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## The association between angioembolization and splenic salvage for isolated splenic injuries



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### ABSTRACT

**Background:** Recent data suggest improved splenic salvage rates when angioembolization (AE) is routinely employed for high-grade splenic injuries; however, protocols and salvage rates vary among centers.

**Materials/Methods:** Adult patients with isolated splenic injuries were identified using the National Trauma Data Bank, 2013–2014. Patients were excluded if they underwent immediate splenectomy or died in the emergency department. To characterize patterns of AE, trauma centers were grouped into quartiles based on frequency of AE use. Unadjusted analyses and mixed-effects logistical regression controlling for center effects were performed.

**Results:** Five thousand and ninety three adult patients were identified. Overall, 705 (13.8%) underwent AE and 290 (5.7%) required a splenectomy. In unadjusted comparisons, splenectomy rates were lower for patients with severe spleen injuries who underwent AE (7% versus 11%,  $P = 0.02$ ). In mixed-effect logistical regression patients with severe splenic injuries undergoing AE had a lower odds ratio (OR) for splenectomy (OR = 0.67,  $P = 0.04$ ). Patients treated at centers in the highest quartile of AE use had a lower OR for splenectomy (OR = 0.58,  $P = 0.02$ ).

**Conclusions:** The use of AE in patients with isolated severe splenic injuries is associated with decreased splenectomy rates. There is an association between centers that perform AE frequently and reduced splenectomy rates.

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### Introduction

The spleen is a frequently injured organ. While the management for unstable patients with splenic injuries involves splenectomy, nonoperative management for hemodynamically

stable patients has become common. As nonoperative management has evolved, angioembolization (AE) has been introduced as an adjunct to reduce the need for splenectomy, especially in severe splenic injuries.<sup>1–6</sup> Some centers have created protocols that incorporate AE into the management of

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splenic injuries. Data from these centers suggest improved splenic salvage rates when AE is employed for all high-grade injuries.<sup>1,2</sup>

Protocols for managing splenic injuries vary among trauma centers, and reported salvage rates are not consistent.<sup>1-6</sup> A meta-analysis by Requarth *et al.*<sup>3</sup> of 24 unique data sets comprising 14.5 y of data calculated an overall failure rate of nonoperative management of 8.3%. Failure rates were observed to be higher in grade 4 and 5 splenic injuries ranging from 43.7% to 83.1%, respectively. The addition of splenic artery embolization decreased failure rates, particularly in grade 5 injuries.<sup>3</sup> Miller *et al.*<sup>1</sup> report their institution's experience after initiation of a protocol where AE was performed for all grade 3-5 splenic injuries. Nonoperative failure rates decreased from 15% to 5% compared to preprotocol outcomes. Bhullar *et al.*<sup>7</sup> similarly reported on their protocol, where AE was performed for all grade 4-5 injuries or for radiographic evidence of a contrast blush on computed tomography. They observed an overall decrease in failure rates from 4% to 1%; however, the decrease in failure rates was most prominent in grade 4-5 injuries, decreasing from 19% to 3%. These recent studies point to an overall trend in increased splenic salvage with the introduction of a protocol for AE.

Despite these promising findings, it is difficult to draw conclusions about whether these protocols should be universally applied. The protocols are highly variable, including the threshold by which AE is performed, the use of contrast blush as an indication for the procedure, and what methods of embolization should be used.<sup>3,8-11</sup> Furthermore, there is no universal definition for "failure" of nonoperative management. It is possible that use of a protocol for AE is associated with a higher threshold and increased reluctance to perform splenectomy. Finally, the long-term consequences and failure rates for AE have not been explored.

Given this variability, there remains no consensus on when to utilize AE for splenic injuries. Given the lack of consensus, our primary goal was to evaluate the use of this technique across U.S. trauma centers to study the relationship between patterns of AE use and splenectomy rates. We hypothesized that an association between splenectomy rates with the use of AE would be present. Furthermore, we aimed to explore if the association between AE and splenectomy rates would be affected by high or low utilization of AE at trauma centers.

## Patients and methods

Data for this study were abstracted from the Committee on Trauma, American College of Surgeons, National Trauma Data Bank (Chicago, IL, 2013-2014). Patients were included in the study if they had International Classification of Disease, Ninth Revision, Clinical Modification (ICD-9-CM) codes for splenic injury (865.0-865.2) and were 18 y or older. To avoid confounding by other injuries, we included only patients with isolated splenic injuries. Patients with an injury with an abbreviated injury score (AIS) of two or more in any other body system were therefore excluded. Patients were also excluded if they died in the emergency department. Because we were evaluating patients who were undergoing a nonoperative management plan on admission, patients undergoing emergent splenectomy were excluded from analysis. We further excluded patients from centers that did not perform any splenectomy or AE procedures. Because the ultimate splenectomy rate is dependent to some degree on splenectomy rates upon admission, a sensitivity analysis was performed analyzing rates of overall splenectomy and AE depending on centers' rates of immediate splenectomy. This was done by creating quartiles of centers based on the rate of patients who

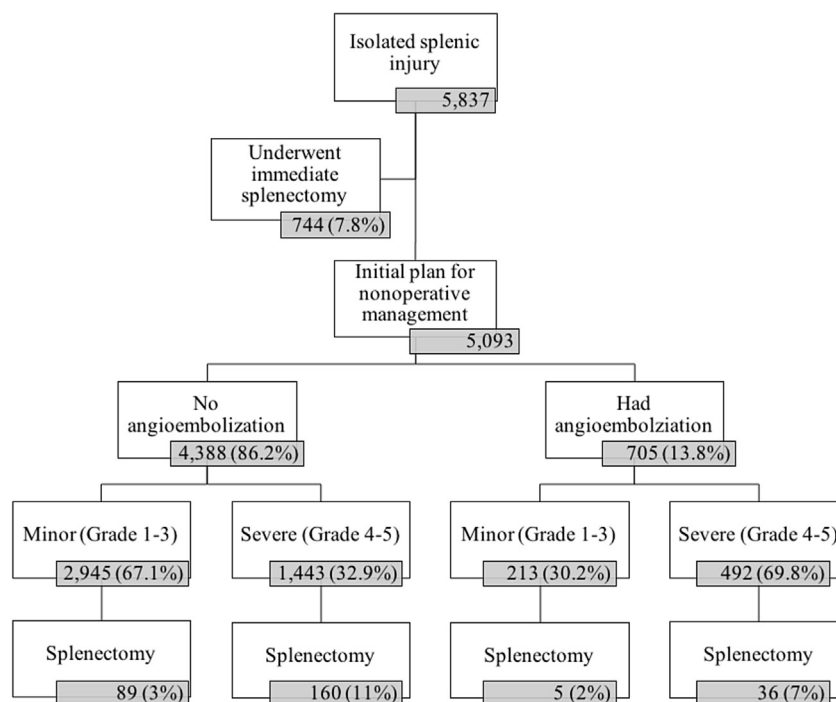


Fig. 1 – Flowchart of analytic cohorts after exclusion criteria and broken into subgroups by severity of splenic injury.

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