



# Interventions in Visceral Artery Bleed

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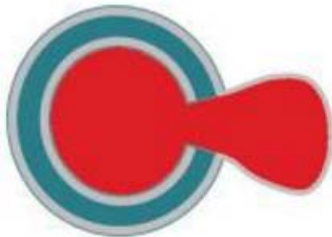




# INTRODUCTION

- Visceral artery aneurysms (VAAs) are rare, reported incidence of 0.01 to 0.2% on routine autopsies
- VAAs are clinically important and potentially lethal
- 22% of all visceral artery aneurysms present as clinical emergencies and 8.5% result in death
- A ruptured pseudoaneurysm is most fatal complication with a reported mortality ranging from 12.5% in treated patients to 90% in untreated cases

Cross  
section  
of artery



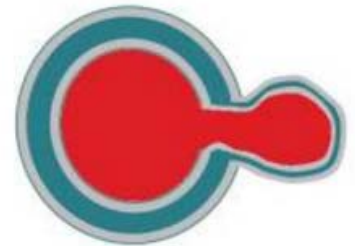
Pseudoaneurysm

- Thin wall
- Irregular outline
- Surrounding hematoma

vs.

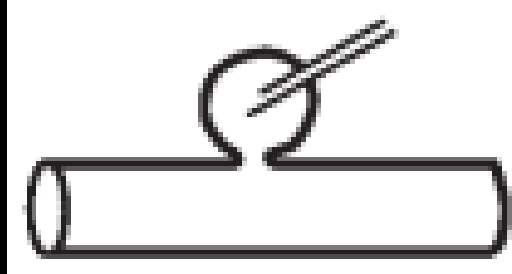
True aneurysm

- Thick wall
- Smooth outline



# Algorithmic Approach for management of Pseudoaneurysm

## 1. Superficial Artery



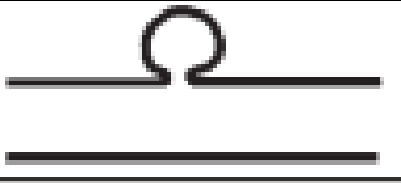
USG Compression of pseudoaneurysm neck or sac  
Direct Percutaneous management

## 2. Endoluminally Inaccessible



Direct Percutaneous management :  
Coil/Glue/Thrombin

## 3A. Endoluminally Accessible (Inexpendable Donor Artery)

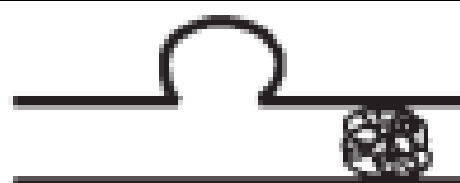


**Narrow Neck :**  
Embolisation of  
pseudoaneurysm  
itself

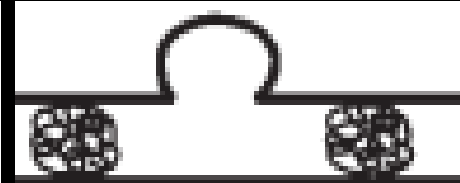


**Wide Neck :**  
Stent/Balloon  
remodelling/Sten  
t Graft

## 3B. Endoluminally Accessible (Expendable Donor Artery)



**No Collateral Supply :**  
Proximal  
embolisation of donor  
artery



**Collateral Supply:**  
Proximal and distal  
embolisation of  
donor artery



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# Understand important collateral pathways

Common collaterals are

- 1) between SMA and celiac axis through anterior and posterior pancreatico-duodenal arcades
- 2) between branches of gastroepiploic, short gastric and splenic arteries (within the celiac arterial system)
- 3) between right and left hepatic arteries.

