Splenic Artery Embolisation in Blunt Splenic Trauma: A Review of Evidence and Experience at a High-Volume Australian Level 1 Trauma Centre

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1. Learning Objectives

- To recognise the imaging findings and grading systems for splenic trauma.
- To review current literature surrounding the efficacy and practice of splenic artery embolisation (SAE) for splenic trauma.

2. Background

Splenic salvage is now the goal of blunt splenic injury management.

- The spleen is the most commonly injured solid organ in blunt abdominal trauma (20-35% of cases).[1]
- Splenic injury carries important haematological and immunological implications.
- Non-operative management has become the standard of care for haemodynamically stable patients.
- SAE aims to reduce splenic perfusion pressure to promote physiological haemostasis, while preserving splenic function.
- SAE mitigates splenectomy-associated risks, is more cost-effective and is associated with a shorter length of stay.[2,3]

3. Imaging Findings & Grading System

Multi-phase contrast-enhanced CT is the modality of choice for grading splenic injury and selecting patients for SAE.

- Arterial phase for vascular injuries, including pseudoaneurysm, arteriovenous fistula, and active extravasation.
- Portal venous phase for parenchymal defects.
- Arterial and portal venous phases can be combined in a “dual bolus”.

AAST-OIS is the most widely accepted grading system. Any splenic vascular injury makes the injury high grade.

- The revised 2018 American Association for the Surgery of Trauma Organ Injury Scale (AAST-OIS) incorporates vascular injuries into the grading system (Figure 1).[4]
- AAST-OIS 2018 upgraded high-grade (IV-V) injuries from 54% to 82% (SPLEEN-IN) based on presence of vascular injuries.[5]
- Yet, CT under-calls vascular injury (59% on CT vs 79% on angiography). 44% of AAST III with ≥3 quadrant haemoperitoneum had occult vascular injury on angiography, not demonstrated on CT.[5]

Figure 1. AAST-OIS 2018 Grading System for Splenic Trauma.[4]

Grade I

- Subcapsular haematoma <10% surface area.
- Parenchymal laceration <1 cm depth.
- Capsular tear.



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Grade II

- Subcapsular haematoma 10-50% surface area.
- Intraparenchymal haematoma <5 cm.
- Laceration 1-3 cm depth.



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Grade III

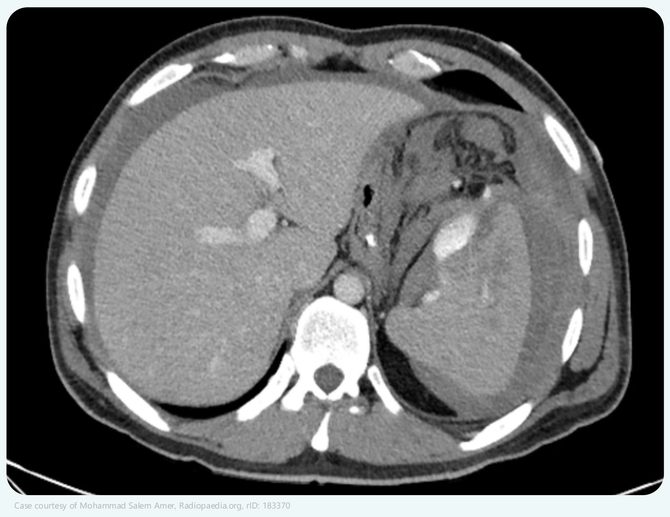
- Subcapsular haematoma >50% surface area or ruptured.
- Intraparenchymal haematoma ≥5 cm.
- Laceration >3 cm depth.



Case courtesy of Craig Hacking, Radiopaedia.org, rID: 86055

Grade V

- Any injury in the presence of splenic vascular injury with active bleeding extending beyond the spleen into the peritoneum.
- Shattered spleen.



Case courtesy of Mohammad Salem Amer, Radiopaedia.org, rID: 183370

Grade IV

- Any injury in the presence of a splenic vascular injury or active bleeding confined within the splenic capsule.
- Parenchymal laceration involving segmental or hilar vessels with >25% devascularisation.



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Additional Criteria

- Vascular injury (pseudoaneurysm or AV fistula) = a focal collection of vascular contrast that decreases in attenuation with delayed phases.
- Active bleeding = focal or diffuse collection of vascular contrast that increases in size or attenuation in delayed phases.
- More than one grade of splenic injury may be present and should be classified by the higher grade of injury.
- Advance one grade for multiple injuries, up to grade III.

