Management of blunt splenic injury: down the rabbit hole and into the bucket

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ABSTRACT

Management of splenic trauma has changed dramatically over the past 30 years. Many of these advances were driven by the Memphis team under the leadership of Dr. Timothy Fabian. This review article summarizes some of those changes in clinical care, especially related to nonoperative management and angioembolization.

Matching into a fellowship in Memphis, TN, had a lot of implications beyond learning to be a trauma surgeon at one of the busiest trauma centers in the country. Crossing the threshold of the Elvis Presley Trauma Center was joining a family or the Memphis Mafia depending on your preference. But as with all families, there were idiosyncrasies, rules and expectations. And one of this behavior modeled time and again was that of scientific curiosity. Memphis did not have a lot of fancy labs and expensive toys but they did have a history of research productivity. Dr Fabian, the head of the family to perpetuate the concept off him or get direction for your research trajectory.

This intellectual curiosity, along with the wealth of clinical material available at Memphis, represented a wonderful opportunity to pursue a rigorous and longitudinal approach to answer some of the most controversial issues of the day. An excellent example of this is the issue of the management of blunt splenic injury (BSI). Though we all know that the spleen loves the bucket, Dr. Fabian and his team at Memphis set out to prove if and how much love there was. During the course of 13 papers which he coauthored and 21 subsequent papers from past fellows and faculty, the Memphis group evaluated and re-evaluated the management of BSI during a 30-year period (figure 1).

Returning to this body of literature today, it is fascinating to observe what was gospel gradually morph into the practice patterns we now use. The first BSI paper in Dr. Fabian’s library was published in the Journal of the Tennessee Medical Association in 1993.1 This historic document, preserved in an actual book, saw an early foray into the nonoperative management of an injured spleen. The initial decision to observe was clearly radical and somewhat aggressive, as the authors noted at the time that only 12% to 15% of adults were candidates for nonoperative management. The threshold for failure was also different, and lower, as the patient was taken for splenectomy on hospital day #4 after his heart rate rose 10 beats per minute (from 95 to 105 bpm) and his hematocrit dropped from 39% to 31%. The authors’ conclusions were prescient however. “The data presented here support the nonoperative management of BSI in selected adult and pediatric patients. Selection criteria must be strict and the threshold for subsequent operative intervention must be low.”1

During the following 5 years, Fabian et al worked to define the strict selection criteria needed for the nonoperative approach to BSI. Increased utilization and sophistication of CT allowed identification of contrast blushes and abnormalities of the splenic vasculature, such as pseudoaneurysms. These findings served as clinical predictors of increased failure rates.2–4 Bee et al further defined clinical factors which were associated with increased nonoperative failure including low Glasgow Coma Score, hypotension, large hemoperitoneum and older age.1 Importantly, during this same period, the use of angioembolization to manage some of these concerning characteristics allowed trauma surgeons to attempt splenic salvage in even more patients.

True to Fabian’s leadership and approach, it was down the rabbit hole to try and understand every aspect of BSI and management options (table 1). Santaniello et al, Miller et al and Malhotra et al looked at how BSI was managed in the setting of other major injuries.6–8 Weinberg et al evaluated imaging to understand the incidence and management of pseudoaneurysm in BSI.9 Savage et al and Zarzaur et al followed BSI longitudinally to determine the time to healing and the incidence of late rupture.10,11 These inquiries led to multicenter studies sponsored12 by the American Association for

![Figure 1](image-url)  
**Figure 1** Network analysis of the impact of Dr Timothy Fabian’s blunt spleen injury research.
the Surgery of Trauma, Western Trauma Association and others to further refine our management strategies.13–34

The management of BSI remains surprisingly controversial to this day. Though most would agree that nonoperative management is the gold standard in hemodynamically stable patients, that is about all that we agree on. Centers vary significantly in timing and frequency of angiembolization and the threshold for splenectomy versus continued observation in the face of physiologic changes. Despite such variations, Fabian’s contribution has been fundamental. To return to the conclusion from his 1993 paper, “Selection criteria must be strict and the threshold for subsequent intervention must be low.”