Absence of collateral pathways in the renal arterial system



- Uncommon variations
- Arc of Buhler (persistence of direct embryological communication between celiac trunk and SMA)
- Arc of Barkow (anastomosis of the right and left gastroepiploic arteries)



## Table 1

### Points to Consider Prior to Embolization of Pseudoaneurysm

Size of pseudoaneurysm & its neck

Large size—option of percutaneous approach

Wide neck—risk of non target embolization (liquid agents)

Parent artery

End artery vs. artery with rich collaterals—proximal occlusion vs. sandwich embolization

Expendable vs. in expendable artery—parent artery occlusion vs. preservation approaches

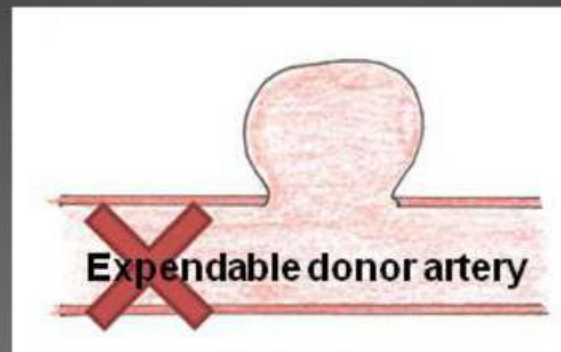
Tortuous artery—difficult catheterization; consider other approaches

Location

Proximal—short landing zone poses difficulty

Patient's coagulation parameters

Deranged—may prolong thrombosis with coils; glue is beneficial



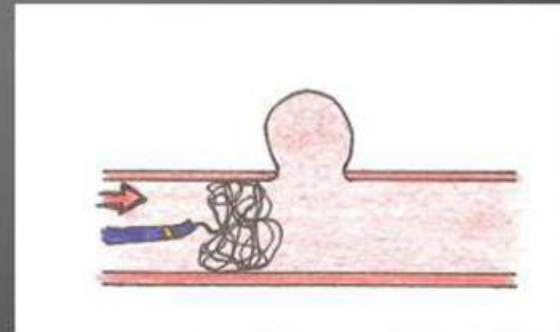
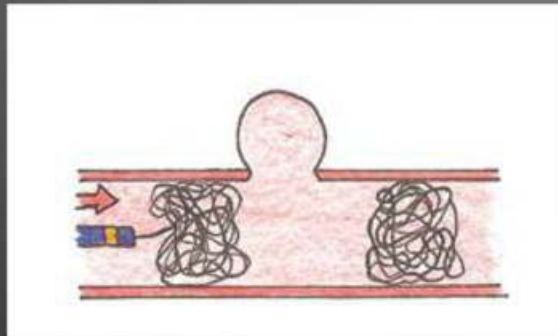
**High collateral circulation**

**No collateral circulation**

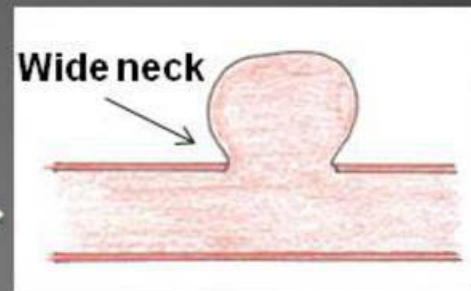
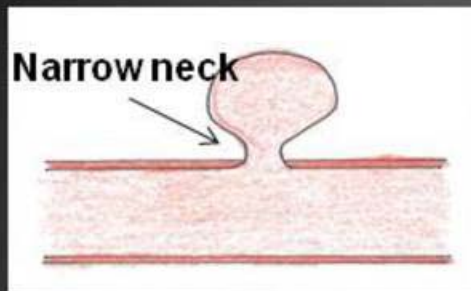


