# Successful arterial embolization of a giant pseudoaneurysm of the gastroduodenal artery secondary to chronic pancreatitis with literature review

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ABSTRACT

We report a case of an uncommon giant pseudoaneurysm of the gastroduodenal artery secondary to chronic pancreatitis. It presented with a perfused volume of 17.3 cm³ close to the branch-off of the right hepatic artery. Superselective transcatheter embolization including interlocking detachable coils and a mixture of Ethibloc and Lipiodol was our technique of choice. Following the procedure, the patient was in hemodynamically stable condition. At that time, he was free of any clinical symptoms and showed no further signs of bleeding or ischaemia. Additionally, we present an overview of the relevant literature.





## CASE REPORT

### CASE REPORT

A 47 year-old patient, with a history of chronic pancreatitis due to long-lasting alcohol abuse, presented with acute upper abdominal pain. On initial presentation, his haemoglobin level was 7.3 g/dl (normal range 13-17 g/dl). Esophagogastroduodenoscopy revealed an erosive duodenitis without any signs of active or recent bleeding.

An ultrasound examination revealed a cystic lesion in the pancreatic head, which pulsated when viewed in doppler mode. Subsequently, a contrast-enhanced (150 ml Imeron 300, Altana, Germany) computer tomography (Definition, Siemens, Erlangen, Germany) was performed. In the arterial phase it detected a giant pseudoaneurysm of the proximal gastroduodenal artery (GDA). The perfused part measured 3.7 x 2.5 x 4.1 cm. The total pseudoaneurysm dimension including the thrombosed part was 4.5 x 5.7 x 6.5 cm (Fig. 1, 2). CT volumetry of the perfused part of the pseudoaneurysm identified a volume of 17.3 cm3. The hepatic, gastroduodenal and splenic artery were well patent and lead to good organ perfusion. The pancreatic parenchyma exhibited scattered calcifications indicating chronic pancreatitis without any signs indicative of an acute pancreatitis.

A surgical approach was deemed unfeasible due to the high risk of rupture and consecutive massive intraabdominal bleeding. Furthermore, the surgical access to an area marked with extensive scar tissue arising out of chronic infection would have proven to be extremely difficult. As a result, the patient was referred to angiography for occlusion of the pseudoaneurysm. An emergency angiography was performed.

Celiac trunk angiography employing a selective F4 cobra catheter in DSA-technique including the injection of 30 ml contrast media (Imeron 300, Altana, Germany) with a flow of 5 ml/sec revealed that the GDA arises from the right hepatic artery. A giant pseudoaneurysm with a small neck was identified at the proximal GDA, very close to the branch-off of the right hepatic artery (Fig. 1, 2, 3).

A F2.7 microcatheter (Progreat , Terumo, USA) was advanced into the GDA distal to the pseudoaneurysm, where three interlocking detachable-coils (Boston Scientific, USA) were deployed: two 8 mm in diameter / 10 cm long coils and one 6 mm / 10 cm coil. Angiographic control confirmed the complete occlusion of the GDA distal to the pseudoaneurysm's neck (Fig. 4).

Secondly, the F2.7 microcatheter was advanced via the small neck into the pseudoaneurysm and 18 interlocking

detachable-coils (Boston Scientific, USA) were deployed: four 10 mm in diameter / 20 cm long, six 9 mm / 20 cm coils, three 8 mm / 20 cm, and three 6 mm / 10 cm (Fig. 4). After the placement of 16 coils, an angiographic control uncovered only a marginal filling of the pseudoaneurysm (Fig. 5). As a consequence, an additional embolization using the liquid embolic agent Lipiodol/Ethibloc -mixture (Ethicon, Norderstedt, Germany) was performed in sandwich-technique: following the injection of 2 ml of 40% glucose, we applied 26 separate portions of 0.6 ml of the embolic-mixture (ratio of 15 ml Ethibloc/10 ml Lipiodol) resulting in a total volume of 15.6 ml liquid embolic agent.

Finally, two interlocking detachable coils (Boston Scientific, USA, 6 mm in diameter / 10 cm long) were deployed. While retracking the superselective catheter that way, one half of the coil remained inside the pseudoaneurysm and the other half was left in the GDA proximal to the pseudoaneurysm. A final angiographic control with selective catheter in the common hepatic artery showed an only discrete residual perfusion in the upper part of the pseudoaneurysm. Because the residual perfusion was only very discrete we expected that it would completely thrombose and no further embolization was required. The right and left hepatic arteries were completely visible (Fig. 5).

The patient's ensuing hospital stay was uneventful and he could be discharged after 6 days without any signs of bleeding or intestinal ischaemia. Laboratory results showed stable haemoglobin and hematocrit values. Pancreatic enzymes were not elevated following the embolization.

The clinical condition remained stable over time, which was confirmed by a follow-up conducted after twelve months. A contrast-enhanced follow-up CT scan (6 weeks post embolization) verified a complete occlusion without any reperfusion of the pseudoaneurysm (Fig. 7).

