

Clinical Science

# Management of splenic trauma: a single institution's 8-year experience



Carl Rosati, M.D.\*, Ashar Ata, M.B.B.S., M.P.H., Gary P. Siskin, M.D.,  
Domenic Megna, M.D., Daniel J. Bonville, D.O., Steven C. Stain, M.D.

Department of Surgery, Albany Medical Center, 50 New Scotland Avenue, Albany, NY 12208, USA

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## Abstract

**BACKGROUND:** Management of splenic trauma has evolved, with current practice favoring selective angiographic embolization and non-operative treatment over immediate splenectomy. Defining the optimal selection criteria for the appropriate management strategy remains an important question.

**METHODS:** This retrospective registry review was conducted at a Level I trauma center. The patient population consisted of 20,561 patients in the State Trauma Registry from April 2004 to May 2012. Splenectomy, angiography, splenic embolization, nonoperative, and noninterventional (NI) observation were the management strategies under study. Morbidity and mortality were the outcome measures. Morbidity and mortality by management strategy.

**RESULTS:** During the 8-year study period, 926 (4.5%) patients sustained splenic injury. Observational management increased over time despite the similar distribution of splenic injury grade over the study period: grade I/II (50%), grade III (24.2%), and grade IV/V (25.8%). Mortality rates associated with each management strategy were the following: immediate splenectomy (IS; 25%), splenic embolization (SE; 3.9%), and angiography only or observation, that is, NI (6.5%) management. Injury severity score (ISS) was highest in IS ( $36.1 \pm 1.3$ ) compared with SE ( $29.1 \pm 1.0$ ,  $P = .001$ ) and NI ( $21.6$ ,  $P < .001$ ). Splenectomy was required in 5 of the 129 (3.9%) patients managed with SE and 9 of the 677 (1.3%) patients managed by NI. Mortality was significantly lower among those managed by SE (odds ratio .12, 95% confidence interval: .05 to .32) or NI (odds ratio .21, 95% confidence interval: .12 to .35). This survival benefit was explained by the association of IS with systolic blood pressure <90, high ISS, low GCS at presentation, ISS, development of shock, need for transfusion, and multiorgan failure.

**CONCLUSIONS:** In this large 8-year single institution study, we observed an increase in nonoperative management by an increased application of angiography and embolization. An aggressive utilization of SE in patients with appropriate indications will result in low failure rates and improved mortality.

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\* Corresponding author. Tel.: +1-518-264-4896; fax: +1-518-264-4934.

E-mail address: [rosatic@mail.amc.edu](mailto:rosatic@mail.amc.edu)  
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The management of splenic injury comprises 3 common treatment strategies: immediate splenectomy (IS), visceral angiography/embolization, and observational management. Over time, splenic embolization (SE) and observational strategies have overtaken splenectomy as the preferred treatment. The benefits of nonoperative treatment of splenic injury include the following: preservation of splenic

function, avoidance of overwhelming post-splenectomy sepsis, avoiding the potential complications of post-splenectomy thrombocytosis, and avoidance of the risks associated with nontherapeutic laparotomy.<sup>1-4</sup> Selection criteria for those who would benefit most from nonoperative management and those at greatest risk for failure of either SE or observational treatment remain incompletely understood. Studies have identified that poor patient selection is associated with both failure of SE and observational management as well as higher morbidity and mortality.<sup>5-8</sup> The purpose of our study was to determine the outcomes of splenic injuries based on management strategies over an 8-year period at our Level 1 trauma center. We assessed the utilization of IS, SE, and noninterventional (NI) management; the risk factors associated with failure of SE and NI; and morbidity and mortality associated with each management strategy.

## Methods

This is a retrospective study using prospectively collected registry data from a Level 1 trauma center over an 8-year period from April 2004 to May 2012. Criteria for patient entry into the trauma registry were established in 1992 by the New York State Department of Health and its State Trauma Advisory Committee. The trauma registry dataset was cross-referenced with the institutional radiology dataset to ensure complete clinical and radiologic data. Trauma patients taken directly to the operating room for laparotomy were differentiated from those admitted to hospital ward or intensive care units. Those patients who subsequently required splenectomy were identified as failures of nonoperative management. Data abstracted from the registry included standard demographics; Injury Severity Score (ISS); mechanism of injury; injury patterns; vital signs at presentation including hypotension defined as systolic blood pressure (SBP) <90 mm Hg; transfusion requirements; complications including shock, respiratory failure, infection, and multiorgan failure; and mortality. Grade of splenic injury was classified according to the American Association for the Surgery of Trauma Organ Injury Scale.<sup>9</sup> Patients were then stratified according to management strategy: IS, SE, and NI, that is, visceral angiography alone or observation alone. The primary outcome of interest was mortality for each of the management strategies. Other variables that were considered as potential confounders of mortality included age, sex, blunt or penetrating injury, ISS, transfusion of packed cells or platelets, respiratory support (continuous invasive mechanical ventilation for 96 hours or more), laparotomy, tracheostomy, infection (pneumonia, urinary tract infection, septicemia, sepsis like syndrome, abscess, cholecystitis, wound infection, empyema, severe sepsis), organ failure (respiratory failure, arrhythmia, acute renal failure, base deficit, coagulopathy, cardiac arrest, encephalopathy, abdominal compartment,

myocardial infection, congestive heart failure, stroke or cerebrovascular accident), thromboembolism (pulmonary embolism, deep vein thrombosis of the lower extremities and central veins), post hemorrhagic anemia, respiratory failure, and shock.

## Statistical analysis

Variables were described by, and assessed for, association with the method of splenic injury management via 2-sample *t*-tests and chi-square analysis. Variables associated with splenic injury management method were then assessed for their effect on mortality via bivariate logistic regression. Purposeful backward selection was then used to create a multivariate logistic regression model to assess the independent effect of various risk factors. We also assessed and compared the risk factors for mortality within subsamples limited by the methods of splenic injury management. All tests were 2 sided and statistical significance was set at .05 levels. Statistical software STATA 11.1 was used for analysis. The study protocol was reviewed and approved by the Albany Medical Center (AMC) Committee on Research involving Human Subjects Internal Review Board.

## Results

Of the 20,561 patients admitted to the trauma center during the 8-year study period, 926 (4.5%) sustained splenic injury. The splenic injuries were managed by IS for 120 (13%) patients, by SE for 129 (14%) patients, and by NI management for 677 (77%) patients. The overall proportion of patients managed by splenectomy, whether immediate or after failure of nonoperative management, was 14.5% and the proportion of patients managed nonoperatively either by observation alone or successful embolization was 85.5%. Over the 8-year study period, we observed the following trends: an increasing proportion of nonoperative management, an initial increase in embolization followed by a gradual decline, and an overall decreasing proportion of patients managed by IS (Table 1, Fig. 1). Demographics, vital signs, injury mechanism, complication rates, and disposition of our study population based on management strategy—NI, SE, or IS—are described in Table 2. Half (50%) of the injuries were grade I or II, and about a quarter each were grade III (24.2%) and grade IV or V (25.8%), respectively. The proportion of grade IV or V injuries was significantly higher among those requiring IS (64.2%) and SE (58.6%) as compared with those managed by NI (12.8%) ( $P < .001$ ). The proportion of patients with injury because of motor vehicle accidents was slightly higher and those because of low falls were slightly lower among those requiring IS (51.3% and 1.7%, respectively) as compared with those managed by nonoperative methods (46.6% and 5.7%, respectively). The mean age of the study sample was  $36.4 \pm .7$  years and 20% of the study population

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