4. Current Evidence and Practice

Indications

SAE is established for stable patients with high-grade injury. Whether to embolise prophylactically (pSAE) or withhold for re-bleeding remains debated.

- Splenic salvage rate at 1 month was not statistically different between pSAE and surveillance. In view of the high proportion of surveillance patients needing subsequent SAE, both strategies appear defensible (SPLASH-RCT).[6]

Our Multidisciplinary Approach

Angiography and SAE are considered if the patient has no other indications requiring urgent laparotomy (e.g., bowel injury, peritonism) and is sufficiently stable or resuscitated, with the following:

- **AAST IV-V injury** regardless of haemoperitoneum
- **AAST III injury with haemoperitoneum in ≥3 quadrants**

A joint decision-making protocol between Trauma, Interventional Radiology and General Surgery consultants is outlined in Figure 2.

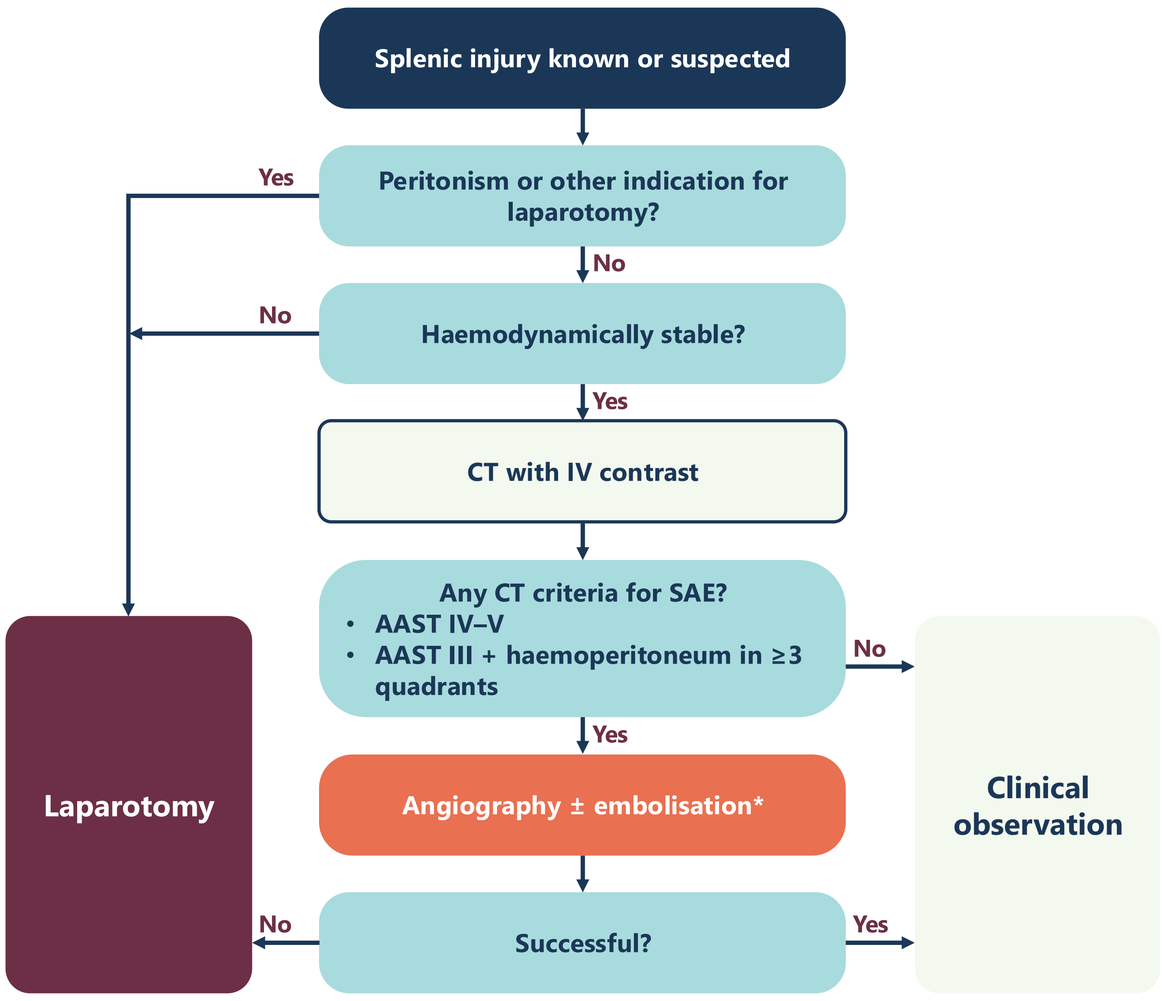
SAE for haemodynamically unstable patients

- SAE achieved a 98% splenic salvage rate in haemodynamically unstable patients (shock index ≥1 or SBP <90 mmHg).[7]
- 30-day all-cause mortality was 4%, not significantly different from upfront splenectomy.[7]

Clinical Outcomes

At our centre, 85% of splenic injuries are managed non-operatively, 38% of these with SAE.