## DISCUSSION

Pseudoaneuryms of visceral arteries are uncommon (5-10%), but occur as critical complications following pancreatic surgery and pancreatitis [1-3, 8]. Therefore, early diagnosis and adequate therapeutic interventions are imperative. Arterial hemorrhage and/or ruptured pseudoaneurysms of the gastroduodenal artery (GDA) are uncommonly reported and studies investigating diagnostic and therapeutic algorithms are rare [8]. Patients with ruptured pseudoaneurysms of the GDA may constitute poor candidates for emergency surgery due to hemodynamic instability and critical general conditions. However, interventional radiology such as superselective embolization offers less invasive treatment methods.

The exact pathogenesis of pseudoaneurysm formation is still unclear, but, to date, three pathogenic mechanisms are being discussed: (1) severe inflammation and enzymatic autodigestion of a pancreatic or peripancreatic artery may cause a disruption of the artery; (2) an established pseudocyst eroding a visceral artery, thereby converting the pseudocyst into a large pseudoaneurysm, and (3) a pseudocyst may erode the bowel wall with bleeding from the mucosal surface itself [4]. Pseudocysts or infected fluid collections are also frequently considered to be associated with the formation of a pseudoaneurysm [6, 7].

Another important mechanism might be an iatrogenic trauma to visceral arteries during pancreaticoduodenectomy e.g. during extensive regional lymphadenectomy or radical resection at the site of the primary tumor [5].

The vast majority of patients with pseudoaneurysms evolving in the setting of pancreatitis present with abdominal pain. However, they do not experience hypotension derived by acute blood loss (62%). The pain is often described as "crescendo" and different from the pain characteristic of pancreatitis [7-9].

Bergert et al reported a 5% prevalence of bleeding pseudoaneurysms for patients with chronic pancreatitis and a 12% prevalence for patients with necrotizing pancreatitis [8]. The most commonly affected arteries were the splenic, intrahepatic and gastroduodenal arteries [8].

Ruptures of pseudoaneurysms of the splenic (about 31%), gastroduodenal (about 24%), pancreaticoduodenal (about 21%), superior mesenteric, hepatic, or gastric arteries are reported with declining incidence [2, 6].

In a systemic review of 214 patients with pancreatitis-associated vascular complications, the splenic artery was most frequently involved, followed by the gastroduodenal, pancreaticoduodenal, and the hepatic arteries [2, 6]. Acute hemorrhage from a pseudoaneurysm is the most rapidly fatal complication of chronic pancreatitis. The mortality rate of untreated patients reaches 90 to even a 100%. Even with the most aggressive treatment, the mortality is still at 12- 50% [10].

Mortality rates after surgical repair of bleeding visceral arteries have been reported in patients with chronic pancreatitis and pseudocysts. Mortality in patients treated with arterial ligation was 43 % for pseudoaneurysms located in the head of the pancreas and 15% involving the body and tail [2]. Insufficient ligation of a vessel with a recurrence of the bleeding due to surrounding tissue infection or insufficient control of bleeding may occur. Additionally, these patients may not be hemodynamically stable enough for surgery and anaesthesia due to their generally poor condition [11].

The detection of an aneurysm mostly depends on CT or angiography [12]. CT should include an arterial phase with thin slices (1 mm) in axial and coronal plane. Pseudoaneuryms appear as sharply delineated lesion with homogenous and intense arterial enhancement and an anastomosis to an artery. Angiography allows for a precise detection of bleeding arteries and pseudoaneurysms. As a result, the decision making, whether an embolization is technically feasible and safe, is facilitated [1, 13]. Interventional techniques are an accepted and safe method in the treatment of arterial complications following pancreatitis [6, 14-16]. Boughene et al reported treatment success rates of embolization therapy alone to reach

approximately 78% [17]. In their study involving 35 patients with pseudoaneurysms associated with pancreatitis Bergert et al arrived at a success rate of 88% and a mortality rate of 19% in 16 embolized patients [8]. The systemic appraisal of the management of major vascular complications of pancreatitis by Balachandra reported that angiographic embolization proved successful in achieving hemostasis in 74% [6].

The angiographic principle of occluding the artery upstream and downstream (front- and backdoor concept) from the origin of the lesion should be adopted. Therefore, it is necessary to perform embolization proximally and distal to the pseudoaneurysm, as well as, within the pseudoaneurysm itself. This is done to exclude it from both arterial backflow and antegrade flow [17, 18].

As chronic pancreatitis is an ongoing inflammatory process, Boughene et al argue that a definitive surgical solution should follow embolization as soon as possible [17]. The results of Bergert et al suggest that the mortality rate is not affected by the mode of treatment in chronic pancreatitis. As a consequence, a successful embolization requires no further treatment [8]. Therefore, angiography represents the diagnostic and, along with embolization, therapeutic procedure of choice. That is, if the patient is hemodynamically stable, and surgery as backup in cases of ruptured pseudoaneurysms is available [4, 8, 13].

