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Association between pediatric blunt splenic injury volume and the splenectomy rate

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ABSTRACT

Background/purpose: While pediatric trauma centers are shown to have lower splenectomy rate as compared to adult trauma centers, it remains unknown whether other institutional factors such as case volumes would have an impact on the splenectomy rate in pediatric blunt splenic injury (BSI).
Methods: Pediatric patients who sustained BSI were identified from the National Trauma Data Bank 2007–2014. A hierarchical logistic regression model was built to evaluate differences in risk-adjusted splenectomy rate and in-hospital mortality in between trauma centers with different pediatric BSI case volumes.
Results: A total of 7621 children who met criteria were treated at trauma centers with different pediatric BSI case volumes (0–60, 61–120, 121–180, 181–240 cases during 2007–2014 for Group 1, 2, 3, and 4, respectively). High volume centers were shown to have decreased splenectomy rates (odds ratios [OR] 0.50 and 0.64, 95% confidence intervals [CI] 0.30–0.83, 0.44–0.95 for Groups 3 and 4, respectively) with an additional survival benefit in Group 4 (OR 0.452, 95%CI 0.257–0.793) when compared to the lowest volume centers (Group 1).
Conclusions: Higher pediatric BSI case volume was associated with lower splenectomy rate with an additional survival benefit. Trauma centers' volume in pediatric BSI may be an important factor for the improved splenic preservation.
Level of evidence: Retrospective comparative study, Level III.

Non-operative management of blunt splenic injury (BSI) in hemodynamically stable patients has become standard practice, even among those with selective high-grade splenic injuries [1–11]. Complications after splenectomy while relatively uncommon can be potentially catastrophic. Mortality rates associated with overwhelming postsplenectomy infections have been reported to be as high as 38%–70% [12]. Especially within pediatric populations, splenic preservation is all the more important given studies describing the benefits including fewer blood transfusions and shorter hospital stay. In light of the importance of splenic preservation, studies have suggested splenectomy rate as a quality indicator for pediatric trauma programs [13].

Trauma center type has also been shown to significantly impact splenectomy rates in pediatric BSI. Several studies have shown that spleen and liver procedures were performed more often at adult trauma centers (ATCs) compared to pediatric trauma centers (PTCs). They demonstrated that children treated at ATCs had significantly higher rates of splenectomy compared to PTCs, after adjusting for confounding factors [13–16]. The disparity between adult and pediatric trauma centers has strong clinical implications with regards to resource utilization. However, the limited number and accessibility of PTCs do not allow for all pediatric trauma splenic injuries to be evaluated in PTCs alone.

Beyond trauma center type, little else is known about the characteristics of the institutions associated with lower pediatric trauma splenectomy rates. Studies have shown higher trauma volume centers are associated with better patient outcomes [17–21]. Similarly, pediatric splenic injury case volume may be one of the predictors of lower splenectomy rate, as larger case volume is generally associated with improved outcomes. However, no study exists to date evaluating the association between the volume of splenic injuries and splenectomy rates. The implications of our hypothesis of higher splenic trauma volume and lower splenectomy rates and thereby improved outcomes, have high impact potential on resource allocation and triage of pediatric trauma patients. Pediatric patients may be treated at the nearest high

Abbreviations: BSI, Blunt Splenic Injury; AAST, American Association for the Surgery of Trauma; OR, Odds Ratio; CI, Confidence Interval; PTC, Pediatric Trauma Center; ATC, Adult Trauma Center; NTDB, National Trauma Data Bank; AIS, Abbreviated Injury Scale; GCS, Glasgow Coma Scale; SBP, Systolic Blood Pressure; ISS, Injury Severity Score; PICU, Pediatric Intensive Care Unit; MTC, Mixed Trauma Center.

