



# Quantification of the impact of interventional radiology in the management of acute pancreatitis

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## Abstract

**Objectives** Interventional radiology plays a central role in the management of complicated acute pancreatitis, contributing to image-guided drainages, treating haemorrhagic complications and maintaining the patency of the biliary tree. In addition, many of these patients require long-term venous access for antibiotics or parenteral feeding. The aim of this study was to evaluate the role and level of involvement of the interventional radiology in this sub-group of patients.

**Methods** This was a single-centre retrospective review of all admissions for acute pancreatitis over a 5-year period. Each case was assessed to determine whether radiological intervention was utilised.

**Results** Our review included 401 patients. A total of 18.7% (75/401) of patients required vascular access procedures and 18.4% (74/401) required image-guided drainage. A total of 1.2% (2/401) patients had embolisation procedures performed. The embolisation procedures were performed to treat a pseudoaneurysm that had formed.

Overall, 20.9% (84/401) of patients were referred to the interventional radiology department for a procedure; a majority of these patients were referred for multiple procedures over the course of their admission. The patients in the ‘severe pancreatitis’ category had a total of 154 procedures performed, which was 65.5% of the total procedures. On average, the patients who underwent multiple interventional procedures tended to have a longer admission and more complex disease.

**Conclusion** The diagnosis and treatment of complicated acute pancreatitis is heavily dependent on the interventional radiology department. A substantial proportion of patients with pancreatitis required radiological intervention as part of their management, the proportion of which increased significantly in complex disease.

**Keywords** Acute pancreatitis · Embolisation · Image-guided drainage · Interventional radiology · Pseudoaneurysm · Pseudocyst

## Introduction

Acute pancreatitis is acute onset inflammation of the pancreas, which can be due to a number of aetiologies, the most common of which are gallstones, alcohol induced or iatrogenic. Acute pancreatitis has a wide spectrum of presentation, from mild inflammatory pancreatitis to severe, life-threatening disease. Under the Atlanta Classification revision in 2012, acute pancreatitis can be divided into two subtypes: interstitial oedematous pancreatitis (IEP) and necrotising pancreatitis [1, 2]. The majority of patients admitted to hospital present with mild acute pancreatitis with no evidence of organ damage or major complications. These patients are managed conservatively with intervention only necessary if they fail to resolve. A minority of patients will, however, develop moderate to severe pancreatitis with evidence of pancreatic necrosis ± single- or multi-organ failure. These patients require multidisciplinary management. Complications in this subtype

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generally require immediate intervention due to the instability and severity of the patient's condition.

The interventional radiology department is able to perform multiple interventions for treatment of complications of pancreatitis. For example, fluid collections such as an acute peripancreatic fluid collection (APFC) an acute necrotic collection (ANC), or a pseudocyst [2], may be drained if the collection fails to resolve spontaneously or if the patient is symptomatic.

Infected pancreatic necrosis can also be drained to stabilise the area prior to further intervention, or as definitive treatment [3–5]. Further treatment may require the removal of the necrotic area (necrosectomy), which can be performed surgically or percutaneously.

A pancreatic pseudoaneurysm is another serious complication requiring treatment due to risk of rupture. It commonly affects the splenic artery or the hepatic artery, due to their proximity and involvement of the pancreas [3, 6–8]. They are usually treated immediately upon diagnosis and once/if patient is haemodynamically stable, either by embolisation (see Fig. 1) or by injecting thrombin under US guidance.

Gallbladder disease is one of the most common causes of acute pancreatitis [9–11]. Percutaneous transhepatic cholangiography is performed in IR, usually after failed ERCP. It allows the radiologist to visualise the ducts ± placement of a stent or removal of a stone. Percutaneous cholecystostomy may be performed in patients who are unable to undergo laparoscopic cholecystectomy (see Fig. 2).