A giant pseudoaneurysm is defined as a pseudoaneurysm equal to, or greater than, 5 cm in size [19]. In our case, the embolization of the giant pseudoaneurysm was critical, as the origin was in close proximity to the branch-off from the right hepatic artery. With regards to the arterial embolization, we faced the therapeutic dilemma of not wanting to occlude the hepatic artery, but to still sufficiently control bleeding from the pseudoaneurysm. It was decided to occlude the GDA first to stop the backflow into the pseudoaneurysm. Secondly, the occlusion of the pseudoaneurysm was achieved by filling it with numerous coils and finally with a mixture of Ethibloc/Lipiodol. Then two coils were positioned partially inside the pseudoaneurysm and partially into the GDA proximal the pseudoaneurysm to close the entry. The angiography performed after embolization (Fig. 6) confirmed the enduring complete patency of the right hepatic artery.

Efficacy for transcatheteral arterial embolization in pseudoaneurysms caused by pancreatitis ranges from 67 to 100%. Mortality rates have been reported to be 0-14% along with a morbidity of 14-25% [7, 20]. In most published reports involving embolization of bleeding sites, such as, pseudoaneurysms or arteries, coil deployment or a combination of coils with additional occluding material is used to achieve successful occlusion [1, 2, 11, 15]. We believe that the choice of occlusion material depends on the type and the location of the bleeding source. In small pseudoaneurysms coil embolization alone can be performed whereas in large pseudoaneurysms additional embolization with a liquid embolic agent might be necessary.

In conclusion transcatheteral embolization can effectively control bleeding from pseudoaneurysms. Emergency surgery should be limited to cases, where angiography cannot bring about the desired results due to the failed catheterization of vessels or insufficient occlusion of the source of bleeding.

In the reported case, interventional embolization was able to successfully occlude a giant pseudoaneurym, thus controlling the risk of massive intraabdominal bleeding without the need for surgery.

## TEACHING POINT

Interventional embolization is able to successfully occlude a giant pseudoaneurym (defined as pseudoaneurysms equal, or greater than, 5 cm in size) of the gastroduodenal artery secondary to chronic pancreatitis even with a wide neck and the origin being in close proximity to the branch-off from the right hepatic artery. At first, one should occlude the GDA distal to the entry of the pseudoaneurysm to stop the backflow. Then one can occlude the pseudoaneurym. Finally, coils can be partially placed inside the GDA to close the entry and to control the risk of massive intraabdominal bleeding. Complete occlusion of the pseudoaneurysm can be achieved without surgery.

