

Surgical management of complex splenic artery pseudoaneurysm

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Abstract

Background: Splenic artery pseudoaneurysm (SAP) is a rare but potentially fatal complication of acute pancreatitis due to the risk of rupture and massive haemorrhage. Although endovascular embolization is the preferred first-line treatment, surgery remains necessary in complex situations.

Methods: We retrospectively reviewed patients with pancreatitis-associated visceral artery pseudoaneurysms managed at our institution between October 2023 and October 2025.

Results: Fourteen patients were identified, including 13 SAP and one gastroduodenal artery pseudoaneurysm. Seven SAP cases were treated successfully with endovascular embolization. Six patients required surgery because of proximal arterial disruption, multiple pseudoaneurysms, rupture, or associated gastric perforation. All were male with alcohol-related pancreatitis (age 24–52 years). Contrast-enhanced computed tomography established the diagnosis in all cases. Distal pancreatectomy with splenectomy was performed in all patients, with additional vascular procedures as required. Two patients developed postoperative pancreatic fistula managed conservatively. No mortality or rebleeding occurred.

Conclusion: Endovascular embolization remains the treatment of choice for SAP; however, surgery provides definitive management in complex cases where embolization is not feasible or fails.

Keywords: Splenic artery pseudoaneurysm, Acute pancreatitis, Visceral artery pseudoaneurysm, Endovascular embolization, Distal pancreatectomy, Splenectomy, Gastrointestinal haemorrhage.

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Introduction

Splenic artery pseudoaneurysm (SAP) is an uncommon but serious complication of acute pancreatitis. It occurs due to enzymatic digestion of the arterial wall by pancreatic enzymes, resulting in arterial wall disruption and formation of a pseudoaneurysm contained by surrounding tissues. Unlike true aneurysms, pseudoaneurysms lack all layers of the arterial wall and therefore have a significantly higher risk of rupture. Pancreatitis accounts for nearly 50% of splenic artery pseudoaneurysms, with trauma and iatrogenic injury representing other causes. Rupture of SAP can lead to catastrophic haemorrhage with mortality rates reported as high as 90% if untreated.

Historically, open surgical treatment was the primary management strategy. However, advances in interventional radiology have led to endovascular embolization becoming the preferred initial treatment due to its minimally invasive nature and high success rates. Despite these advances, surgical intervention remains necessary in certain situations such as hemodynamic instability, complex arterial disruption, failure of embolization, or associated complications including bowel perforation or infected pancreatic necrosis.

This study reviews our institutional experience with the surgical management of complex splenic artery pseudoaneurysms associated with acute pancreatitis.

Materials and Methods

Study Design

A retrospective review was conducted of patients presenting with acute pancreatitis complicated by visceral artery pseudoaneurysm between October 2023 and October 2025 at a tertiary care centre.

Clinical data including demographic details, clinical presentation, imaging findings, treatment modality, operative details, and postoperative outcomes were collected from hospital records.

Diagnostic Evaluation

All patients underwent contrast-enhanced computed tomography (CECT) of the abdomen for diagnosis and assessment of vascular anatomy. Upper gastrointestinal endoscopy was performed in patients presenting with gastrointestinal bleeding.

Ethics approval: The study protocol was reviewed and approved by the institutional ethics committee. **Consent:** For all patients, informed consent for emergency surgical was obtained from the patient or next of kin at the time of admission. For retrospective data use, patient identifiers were removed and confidentiality maintained.

Patient selection and definitions

Inclusion criteria

- Adults (≥ 18 years) referred with acute pancreatitis and imaging evidence of a visceral arterial pseudoaneurysm.

- Pseudoaneurysm confirmed on contrast enhanced computed tomography (CECT)
- Patients who underwent either endovascular embolization or open surgical management during the study period.

Exclusion criteria

- Patients with true (degenerative) splenic artery aneurysms without features of pseudoaneurysm.
- Patients with incomplete records or missing imaging that precluded confirmation of diagnosis.
- Patients managed conservatively without intervention.

Definitions used

- Ruptured pseudoaneurysm: evidence of active contrast extravasation on imaging, intraoperative bleeding attributable to the pseudoaneurysm, or clinical signs of ongoing hemorrhage (hemodynamic instability with falling hemoglobin).
- Pancreatic leak: drainage of amylase-rich fluid from surgical drains consistent with International Study Group on Pancreatic Fistula criteria.
- Proximal lesion: pseudoaneurysm located in the proximal third of the splenic artery (near celiac trunk).
- Distal lesion: pseudoaneurysm located in the distal third of the splenic artery (near splenic hilum or pancreatic tail).

