Splenic Artery Embolization - Indications, Anatomy, Tips and Tricks, Embolization Material, and Complications

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INDICATIONS

Splenic arterial embolization (SAE) is a procedure that has classically been used in the setting of stable post-traumatic splenic laceration hemorrhage. However, given the rise of more advanced techniques in arterial intervention, the procedure has emerged as a valuable tool in many other disease etiologies. The overall indications for SAE can be divided into two overarching categories: traumatic and nontraumatic [1,3]. Table 1 summarizes the further breakdown of these categories (it should be noted this list is not exhaustive but covers the most common indications).

Traumatic	Nontraumatic
Unstable blunt splenic trauma is NOT an indication but included for completeness. This is treated surgically [1,3].	Hypersplenism resulting in thrombocytopenia [1]
Stable blunt splenic trauma causing active bleeding, AV fistula, or pseudoaneurysm [1] – AAST III or higher [3].	Thalassemia [3]
Splenic artery aneurysm	Idiopathic hypersplenism [1]
	Portal hypertension [1,3]

Table 1 Categorical breakdown of SAE indications.

American Association for the Surgery of Trauma Organ Injury: Scale for the Spleen

Grade	Description of Findings
I	Subcapsular hematoma, < 10% surface area; capsular laceration, < 1 cm parenchymal depth
II	Subcapsular hematoma, 10%–50% surface area; intraparenchymal hematoma, < 5 cm diameter; laceration with 1–3 cm parenchymal depth, not involving a trabecular vessel
III	Subcapsular hematoma, > 50% surface area or expanding; ruptured subcapsular or parenchymal hematoma; intraparenchymal hematoma > 5 cm; laceration with > 3 cm parenchymal depth or involving trabecular vessels
IV	Laceration of segmental or hilar vessels that produces major devascularization (> 25% of spleen)
V	Completely shattered spleen; vascular hilar injury with devascularized spleen

Fig 1 Adapted from reference [3], originally [5].

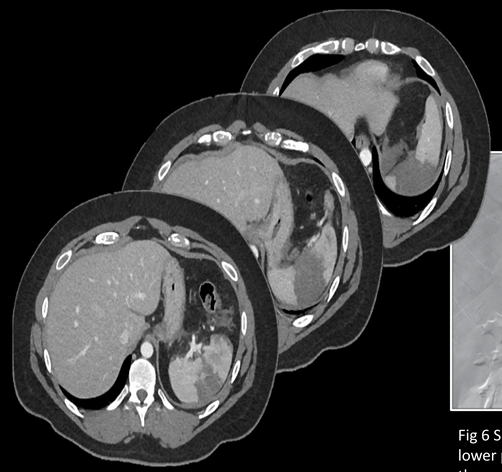

Figure 7 AAST Grade III Splenic Injury [8]

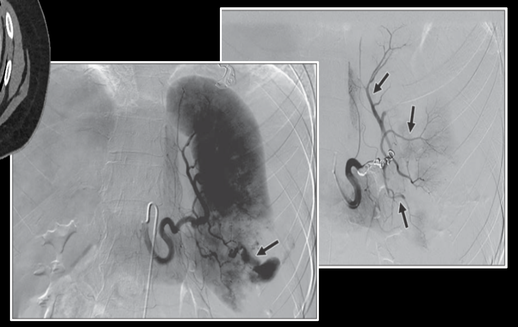

Fig 6 Splenic arteriogram demonstrating active hemorrhage in the lower pole of the spleen. After coiling of the splenic artery, distal to the pancreatic branches, there is decreased flow into the spleen with no active extravasation present. Originally by Madoff et al. [1]