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## FIGURES

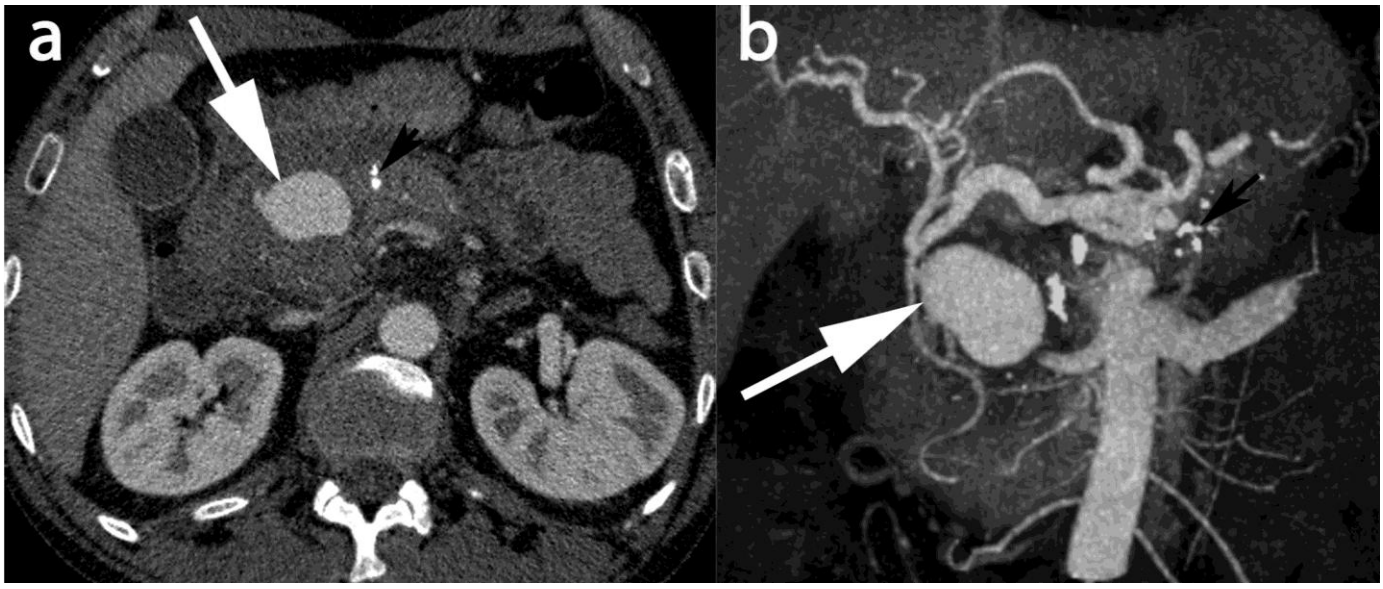


**Figure 1:** 47 year-old male patient with abdominal pain. a) Axial contrast enhanced CT (arterial phase) and b) coronal maximum intensity projection (MIP) of the upper abdomen show a giant pseudoaneurysm (white arrow) 4.5 x 5.7 cm in size and originating from the gastroduodenal artery. As a sign of the underlying chronic pancreatitis, there are calcifications in the pancreatic body (black arrow) (protocol: 120 kV, 250 mAs, 3 mm slice thickness, MIP 20 mm slice thickness, 150 ml Imeron 300, Altana, Germany).

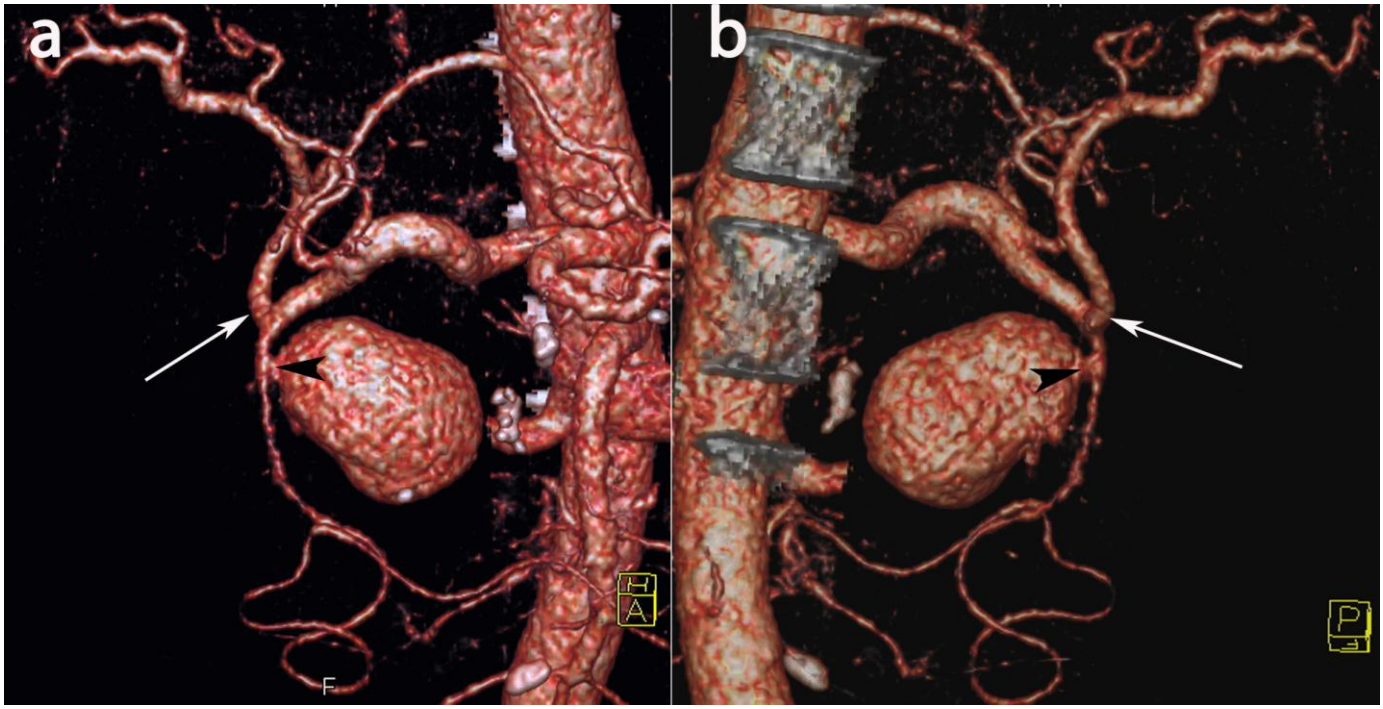


**Figure 2:** 47 year-old male patient with abdominal pain. The volume rendering technique (VRT) of the contrast enhanced CT (arterial phase) in ventral (a) and dorsal (b) view demonstrate that the neck of the giant pseudoaneurysm (black arrow head) is very close of its outlet from the hepatic artery (white arrow) (protocol: 120 kV, 250 mAs, 150 ml Imeron 300, Altana, Germany).