- SAE is highly effective, with 100% technical success and 97% splenic salvage in our experience.[5]
- 3% required splenectomy post-SAE overall, representing 8.5% of grade V and 1.3% of Grade ≤IV.[5] Outcomes were not inferior to those who received upfront splenectomy.
- Preserved immune function indicated by interval increase in IgM memory B cells between median 6.5 months and 8.5 years post-SAE.[8]



**Joint decision by the trauma consultant, interventional radiologist and general surgeon.*

Figure 2. Alfred Hospital splenic embolisation protocol.

5. Procedural Technique

Proximal vs Distal vs Tandem Approach (Table 1)

- At our centre, 76% of SAEs were proximal.
- Location did not affect rates of complication or post-SAE splenectomy.
- Outcomes were equivalent for focal distal injuries.[9]

Suggested Procedural Steps

1. Common femoral artery access.
2. Coeliac artery angiogram.
3. Selective splenic DSA to assess active bleeding/vascular injury + choose approach.
4. Embolisation, typically with coils or plugs
5. Completion run(s).

6. Post-Procedural Considerations

Complications

- General angiography complications (access site complications, dissection, embolus, contrast nephropathy).
- Post-embolisation syndrome – self-limiting inflammatory response to ischaemia, causing fever, pain and nausea.
- Splenic infarction – common, mostly asymptomatic, a consequence of reduced arterial flow.
- Rebleeding – consider splenectomy.
- Splenic abscess – uncommon, greater risk in immunocompromised.

Post-procedural management is summarised in Table 2.

Table 1. SAE Approaches

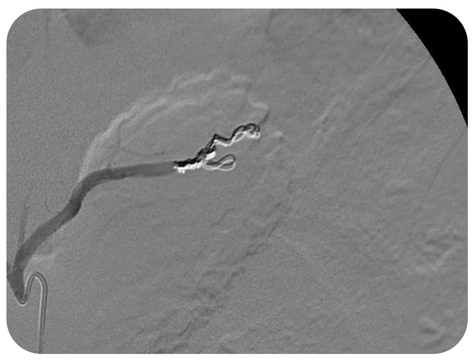
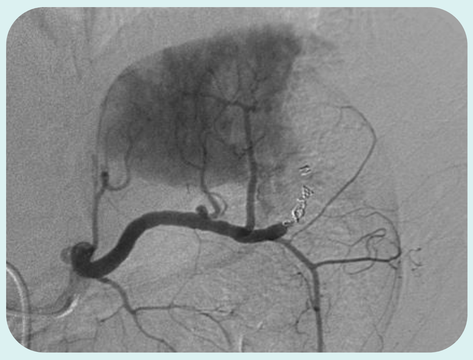
Approach	Target	Notes	Imaging
Proximal	Main splenic artery, ideally between dorsal and great pancreatic arteries	High-grade or multifocal injury. • Quick • Collateral supply via short gastric and gastroepiploic arteries • Higher risk of pancreatitis • Perfusion pressure normalises within 2-4 weeks	 Used with permission from Prof G.S. Goh
Distal	Selected branch(es) beyond the hilum	Targets focal vascular lesion. • More time-consuming • Causes segmental ischaemia	 Used with permission from Prof G.S. Goh
Tandem	Distal, then proximal	High-grade injury + focal vascular injury	 Case courtesy of RMH Core Conditions, Radiopaedia.org, rID: 28448

Table 2. Summary of general post-SAE considerations.

When	Action
Day 0	HDU; repeat contrast CT if worsening pain, falling Hb or ongoing transfusion requirement
Day 2–5 or on discharge	Vaccinate for *Pneumococcus, Meningococcus, Haemophilus influenzae b, Influenza*
>2 weeks (clinic ~6 weeks)	Blood film for Howell–Jolly bodies
>6 months	IgM memory B cell assay if splenic function uncertain

7. Conclusion

SAE is a safe and effective spleen-preserving alternative to splenectomy in high-grade blunt splenic trauma. Accurate AAST-OIS 2018 CT grading, with a low threshold for multidisciplinary input and angiography, facilitates candidate selection for SAE.

References

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