The interventional radiology department plays an important role in the management of complications of acute pancreatitis. While many patients can be managed conservatively, others need intervention which can be safely provided in a minimally invasive interventional format, which has fewer risks than surgical intervention. Acute pancreatitis has a significant disease burden for both patients and hospitals worldwide [12–14]. Hospitals should ensure that management of pancreatitis is done so in a judicious manner, to ensure both

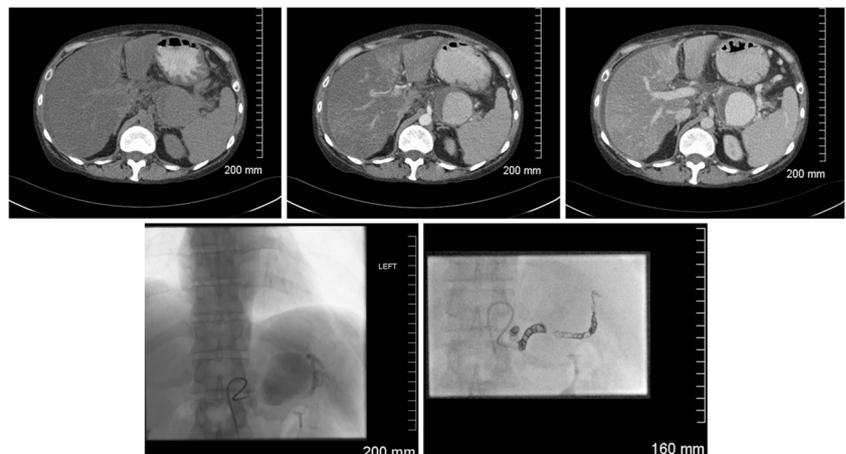


**Fig. 2** Contrast-enhanced CT abdomen/pelvis in a coronal maximum intensity projection reformat showing an internal/external biliary drain, a pigtail catheter in the right iliac fossa and the tip of a peripherally inserted central catheter. They were placed by interventional radiology in a patient with severe acute pancreatitis

minimisation of complications to the patient, as well as economical management of equipment, time and staff.

The objective of this paper is to evaluate the role and level of involvement of the interventional radiology in this sub-

**Fig. 1** Triple phase pancreatic protocol CT showing large splenic artery pseudoaneurysm, the white arrow identifies the pseudoaneurysm in the arterial phase. The two images below show subsequent coil embolisation of the splenic artery under fluoroscopy



group of patients. This paper will not assess the outcome post-intervention in this patient group.

## Materials and methods

This a single retrospective review of all admissions of acute pancreatitis to a tertiary care centre between 2011 and 2015.

A search was performed on the hospital's electronic patient database to determine how many patients were treated for acute pancreatitis in a 5-year period, from January 2011 to December 2015. In total, 401 patients with acute pancreatitis were admitted and treated at the tertiary care centre where the study took place in this time period. Each electronic patient file was reviewed to determine if any interventional procedure was performed during their admission. A search of the NIMIS (National Integrated Medical Imaging System) database was also completed to record information about each procedure performed on the aforementioned patient group.

Each intervention was requested by the primary medical team and discussed with the interventional radiologist performing the procedure. Consent was obtained from each patient or patient guardian to perform each procedure. Patient parameters such as platelet count and international normalised ratio (INR) were assessed pre-procedure, with appropriate interventions made by the primary team if necessary to ensure a safe procedure. All procedures were performed by a consultant radiologist, with or without assistance from a second consultant or radiologist specialist registrar. All interventional procedures performed on patients admitted with acute pancreatitis between January 2011 and December 2015 were included in the study. This included procedures to acquire vascular access, image guided drainage of fluid collections, abscess and gallbladder (cholecystostomy), radiologically inserted gastrostomies, arterial embolisation and thrombin injection to treat pseudoaneurysm or haemorrhage and percutaneous transhepatic cholangiogram.

The tertiary centre where the study was performed does not require ethical approval for retrospective studies, and as a result, ethical approval was not sought.

Data was collected and stored on a Microsoft Office Excel spreadsheet (Microsoft Corporation, CA, USA). A fixed data set was set up using the spreadsheet to ensure standardised collection of data for each procedure. Statistical analysis was also performed using Microsoft Office Excel.