Data collection and variables

A prospectively maintained departmental database and individual patient records were reviewed. The following data were extracted:

- Demographics: age, sex, comorbidities, alcohol history.
- Clinical presentation: symptoms, hemodynamic status on arrival, transfusion prior to referral.
- Laboratory values: haemoglobin, platelet count, coagulation profile, serum amylase/lipase.
- Imaging: CECT findings (location and size of pseudoaneurysm, active extravasation, pancreatic necrosis, collections), DSA findings when available.
- Interventions: indication for intervention, endovascular technique if used, surgical procedure performed, intraoperative findings.
- Perioperative care: ICU admission, blood products transfused, antibiotics, use of somatostatin analogues.
- Outcomes: intraoperative blood loss, operative time, postoperative complications (pancreatic leak, wound infection, rebleeding), length of ICU stay, length of hospital stay, 30-day mortality, follow-up status.

Data were entered into a secure spreadsheet and cross-checked against source records for accuracy.

Imaging protocol and interventional radiology approach

CECT protocol: All patients underwent multiphase CECT abdomen with arterial and portal venous phases to identify pseudoaneurysm, active bleeding, and associated pancreatic pathology. Imaging reports were reviewed by a radiologist experienced in abdominal vascular imaging.

Angiography and embolization criteria: Patients considered for endovascular therapy underwent DSA to assess celiac axis and splenic artery anatomy. Endovascular embolization was attempted when vascular access and anatomy were favorable, and when the lesion

could be selectively catheterized. Embolization materials and techniques (coils, glue, or combination) were selected by the interventional radiology team based on lesion morphology. Patients with severe celiac stenosis, inaccessible arterial segments, multiple discontinuities, or ongoing peritonitis were triaged for surgery.

Surgical indications and operative technique**Indications for surgery in this series**

- Failed or infeasible endovascular access due to vascular anatomy (e.g., celiac stenosis).
- Active rupture with peritonitis or visceral perforation requiring laparotomy.
- Multiple level arterial discontinuity or proximal arterial disruption not amenable to embolization.
- Concomitant pancreatic necrosis or infected collections requiring debridement.

Standard operative approach

- Anaesthesia and positioning: General anaesthesia with endotracheal intubation; supine position with slight left flank elevation as needed.
- Access: Midline laparotomy to allow rapid control of haemorrhage and exploration.
- Haemorrhage control: Early proximal vascular control achieved by exposing the celiac trunk and controlling the splenic artery at its origin when proximal rupture was suspected. Temporary vascular clamps or vessel loops were used as required.
- Definitive procedure: In all six surgical patients in this series, caudal (distal) pancreatectomy with splenectomy was performed to remove the diseased pancreatic tail and control distal arterial bleeding. For proximal ruptures, proximal splenic artery ligation just distal to the celiac trunk was performed. Aneurysmorrhaphy was performed in one patient where the lesion morphology and tissue quality permitted repair. Primary repair of gastric perforation was performed when present, with peritoneal lavage and drain placement.
- Drainage and haemostasis: Closed suction drains were placed near the pancreatic remnant and in the lesser sac. Meticulous haemostasis was ensured before closure.

Perioperative management and postoperative care

- Resuscitation: All patients received aggressive resuscitation with crystalloids and blood products as needed; central venous access was established for monitoring and transfusion.
- Antibiotics: Broad-spectrum antibiotics were started on admission and adjusted according to cultures.
- Pancreatic leak management: Routine drain monitoring; conservative management with nil per os, enteral nutrition as tolerated, and somatostatin analogues when clinically indicated.
- Vaccination and splenectomy care: Patients undergoing splenectomy were counselled regarding infection risk and scheduled for appropriate vaccinations per institutional protocol during follow up.

Follow up imaging: Repeat CECT or ultrasound was performed when clinically indicated to assess for residual collections, rebleeding, or splenic bed complications.

Outcome measures and statistical analysis

Surgical management of complex splenic artery pseudoaneurysm

Primary outcome: procedural success defined as control of haemorrhage without need for immediate reintervention and 30-day survival.