At the core, Dr Fabian’s contribution to splenic science has been to define the natural history of the bluntly injured spleen when left in situ. The fundamental aspect of this was identification of the incidence of pseudoaneurysm and the description of how this vascular abnormality contributes to delayed failure. Much of his subsequent oeuvre then expanded on this core concept including patient, global injury characteristics and the evolution of the spleen in the wild, that is, time to healing or rupture after discharge. With his quintessential ‘he he he,’ bow tie and soft-spoken presence, Dr Fabian has influenced a generation of us to truly learn about the spleen and remains a much-loved mentor.

It is a relative triumph that nonoperative management has such a high success rate. In part, this is due to a refinement of our management strategies during the last three decades but is also in large part due to improved patient selection (a selection bias perhaps). Fabian’s “strict criteria” are the heart of successful management of BSI because, fundamentally, the spleen does love the bucket. Our job as trauma surgeons is to ensure the right ones get there.

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Table 1 Longitudinal study of blunt spleen injury by Fabian et al

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<thead>
<tr>
<th>Authors</th>
<th>Study</th>
<th>Findings</th>
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<tr>
<td>Charash et al</td>
<td>Case report of early nonoperative management of BSI</td>
<td>Nonoperative management reasonable with strict patient criteria</td>
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<td>Schurr et al</td>
<td>309 total patients</td>
<td>Contrast blush on CT highly predictive of failure of observation for BSI</td>
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<td></td>
<td>▶ 69% managed nonoperatively</td>
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<td></td>
<td>▶ Initial CT to determine management</td>
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<tr>
<td>Gavant et al</td>
<td>263 patients with BSI</td>
<td>Vascular abnormalities in BSI aka pseudoaneurysms, highly associated with failure of nonop management</td>
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<td></td>
<td>▶ 40% treated nonop</td>
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<td></td>
<td>▶ 85% of nonop treatment successful</td>
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<tr>
<td>Davis et al</td>
<td>524 patients, 66% managed initially without operation</td>
<td>Embolization is successful in salvaging blunt spleen injuries in the setting of contrast blush or pseudoaneurysm</td>
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<td></td>
<td>▶ CT imaging to evaluate for pseudoaneurysm or blush</td>
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<tr>
<td>Bee et al</td>
<td>558 patients with BSI</td>
<td>More severe splenic injuries may be managed nonoperatively with ever-improving success rates</td>
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<td>▶ 77% initially observed</td>
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<td></td>
<td>▶ Age and higher grade of injury associated with higher failure</td>
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<td>Santaniello et al</td>
<td>84 patients with blunt aortic injuries, 33% with associated intra-abdominal organ injury</td>
<td>It is safe to anticoagulated low-grade spleen or liver injuries in the setting of aortic repair</td>
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<td>Miller et al</td>
<td>803 patients with blunt spleen, liver or both spleen and liver injuries</td>
<td>Incidence of missed injury is very low (though greater with blunt liver over blunt spleen injury)</td>
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<td></td>
<td>▶ Assessed for missed injury in the setting of nonoperative management</td>
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<td>Malhotra et al</td>
<td>1288 patients with blunt spleen, blunt liver or both injured</td>
<td>Patients with injury to both liver and spleen have higher ISS, greater mortality and higher rates of nonoperative failure</td>
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<td>Weinberg et al</td>
<td>426 patients with nonoperative management of BSI were managed with serial imaging</td>
<td>Improved late detection and embolization of pseudoaneurysm, further improving success of nonoperative management</td>
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<td>Savage et al</td>
<td>637 patients with BSI managed nonoperatively with serial imaging to determine healing rates</td>
<td>Most injuries heal by 2 months but 10% worsen. Recommend ongoing follow-up to 3 months</td>
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<td>Zarzaur et al</td>
<td>4103 patients with BSI assessed for readmission or late mortality</td>
<td>Most late splenectomies occur within 8 days but 1.4% of patients readmitted with spleen-related complications</td>
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<tr>
<td>Zarzaur et al</td>
<td>Survey of practice patterns for management of BSI among AAST members</td>
<td>Considerable variation exists in regard to management of BSI, especially with higher grade injuries</td>
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<tr>
<td>Zarzaur et al</td>
<td>11 793 patients from the NTDB identified to determine factors related to urgent splenectomy</td>
<td>Specific patient factors related to need for urgent splenectomy. Important hospital factors include region, hospital type and trauma center status</td>
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AAST, American Association for the Surgery of Trauma; BSI, blunt splenic injury; ISS, Injury Severity Score; NTDB, National Trauma Data Bank.
REFERENCES