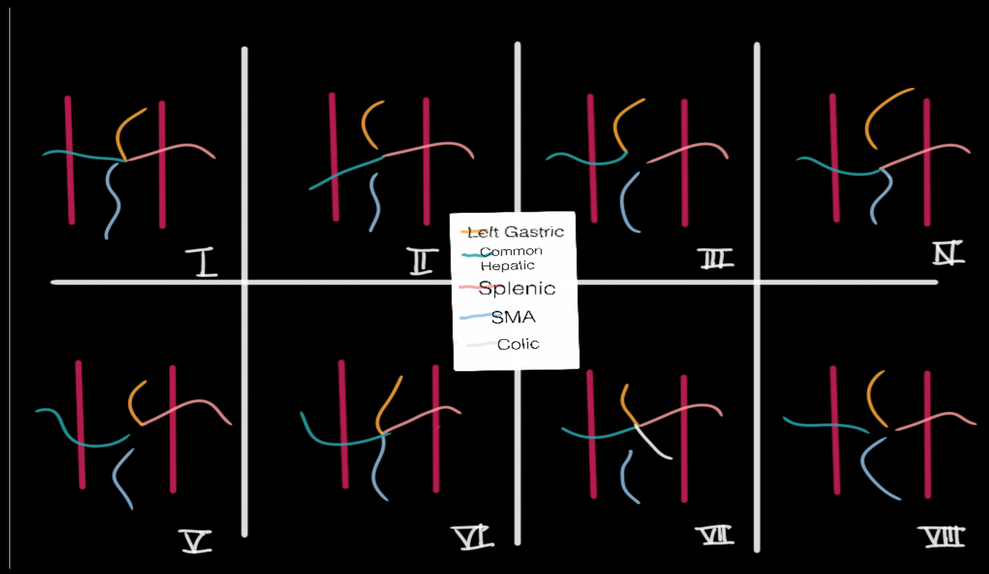

Fig 4 Variation of celiac trunk and origin of the splenic artery according to the Uflacker's classification. Adapted from Yash et al. [7]

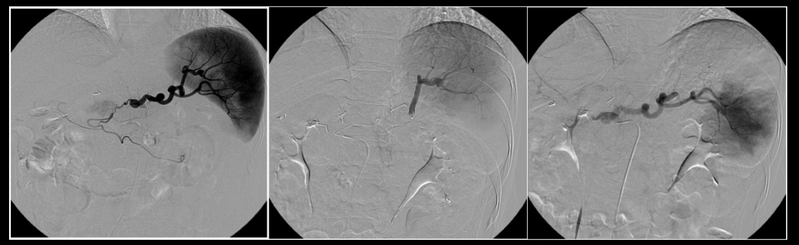

Fig 5 Splenic arteriogram demonstrating normal parenchymal blush, followed by upper pole embolization, followed by normal lower pole blush in the absence of upper pole flow. Originally by Ahuja et al. [3]

Materials Used
Gelatin sponge pledgets
Polyvinyl alcohol particles (PVA)
Coils

Table 2 Most commonly used embolic materials.

Origin	Course	Terminus	
Celiac axis (90.6%)	Suprapancreatic (74.1%)	Divided prior to hilum (97%)	Two (63.1%)
Aorta (8.1%)	Enteropancreatic (18.5%)		Four (18.8%)
Other (1.3%)	Intrapancreatic (4.6%)		Six (9.7%)
	Retropancreatic (2.8%)		Greater than six (5.6%)
		Passed through hilum without division (3%)	

Table 3 Origin, course, and terminus of the splenic artery variants and their incidences examined from cadavers. Adapted from Pandey et al. [2]

TECHNIQUE

All technique begins with ultrasound-guided access to the femoral artery, and selection of the celiac trunk with a curved catheter (4-5 French) [1] – such as Cobra C2 or RC2 (Cook Medical). Alternatively, a reversed-curve catheter may also be used – such as Simmons 1 or VS1 (Cook Medical) [1]. Angiogram of the celiac trunk helps determine the origin of the splenic artery and demonstrates the surrounding collateral vasculature. These collaterals include the left gastric artery, gastroepiploic arteries, and pancreatic artery branches [1-5].

Blunt splenic trauma

- Microcoils [1], gelatin, or particles (300-500 µm) [3] placed as distally as possible in the region of active vascular damage using a micro-selective catheter
- Try to spare as much of the normal spleen as possible
- in case of re-rupture, place more proximally – just distal to the pancreatic branches [1] – to decrease overall pressure in splenic vasculature

Hypersplenism (and other similar pathologies related to increased destruction of red blood cells)

- Partial embolization is preferred in order to preserve the spleens normal function, typically 60-70% of total visceral mass [1]
  - Selective vs nonselective method
    - Selective method requires more distal branch catheterization with embolization performed, using 300-500 µm or 500-700 µm particles [3], until the desired splenic volume persists on parenchymal angiogram
    - Nonselective method uses a more proximal method with random injection of embolic particles (polyvinyl alcohol particles [1]) until the desired splenic volume persists on parenchyma angiogram
- Typically proximal embolization will not be successful due to the collateral vessels that will remain intact
- Used more commonly in patients preparing for surgical splenectomy

Portal hypertension

- Reduction of spleen volume results in less venous drainage into the portal vein, leading to decreased portal pressures, and theoretically alleviating symptoms
- Classically treated with partial embolization, although data is limited

Splenic artery aneurysm

- Relatively common, prevalence of 0.8% [1]
- Indications: epigastric pain, back pain, female sex, portal hypertension, planned liver transplantation, aneurysm diameter > 2.5 cm
- Embolize via "Sandwich method" – coils placed proximal and distal to segment containing aneurysm, in addition to coils within the aneurysm [1,3]
- Direct percutaneous thrombin injection is a less common option but has proved successful

COMPLICATIONS

- Persistent hemorrhage
- Infarction
- Splenic abscess
- Splenic rupture
- Sepsis
- Splenic vein thrombosis
- Unremitting bronchopneumonia [1,3]

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