Secondary outcomes: postoperative complications

TABLE 1- Patient Distribution

Parameter	Number
Total pseudoaneurysm patients	14
Splenic artery pseudoaneurysm	13
Gastroduodenal artery pseudoaneurysm	1
Managed with embolization	7
Managed with surgery	7

One patient with gastroduodenal artery pseudoaneurysm underwent surgery due to celiac artery stenosis preventing catheter access.

Among splenic artery pseudoaneurysms, six patients required surgery due to complex vascular anatomy or associated complications.

RESULTS

A total of 14 patients with pancreatitis-related pseudoaneurysms were identified, including 13 splenic artery pseudoaneurysms and one gastroduodenal artery pseudoaneurysm (Table 1). Seven patients were managed with endovascular embolization, while seven required surgical intervention. The patient with gastroduodenal artery pseudoaneurysm underwent surgery due to celiac artery stenosis preventing catheter access. Among splenic artery pseudoaneurysms, six patients required surgery due to complex vascular anatomy or associated complications.

The surgically managed group comprised six male patients aged 24–52 years, all with alcohol-related pancreatitis (Table 2). Abdominal pain and anaemia were present in all patients, with two presenting with hematemesis. All patients had received prior blood transfusion, and contrast-enhanced CT confirmed the diagnosis. Two patients had associated gastric perforation.

Radiological findings included proximal splenic artery rupture with discontinuity (n=2), multiple pseudoaneurysms (n=2), and distal pseudoaneurysm rupture (n=2), with two cases associated with gastric perforation (Table 3).

All patients underwent distal pancreatectomy with splenectomy, with additional procedures including proximal splenic artery ligation (n=3), aneurysmorrhaphy (n=1), and primary repair of gastric perforation (n=2) (Table 4).

Postoperatively, two patients developed pancreatic fistula managed conservatively. There was no rebleeding or mortality, and all patients remained asymptomatic during follow-up (Table 5).

TABLE 2- Patient Characteristics

Variable	Findings
Number of patients	6
Gender	All male
Age range	24–52 years

(pancreatic leak, wound infection), length of ICU and hospital stay, transfusion requirements, and need for reintervention.

Variable	Findings
Aetiology of pancreatitis	Alcohol-related
Presenting symptoms	Abdominal pain (6), anaemia (6), hematemesis (2)
Prior blood transfusion	6
Imaging modality	CECT abdomen

Two patients with hematemesis were found to have gastric perforation associated with ruptured pseudoaneurysm.

TABLE 3- Radiological Findings

Finding	Number of Patients
Proximal splenic artery rupture with discontinuity	2
Multiple splenic artery pseudoaneurysms	2
Distal pseudoaneurysm rupture	2
Associated gastric perforation	2

Table 4- Surgical Management

All six patients underwent distal pancreatectomy with splenectomy.

Additional procedures included:

Surgical Procedure	Number
Distal pancreatectomy with splenectomy	6
Proximal splenic artery ligation	3
Aneurysmorrhaphy	1
Primary repair of gastric perforation	2

Table 5- Postoperative Outcomes

Outcome	Findings
Pancreatic fistula	2
Rebleeding	0

Both pancreatic fistulas were managed conservatively. All patients remained asymptomatic during follow-up.

Operative Details

All patients were operated under general anaesthesia through an upper midline laparotomy. On entry into the peritoneal cavity, hemoperitoneum and inflammatory changes around the pancreas were frequently encountered. The lesser sac was accessed by dividing the gastrocolic ligament to expose the pancreas.

Dense inflammatory adhesions were carefully dissected to identify the pancreas and splenic vessels. The splenic artery was traced proximally toward its origin from the celiac trunk to achieve early vascular control. In

patients with proximal arterial rupture, the splenic artery was ligated near its origin to control bleeding. Distal pancreatectomy with splenectomy was performed in all cases because the pseudoaneurysms were associated with disease involving the pancreatic body and tail. The pancreas was mobilized from the retroperitoneum, and the distal pancreas was transected using stapled or hand-sewn techniques depending on intraoperative conditions. The splenic vein and remaining arterial branches were ligated and divided. In one patient with a proximal pseudoaneurysm, aneurysmorrhaphy was performed after obtaining proximal and distal vascular control. Two patients had associated gastric perforation, which was repaired primarily in two layers after thorough peritoneal lavage.

Haemostasis was ensured, and closed-suction drains were placed in the pancreatic bed. The abdomen was closed in standard fashion. All patients were monitored postoperatively in the intensive care unit.

