bank was evaluated for BSI for the year 2008. Observations were evaluated by facility, the time to splenectomy, and the volume of BSI admissions.

RESULTS: Of 15,732 BSIs identified, the overall splenectomy salvage rate was 81%. After the 5th hour, the NOM success rate was 95%. Multivariable analysis revealed that higher BSI grades, level 2 centers and community hospitals, and age $\geq 55$ were associated with failed NOM.

CONCLUSIONS: The grade of injury is an important predictor for failure of NOM. If a 5\% failure rate is to be considered a benchmark, then the 5-hour time point after admission should be used for the calculation of NOM success rates.

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The management of blunt splenic injury (BSI) has changed greatly over the past 20 years with the majority (approximately 80\%) now managed nonoperatively.\textsuperscript{1} The grade of injury is one of the strongest predictors of the failure of nonoperative management (NOM).\textsuperscript{2} The NOM failure rate of BSIs was calculated after eliminating patients who were taken to the operating room “urgently” after arrival to the hospital. Because there is no accepted definition of “urgent” operation in terms of time after arrival, there is logically no accepted definition of NOM failure. For example, an institution that defines urgent operations as those occurring within 1 hour of arrival might find that its NOM failure rate could be different from a center that defines an urgent operation as occurring within 2 hours of arrival. By changing the definition of what constitutes an “urgent operation,” the NOM failure rate of an institution might be altered.

There have been attempts to define NOM in the literature such as when a progress note is written documenting that the patient is undergoing NOM or that no operation has been performed in the first 3 hours of admission or even modifying the arrival times for urgent operations after the 2-hour mark.\textsuperscript{1,3} This is important because the NOM failure rate of BSIs at an institution is a reflection of the quality, sophistication, and commitment to trauma care by the institution. Numerous publications celebrating successful NOM of BSIs based on low NOM failure rates exist.\textsuperscript{4-6} It follows that to meaningfully evaluate successful NOM protocols for BSIs between different institutions, there must be an objective definition of NOM failure. A recent study by Bhullar et al\textsuperscript{4} in 2012 reported only 64\% of all their BSI admissions...
underwent NOM. Similarly, the Eastern Association for the Surgery of Trauma (EAST) study from 2000 reported that nearly 40% of their BSIs were taken directly to the operating room. Our study in 2011 reported a splenectomy incidence of 18%. Thus, over a decade or more, the incidence of splenectomy is institutionally dependent and varies widely from 18% to as much as 40%.

Patient selection is paramount in determining who is a candidate for NOM, and this clearly influences the salvage and success rates. We proposed a new paradigm and standard for objectively describing success rates of splenectomy by evaluating a large database so that meaningful comparisons can be made among institutions. We hypothesized that in order to objectively describe NOM success rates, it is necessary to specify a time point after admission to define when NOM begins. Our aims were to elucidate the differences in NOM between institutions by level of trauma center and admission of BSI volume.

Methods

The 2008 year National Trauma Data Bank (NTDB) database was used to evaluate BSIs after obtaining hospital institutional review board approval for exempt studies using deidentified data. The study population consisted of patients aged 13 and older who were admitted to a level 1 or 2 trauma center. Diagnosis codes 865 to 865.09 were used to establish the patient cohort for BSIs. Procedure codes for the spleen were then used to define those requiring surgical intervention (41.2, 41.43, and 41.5). All patients included in the cohort suffered at least BSI but could have additional solid organ injury, chest trauma, brain trauma, and extremity injury. Only procedure codes for the spleen were identified, but other procedures may have occurred in the abdomen or elsewhere. Our only exclusion criteria were the previously mentioned age and level of trauma center. In addition, the 1998 Abbreviate Injury Score (AIS) was used to establish the grade of injury. Grade I and II spleen injuries as per AIS98 were grouped together, with separate AIS codes for splenic injury grades III, IV, and V. AIS predet codes were also used to establish injury grades. Injury Severity Scores and admitting vitals (eg, blood pressure) were obtained. NTDB facility codes were used to establish the volume of BSIs admitted to each center. Centers were grouped into tertiles based on the volume of BSIs (ie, low, medium, and high volume). Hospitals were also categorized into university, community, and nonteaching centers. The time to splenectomy was obtained from the NTDB and was defined as the time of failure of NOM. Univariate analysis using the chi-square test for categoric variables and the 2-sample t test for continuous variables was performed. Multivariable analysis was performed with Cox proportional hazard regression to evaluate if there were predictors of NOM failure. Indeterminant grades (not further specified) of BSIs were not used in the multivariable analysis or survival models.