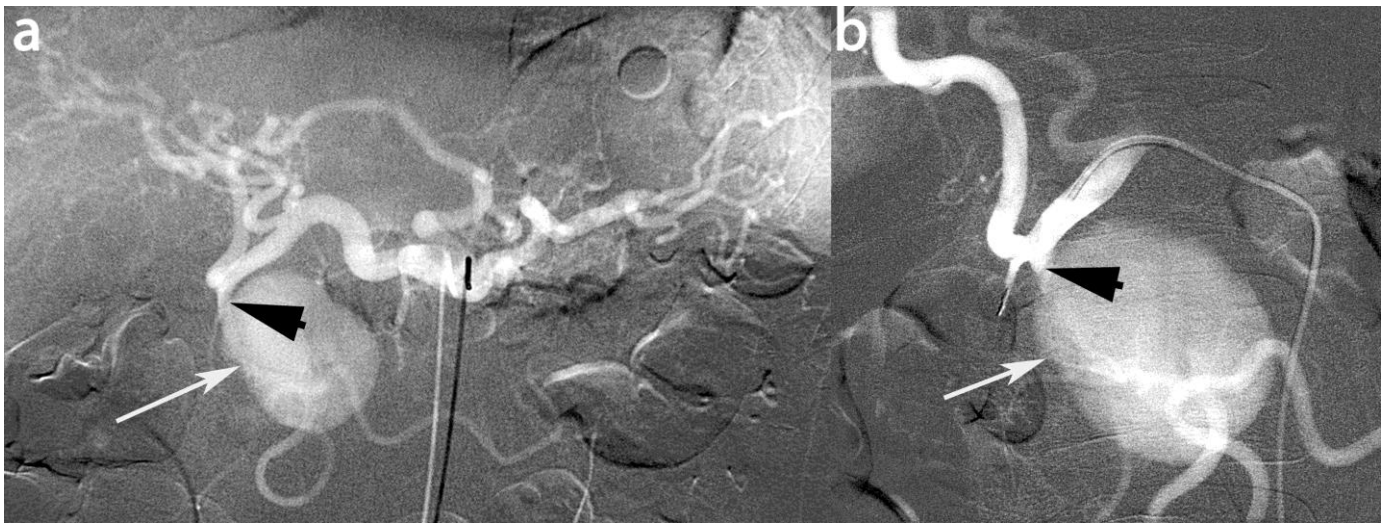


**Figure 3:** 47 year-old male patient with abdominal pain. Celiac trunk angiography (arterial phase) using a selective F4 sidewinder-catheter (a) in DSA-technique with injection of 30 ml contrast media at a flow of 5 ml/sec revealed that the gastroduodenal artery (GDA) arises from the right hepatic artery. Superselective angiography with a F2.7 microcatheter (Progreat , Terumo, USA) in the GDA (b) (injection of 12 ml contrast media with a flow of 2 ml/sec; Imeron 300, Altana, Germany) reveals the giant pseudoaneurysm (white arrow) with a small neck at the proximal GDA very close to the branch-off of the right hepatic artery.

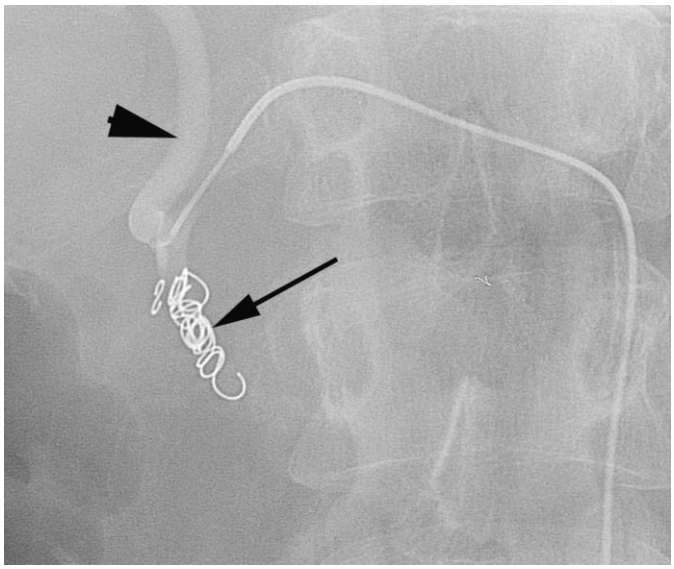

**Figure 4:** 47 year-old male patient with abdominal pain. Superselective angiography with a F2.7 microcatheter (Progreat , Terumo, USA) placed in the GDA after complete occlusion of the GDA distal to the entry of the pseudoaneurysm with three Interlocking Detachable Coils (black arrow). The hepatic artery is patent (black arrowhead) (manual injection of 2,5 ml Imeron 300, Altana, Germany).