## Results

Of the 401 patients admitted with acute pancreatitis, 84 of the patients had an interventional procedure(s) performed. The majority of patients had one interventional procedure

performed during their admission; however, a number of patients had multiple interventions to manage their pancreatitis. In total, 235 procedures were performed within this patient group. Of the 235 procedures performed, 32% (75/235) were vascular access procedures, 31% (74/235) image-guided drain insertion, 18% (44/235) were review of drain with fluoroscopic or CT-guided imaging, 12% (29/235) were aspiration procedures, three radiologically inserted gastrostomies, two embolisation procedures to treat a pseudoaneurysm, two stent insertions, four percutaneous transhepatic cholangiograms, one injection of thrombin and one cholecystostomy. These findings are summarised in Table 1.

In total, 46.5% of the patients were female and 53.5% of the patients were male.

Fluoroscopic guided catheterisation for central venous access was the most commonly performed procedure in this cohort of patients. In total, 75 central venous catheters were inserted in a group of 50 patients. Sixty-five were peripherally inserted central catheters inserted in a total of 46 patients. Ten were tunnelled lines inserted in a total of five patients. Certain patients within this subgroup had this procedure performed more than once either for reinsertion of a central line or change of location of access.

Image-guided drainage was performed 74 times on a subgroup of 41 patients.

Fluoroscopic or CT-guided review of drain placement was performed 44 times within a group of 30 patients. Drain size varied. Eight French was the most used initial drain size for placement; however, drain size up to 20 French was placed for the initial drain. Initial drain size for abscess drainage varied between 12 and 20 French. The majority of CT drain reviews were performed to reassess collection size post-drain insertion. Overall, 21 drains were exchanged for new drains, and 17 drains were upsized.

All four patients who had a percutaneous transhepatic cholangiogram had a biliary stent and drain inserted.

Two embolisation procedures were performed to manage development of a pseudoaneurysm. These procedures were performed in two separate patients, both of whom had formed pseudoaneurysms that had not ruptured. One of these patients had thrombin injected under ultrasound guidance for management of their pseudoaneurysm.

Many patients had multiple interventional procedures performed for treatment of their pancreatitis. The most procedures performed to treat a single patient was 27 interventions. Half of the procedures for this patient were drain review.

Each patient was graded using the CT severity index for acute pancreatitis. Of the 84 patients who had interventions performed, 38% (32/84) were graded severe (8–10/10), 31% (26/84) were graded moderate (4–6/10) and 31% (26/84) were graded mild (0–2/10).

Using the results from the CT severity index, the number of procedures for each group was calculated. Overall, the

**Table 1** Breakdown of total number of interventional procedures performed on patient cohort

Index	
Intervention	Number of procedures performed
Vascular access procedure	75/235
Image-guided drainage	74/235
Review of drain under fluoroscopic or CT-guided imaging	44/235
Aspiration procedure	29/235
Percutaneous transhepatic cholangiogram	4/235
Radiologically inserted gastrostomies	3/235
Embolisation procedure	2/235
Insertion of stent	2/235
Thrombin injection	1/235
Cholecystostomy	1/235

patients in the ‘severe’ category had a total of 154 procedures performed, which is 65.5% of the total procedures. The patients in the ‘moderate’ group has 49 procedures (20.8%), and the patients in the ‘mild’ category had 32 procedures (13.6%).

## Discussion

### Conservative vs interventional management

Generally, acute pancreatitis can and should be managed conservatively. Intervention should only be considered where necessitated by complications of a certain severity. Our results showed that 69% of the total patients for intervention had a score of moderate to severe acute pancreatitis based on the CT severity index. Indeed, when a complication occurs, first-line management should generally favour conservative management if possible due to the possibility self-resolution, thereby avoiding the intrusion and risks of following an interventional course.

However, when intervention is necessitated by the failure of conservative management, a minimally invasive intervention should be considered. This is due to the numerous patient and economic benefits which pertain when intervention is compared against alternatives, such as surgery. Unlike surgery, interventions avoid the risks associated with anaesthesia and post-operative surgery-specific complications, as well as posing a decreased infection risk [2, 4, 15]. The majority of patients who received intervention in this study were suffering from moderate to severe pancreatitis. This puts them at a higher anaesthetic risk, regardless of any premorbid risk factors [16, 17]. If conservative management does fail, being able to perform an equivalent procedure without general anaesthetic avoids any further risk on top of the procedure itself.