Results

We identified 15,732 BSIs in the NTDB 2008 cohort. Of these, 2,966 operative procedures were performed on the spleen. Thus, 19% of the overall cohort required surgical intervention for BSIs. The proportions of patients with BSIs receiving splenic procedures in our entire cohort were 5% for grades 1 and 2, 15% for grade 3, 42% for grade 4, and 62% for grade 5. Patients who failed NOM were older (mean age, 40.5 ± 18.2 vs 36.7 ± 18.2 years, P < .001) and had a higher mean Injury Severity Score (29.6 ± 13.7 vs 21.1 ± 13.7). Sequential chi-square analyses were performed based on each hour after arrival up to 5 hours to calculate the NOM success comparing level 1 and level 2 trauma centers and the volume of the trauma center. The NOM success rates vary when different time points after admission are taken into consideration. For example, success rates in level 1 centers were better than in level 2 centers until a point in time of >5 hours was reached. Similarly, medium-volume trauma centers also had a greater rate of success of NOM. Older patients (ie, >54 years old) had overall lower NOM success (Table 1). The tertiles for BSI admissions that were created for the various facilities ranged from 1 to 48 for the low-volume centers, 49 to 92 for medium-volume centers, and 93 to 258 for high-volume centers.

Table 2 shows the Cox proportional hazards multivariable regression and had a nonsignificant proportional hazard assumption. Higher grades of BSI were the strongest predictors for failure of NOM when compared with lesser grades. Other independent predictors of failure of NOM were age ≥55 years, male sex, discharge with home care, discharge to an intermediate care hospital, death, level 2 trauma centers, community hospitals, and high-volume trauma centers.

Comments

NOM for BSI is a dynamic process with many institutionally driven guidelines. We have attempted to quantify the outcomes of NOM with greater fidelity and stratification to facilitate data reporting, recording, and comparison. If the 5-hour time point was selected to determine when NOM began, the NOM failure rate would be 5%.

Bhullar et al reported the need to immediately operate on 36% of all patients with BSIs who arrived at their institution, citing hemodynamic instability as the primary factor leading to this decision. They also reported that of their NOM failures retrospective analysis determined that a significant number of them were not suitable for NOM. In our series in 2011, we had an 18% splenectomy rate, which included patients who had emergent splenectomies. A large NTDB analysis performed by Smith et al noted that 21% of all BSIs required operation. In this current analysis based on the 2008 NTDB database, we reported a 19% failure rate for all BSIs.
found no age association with failure of NOM. Our own published research in 2011 also agreed with this finding. However, we found that age was a significant predictor of failure of NOM, with older patients having an increased risk of splenectomy in this 2008 NTDB patient cohort.

From the results in Table 1, it can be seen that the NOM success rates can be altered by defining the outcome based on the time of determination of NOM after arrival. If the 1-hour mark was used to define the failure of NOM, the success rate would be 8 percentage points lower than if NOM failure was defined at the 4-hour mark (86% vs 94%).

We found minor but significant differences in the univariate analysis between the level and volume of the trauma center, which equalized by the 5-hour mark. The minor differences in the NOM success rate between the level of trauma center designation and the volume of the trauma center are significant because of the large size of the database.

We cannot comment on each individual institution’s philosophy and practice of NOM for BSI. Removing a higher number of spleens at the time of admission can certainly skew the data toward high success rates for the remaining spleens treated nonoperatively. Dr. Richardson in the Scudder Oration on Trauma said the following “The manner in which NOM success rates are reported is also deceiving. Numerous reports of a 95% success made little mention of the 17% to 45% of patients who must have urgent splenectomy.” The lack of consensus of what defines an “urgent” splenectomy makes meaningful comparisons of NOM success rates difficult across different institutions and management strategies.

Adjuncts such as pseudoaneurysm screening and embolization, whether empiric or therapeutic, can also impact NOM success. AIS injury grades of 3 and 4 have high rates of splenectomy. It is these splenic injuries that need to be addressed if the rates of successful NOM are to improve.

The NOM failure rate of any institution may be changed simply by using different time points after hospital admission to define when NOM begins. If a NOM failure rate of 5% is to be considered as an acceptable benchmark for splenic preservation, then the 5-hour mark after admission should be chosen to define when NOM should begin. Regardless of what constitutes an acceptable benchmark for NOM failure, we believe that all studies evaluating NOM

### Table 1 Successful NOM by trauma center

<table>
<thead>
<tr>
<th>Trauma Center</th>
<th>Time by hour into admission (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Arrival</td>
</tr>
<tr>
<td>Level 1*</td>
<td>82</td>
</tr>
<tr>
<td>Level 2</td>
<td>79</td>
</tr>
<tr>
<td>Low</td>
<td>81</td>
</tr>
<tr>
<td>Medium*</td>
<td>83</td>
</tr>
<tr>
<td>High</td>
<td>80</td>
</tr>
<tr>
<td>Age &lt;55 y†</td>
<td>82</td>
</tr>
<tr>
<td>Age ≥55</td>
<td>77</td>
</tr>
</tbody>
</table>

NOM = nonoperative management.

*Less than 55 years of age.
†Male.
‡White.
*Level 1.
†University.
§Grades I and II.
Home.
**Low volume.

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for BSI should future incorporate a time-based definition in the future.

References