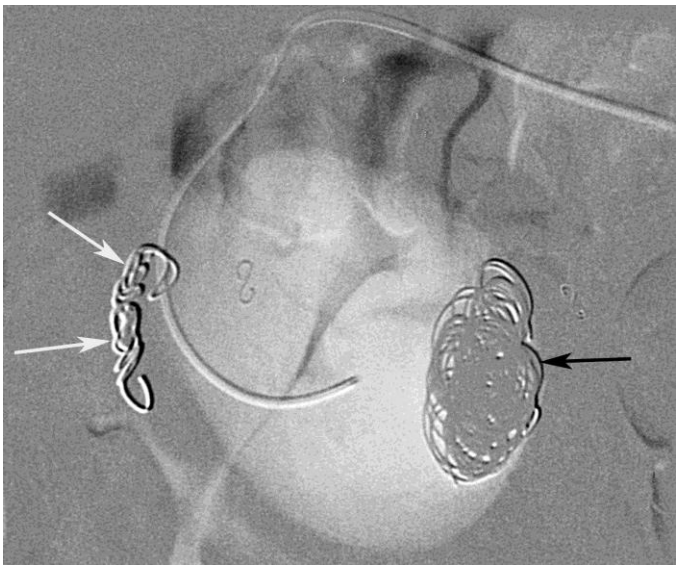

**Figure 5:** 47 year-old male patient with abdominal pain. Angiogram with microcatheter (Progreat , Terumo, USA) located in the pseudoaneurysm after occlusion of the GDA distal to the entry of the pseudoaneurysm with three Interlocking Detachable Coils (white arrows) and superselective embolization of the pseudoaneurysm with 18 Interlocking Detachable Coils (black arrow) (manual injection of 2,5 ml Imeron 300, Altana, Germany).

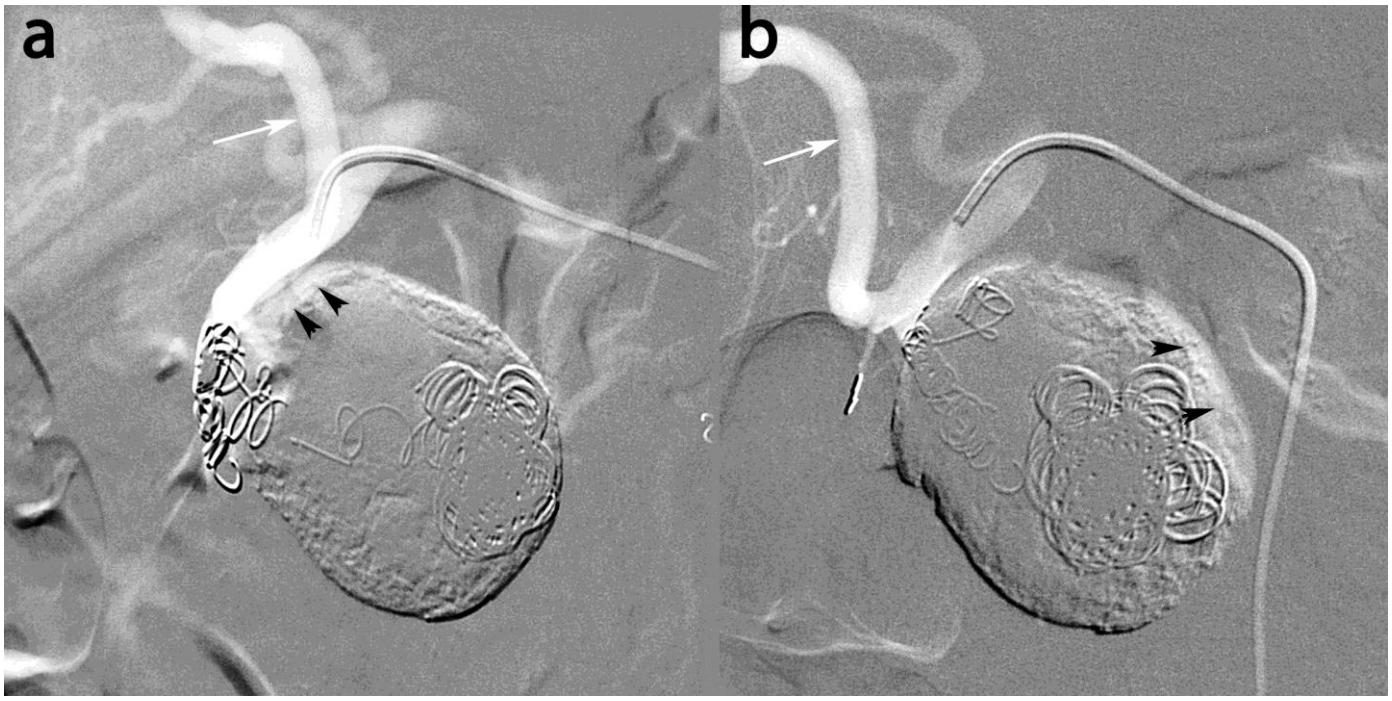


**Figure 6:** 47 year-old male patient with abdominal pain. Superselective angiogram (microcatheter, Progreat, Terumo, USA) (a a.p. projection, b 25° RAO projection) after embolization of the pseudoaneurysm with Interlocking Detechable Coils and additional embolization with a Lipiodol and Ethibloc composite (15.6 ml). Marginal residual perfusion in the giant pseudoaneurysm (black arrow heads). Persistent complete patency of the right hepatic artery (white arrow) (flow 1.5 ml/sec, 10 ml Imeron 300, Altana, Germany).