From an economic perspective, the cost of performing an interventional procedure over a surgical procedure is significantly less, not least because fewer staff are required to

perform an interventional procedure. In van Santvoort et al., they demonstrated a 12% reduction in total cost per patient with the step-up approach, compared to open necrosectomy, from admission to 6-month follow-up. Their results also showed a significant reduction in ICU admissions post step-up approach (16%) compared to open necrosectomy (40%), which has significant implications for overall expenditure per patient [4, 5]. Furthermore, in the normal course, interventional procedures can be performed faster than surgical procedures, meaning staff, equipment, and space can be reallocated for other uses meaning more procedures can be performed in a day. Hospitals should therefore ensure sufficient resources are available for their radiology department as performing interventional procedures will benefit the patient clinically as well as the hospital economically.

### Supportive intervention

Early nutritional support is extremely important in the management of pancreatitis. Patients with acute pancreatitis are more likely to become malnourished or present in a state of malnutrition, due to increased energy requirements and altered digestion pathway. Early enteral feeding is preferred for both simple and complicated cases of pancreatitis [18–20]. Initially, parenteral nutrition was preferred as nutrition supplementation of choice; however, recent studies have shown that enteral feeding reduces infectious complications and overall patient mortality [20–22]. It is therefore the preferred method of nutritional supplementation if possible. Generally, patients are treated with nasogastric tube feeding to provide supplemental nutrition over the course of a short admission. When a patient has a prolonged admission for complicated pancreatitis, however, the team will have to consider alternative management for longer-term feeding as NG may not be a safe or sustainable option. Three patients in this study had radiologically inserted gastrostomies for long-term feeding. Also, selected patients in our cohort had central venous catheters inserted, 75 in total,

which may have been used in part to deliver total parenteral nutrition. This demonstrates the role of the radiologist not only in the management of complications but also in the supportive medical management of pancreatitis.

### Future interventional management

Treatment of solidified pancreatitis necrosis percutaneously is an alternative option to open necrosectomy in the treatment of pancreatic necrosis. While percutaneous drains can be placed to manage liquefied necrosis, the removal of solidified necrosis has generally been managed with open necrosectomy. Many cases of pancreatic necrosis will resolve with placement of a drain alone; however, solidified tissue is difficult to drain and can cause difficulties with drainage, such as blockage. Sandvoort et al. performed a randomised control trial where they performed either open necrosectomy or a step-up approach of percutaneous drainage, plus percutaneous retroperitoneal necrosectomy if required on a cohort of patients with pancreatic necrosis. The study found that a step-up approach is associated with reduced rate of major complications or death compared to open necrosectomy [4]. Morato et al. and Rasch et al., in their retrospective cohort studies based on the findings in Sandvoort's paper, also found that a step-up approach was superior to classical management, with a direct decrease in the mortality rate [5, 23].

While the management of necrotising pancreatitis should be managed on a case by case basis, we would advocate for a conservative, step-up approach involving the interventional radiology department when clinically possible.

### Conclusion

The treatment of acute pancreatitis is heavily dependent on interventional radiology. While patients with moderate acute pancreatitis may require some form of intervention, such as drainage of a fluid collection, patients of acute severe pancreatitis will generally require one, or multiple forms of intervention. In the future, the possibility of treating pancreatic necrosis with a minimally invasive approach would also mean a heavier reliance on the interventional radiology team.

Tertiary hospitals rely heavily on their radiology department for the diagnosis, monitoring and treatment of acute pancreatitis. Close collaboration between the radiologist, gastrointestinal and surgical team, as well as adequate staffing and equipment, are essential to ensure effective treatment of acute pancreatitis.

### Compliance with ethical standards

**Conflict of interest** The authors declare that they have no conflicts of interest.

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