Operative challenges

Surgery was technically demanding due to dense inflammation and distorted anatomy related to pancreatitis. Early proximal control of the splenic artery was critical to prevent uncontrolled bleeding during dissection.

Splenic artery pseudoaneurysm (SAP) is an uncommon but potentially catastrophic vascular complication of pancreatitis. The pathogenesis involves enzymatic digestion of the arterial wall by activated pancreatic enzymes, resulting in disruption of the vessel wall and formation of a contained pseudoaneurysm. Compared with true aneurysms, pseudoaneurysms lack the normal arterial wall layers and therefore carry a significantly higher risk of rupture.

Among visceral artery pseudoaneurysms associated with pancreatitis, the splenic artery is the most frequently involved vessel due to its close anatomical relationship with the pancreas, particularly the body and tail. Reported incidence in pancreatitis ranges from 4% to 10%, although many cases remain undiagnosed until rupture occurs. Clinical presentation is often nonspecific and may include abdominal pain, gastrointestinal bleeding, or sudden hemodynamic deterioration.

In recent decades, endovascular techniques have transformed the management of SAP. Multiple studies have reported technical success rates exceeding 80–90% with coil embolization or other embolic agents. These techniques allow rapid control of bleeding while avoiding the morbidity associated with open surgery. As a result, most centres now consider endovascular embolization as the first-line therapy in hemodynamically stable patients.

Despite these advances, several factors may limit the applicability of endovascular management. These include complex vascular anatomy, proximal arterial disruption, multiple pseudoaneurysms, or inability to achieve catheter access. In addition, SAP may coexist with complications of pancreatitis such as infected necrosis, pseudocyst formation, or gastrointestinal perforation, situations in which surgical intervention becomes unavoidable.

In the present series, six patients required operative management despite the availability of endovascular

Figure 1 – Exposure of splenic artery pseudoaneurysm

Intraoperative exposure of the splenic artery pseudoaneurysm after entering the lesser sac and dissecting inflammatory adhesions around the pancreatic body and tail. Pseudoaneurysm cavity with surrounding necrotic pancreatic tissue and thrombus visible during dissection.

Figure 2 – Distal pancreatectomy with splenectomy
Operative field demonstrating inflamed pancreas and splenic hilum during distal pancreatectomy. Resection of the distal pancreas with splenectomy after vascular control of the splenic artery.

Figure 3. Operative field after vascular control
Close intraoperative view showing the pseudoaneurysm sac containing organized thrombus within inflamed pancreatic tissue.

Figure 4. Operative field of aneurysm cavity

Figure 5. CT cuts of arterial phase of aneurysm and pseudocyst sac

Discussion

treatment. The primary indications for surgery included proximal splenic artery rupture with discontinuity, multiple pseudoaneurysms involving the splenic artery, and associated gastric perforation. These findings are consistent with previous reports indicating that complex vascular disruption and associated visceral complications frequently necessitate surgical treatment.

Distal pancreatectomy with splenectomy was performed in all patients in our study. This approach provides definitive control of bleeding by removing the diseased pancreatic segment responsible for enzymatic vessel erosion while simultaneously allowing direct control of the splenic artery. Additional procedures such as proximal artery ligation or aneurysmorrhaphy were performed depending on intraoperative findings.

Surgery in the setting of pancreatitis can be technically demanding due to dense inflammation and distorted anatomy. Reported surgical mortality for ruptured SAP in earlier literature ranged from 16% to 50%. However, outcomes have improved significantly with better perioperative care and earlier diagnosis. In our series, no mortality was observed, although two patients developed postoperative pancreatic fistula which was successfully managed conservatively.

Our findings support the concept that surgical management remains an essential component in the treatment algorithm for SAP, particularly in patients with complex anatomical disruption or complications that cannot be addressed through endovascular means. A multidisciplinary approach involving surgeons, interventional radiologists, and intensivists is crucial to optimize outcomes.

Limitations

The present study is limited by its small sample size and retrospective design. Larger multicentre studies are required to further define optimal management strategies for complex splenic artery pseudoaneurysms.

Conclusion

Endovascular embolization remains the preferred initial treatment for splenic artery pseudoaneurysm. However, surgical intervention remains essential in complex cases where embolization is not feasible or fails. Distal pancreatectomy with splenectomy combined with vascular control provides effective definitive management in selected patients.

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