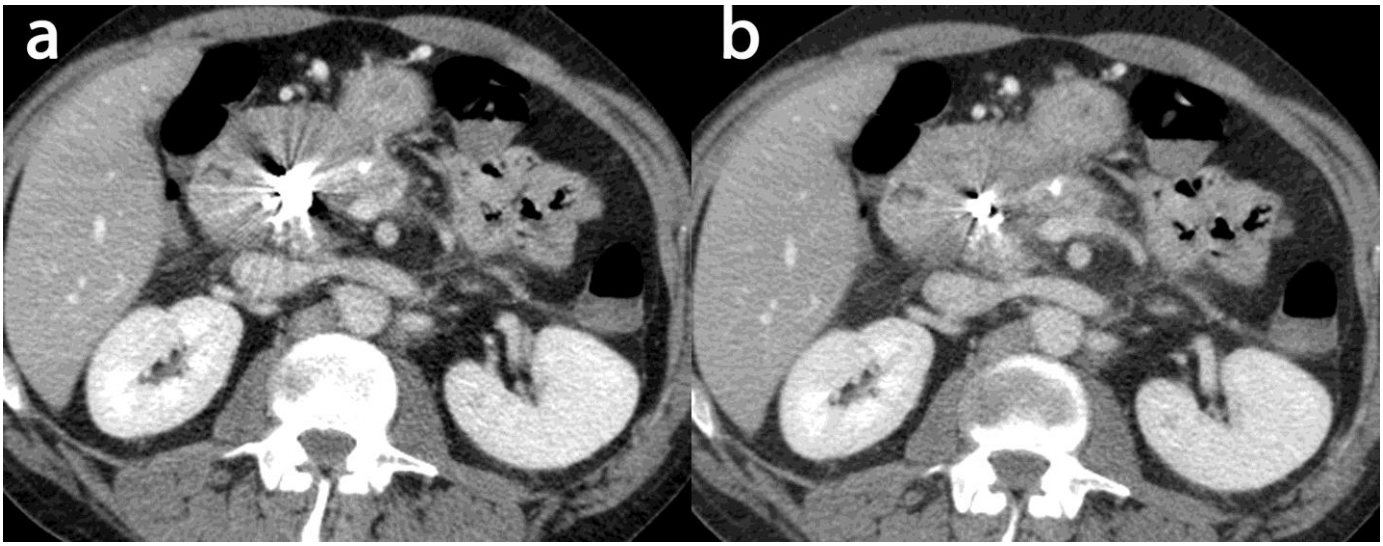


**Figure 7:** 47 year old male after embolization of a giant pseudoaneurysm in the pancreas head with coils and Lipiodol and Ethibloc composite. Contrast-enhanced computed tomography (portalvein phase) (a upper slice, b lower slice) 6 weeks after embolization shows no relevant perfusion of the pseudoaneurysm in the arterial, portalvein or delayed phase (protocol: 120 kV, 290 mAs, 3 mm slice thickness, 150 ml Imeron 300, Altana, Germany).