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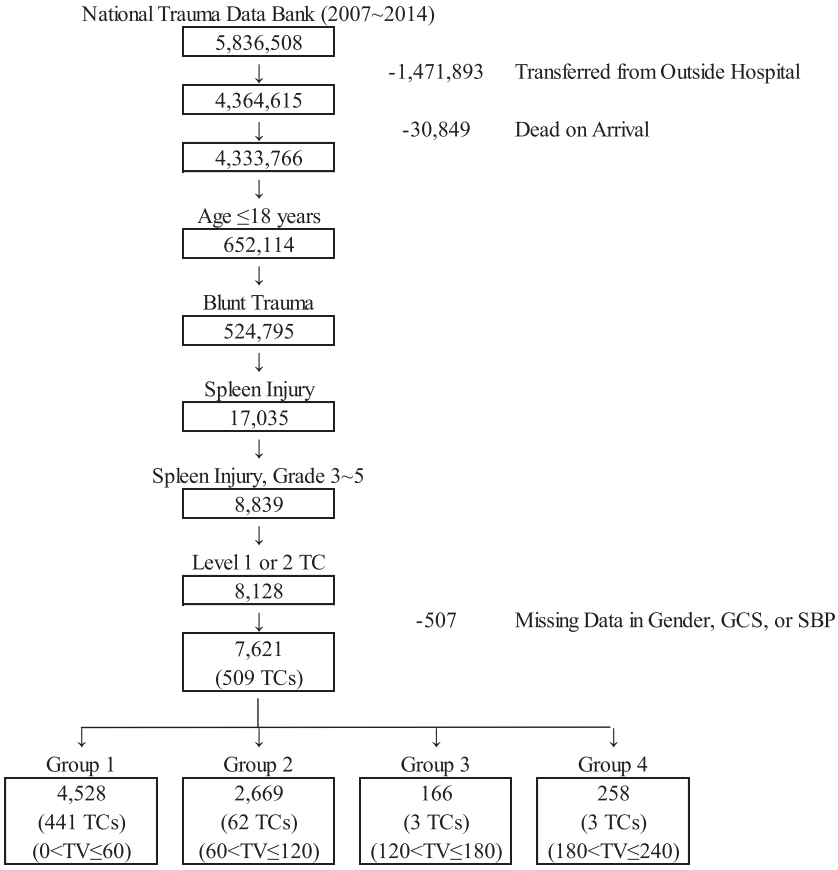

GCS, Glasgow coma scale; SBP, systolic blood pressure; TC, trauma center; TV, trauma volume (number of blunt spleen injury (any grade) patients who were admitted at each trauma center during 8 years, range 1-234)

Fig. 1. Inclusion and exclusion criteria.

volume trauma centers (ATCs or PTCs), which may be more readily accessible from the scene of the accident compared to PTCs. The purpose of this study was to elucidate the relationship between pediatric BSI trauma volume and the center-specific splenectomy rates. We hypothesized that trauma centers with higher pediatric BSI volume would have lower splenectomy rates as compared to lower pediatric BSI volume trauma centers.

1. Materials and methods

This was a retrospective, observational study utilizing data from the National Trauma Data Bank (NTDB) from 2007 to 2014. All pediatric patients (≤18 years of age) who sustained BSI of American Association for the Surgery of Trauma injury grade III to V admitted to pediatric or adult trauma centers with level 1 or level 2 state designation or American College of Surgeons Committee of Trauma (ACSCOT) verification were included. BSIs were identified by Abbreviated Injury Scale (AIS) predot codes 544,210–544,299. Grade III, IV, and V splenic injuries were identified by corresponding AIS predot codes (544,214 & 544,224, 544,226, and 544,228, respectively) [22]. To analyze pure examples of BSIs admitted directly from the scene and to minimize any treatment effect of the primary receiving hospitals, patients who were transferred from outside hospitals were excluded. Patients who were dead on arrival were also excluded. Demographics, descriptive variables and outcomes were extracted from the database. Clinical characteristics included age, gender, mechanism of injury, initial Glasgow Coma Scale (GCS), initial systolic blood pressure (SBP), Injury Severity Score (ISS), associated injuries in other body systems, and each body system's AIS. Initial SBP was further categorized as hypotension based on the following definitions: a) less than 70 + 2 x age in years for age < 10, or b) less than 90 for age > 10.

In addition to the abovementioned patient characteristics, the following characteristics of the treating trauma center were recorded: ACSCOT adult or pediatric trauma verification and state designation level, trauma center types (adult trauma center, pediatric trauma center, mixed trauma center), and presence or absence of pediatric intensive care unit (PICU). We defined an ATC as any center having adult ACS verification or adult state designation and no pediatric qualifications. PTC was defined as any center having exclusively either pediatric ACS verification or pediatric state designation. Mixed trauma center (MTC) was defined as any center having both adult and pediatric ACS verifications or state designations.

Case volumes of pediatric BSI at all level 1 or level 2 pediatric or adult trauma centers were calculated using the same datasets. Trauma centers were then stratified into four groups according to percent quartiles based on pediatric BSI case volumes: lowest (Group 1), lower (Group 2), higher (Group 3), and highest (Group 4) volume trauma centers. Patients were stratified into these four groups depending on which group of hospital they were treated at.

The primary outcome was the incidence of splenic surgeries defined as follows: partial splenectomy (International Classification of Diseases [ICD]-9 code 41.95), total splenectomy (ICD-9 code 41.5), and splenorrhaphy (ICD-9 code 41.43). We compared the splenic surgery rate as well as total splenectomy rate in between the four trauma