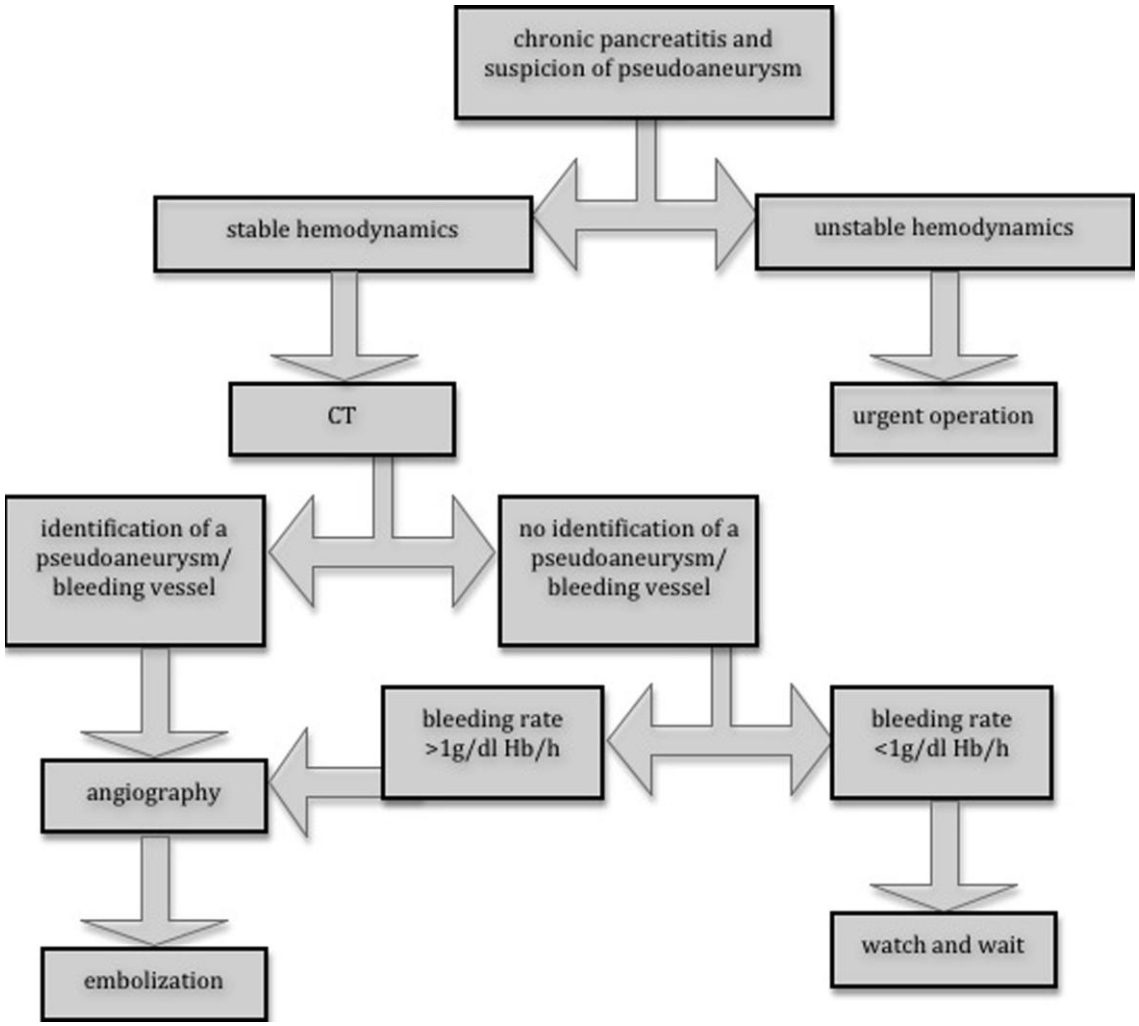


**Figure 8:** Diagrammatic scheme to manage visceral pseudoaneurysms

| | |
|---|---|
| **Etiology** | Pseudoaneurysm secondary to chronic pancreatitis |
| **Incidence** | Bleeding pseudoaneurysms in 5% of patients with chronic pancreatitis |
| **Gender ratio** | No gender predilection |
| **Age predilection** | No age predilection |
| **Risk factors** | Chronic pancreatitis secondary to alcohol abuse, smoking, hereditary chronic pancreatitis |
| **Treatment** | Interventional embolization of the pseudoaneurysm or surgical resection |
| **Prognosis** | The mortality is 12-50% for an acute hemorrhage of a pseudoaneurysm |
| **Findings on imaging** | CT and MRI: Sharply delineated highly perfused lesion with anastomosis to an artery, homogenous enhancement, intense enhancement in arterial phase<br>MRI: On T1 homogeneous hypointense, on T2 homogeneous hyperintense lesion. |

**Table 1:** Summary table of pseudoaneurysm secondary to chronic pancreatitis

| | **CT** | **MRI** | **Angiography** | **US** |
|---|---|---|---|---|
| **Pseudoaneurysm** | Sharply delineated lesion with homogenous enhancement and intense enhancement in the arterial phase, anastomosis to an artery | On T1 homogeneous hypointense, on T2 homogeneous hyperintense lesion, intense enhancement in arterial phase | Sharply delineated, highly perfused lesion with anastomosis to an artery | Hypoechogenic, cystic, in the Doppler mode pulsating lesion |
| **Neuroendocrine pancreatic tumor** | Hyperattenuating, well-defined lesion in the arterial and venous phase without anastomosis to a vessel | On T1 hypointense, on T2 hyperintense lesion, hyperattenuating after administration of contrast medium | Well-defined lesion with high contrast medium enhancement | Sharply defined lesion, hypoechogenic |
| **Hypervascular metastases** | One or more lesions with heterogeneous enhancement, hyperdense in the arterial phase | On T1 hypo- or isointense, on T2 hyper- or isointense lesion, hyperattenuating in arterial phase | Heterogeneous lesion with higher contrast-medium enhancement than surrounding tissue | One or multiple hypoechogenic lesions |

**Table 2:** Differential table of pseudoaneurysm





## ABBREVIATIONS

CT = computed tomography
GDA = gastroduodenal artery

## KEYWORDS

Angiography; embolization; pseudoaneurysm; interventional radiology; chronic pancreatitis

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