**Proximal and distal embolization  
of donor artery**

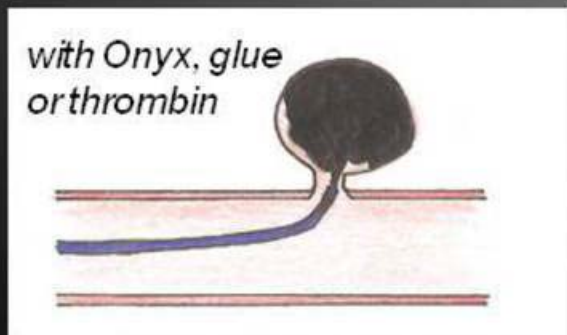
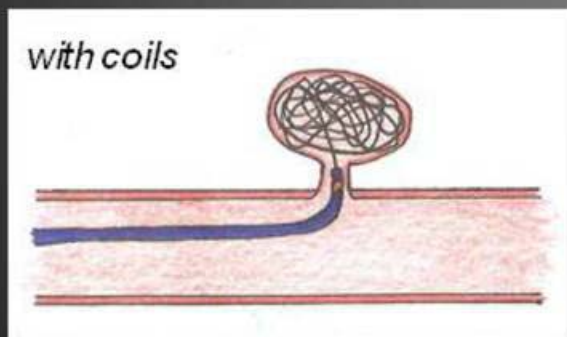
**Proximal embolization of  
donor artery**



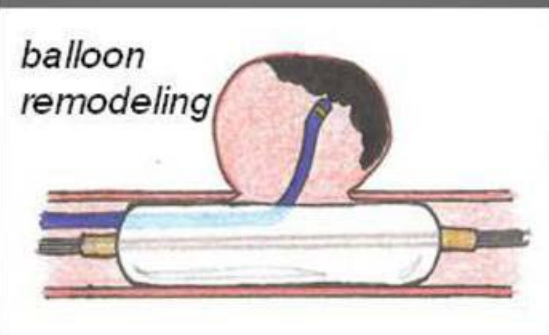
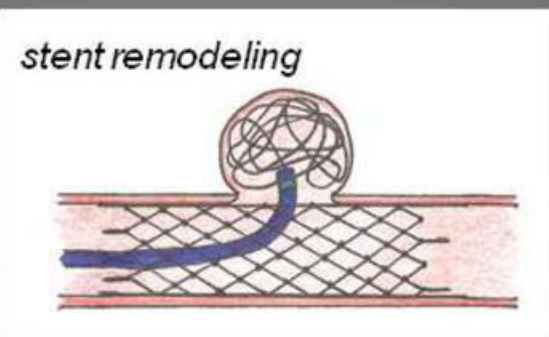




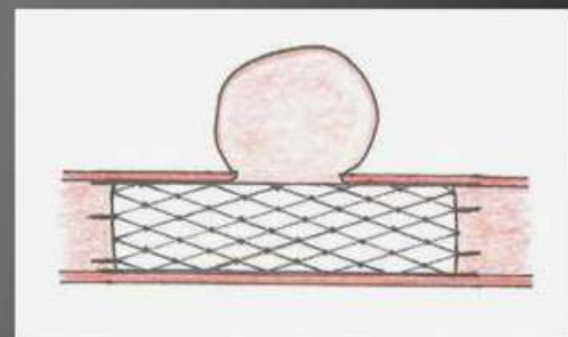
**Embolization of PSA itself**



**Embolization with remodeling**



**Stent-graft placement**





# Embolic Materials



Category	Examples
Permanent Mechanical Embolic Agents	Coils Plugs
Permanent Particulate Agents	PVA Tris-Acryl Microspheres Hydrogel–Polyzene F Microspheres Drug-Eluting Microspheres
Temporary Embolic Agents	Autologous Blood clot Gelatin Sponge Microfibrillar collagen
Liquid Embolic Agents	Sclerosant agents: e.g., absolute alcohol, sodium tetradecyl sulphate <ul style="list-style-type: none"><li>• Glues: N-butyl cyanoacrylate (NBCA)</li><li>• Elastic polymers: OnyxR</li><li>• Iodized poppy seed oil droplets: lipiodol</li></ul>

# Choice of embolic material



Depends on

Duration of Occlusion  
required

Permanent

Temporary

Eg Trauma patient with bleeding from a pelvic fracture; temporary embolization of the entire internal iliac artery can be a rapid and life-saving maneuver.

**Gelfoam/Autologous blood clot can be used**

Desired level of occlusion

**Proximal occlusion**  
Eg, in splenic artery embolisation before surgical splenectomy

**Distal occlusion**  
with particulate/liquid embolic agents is required to obtain a more durable result in chronic inflammatory and most neoplastic processes

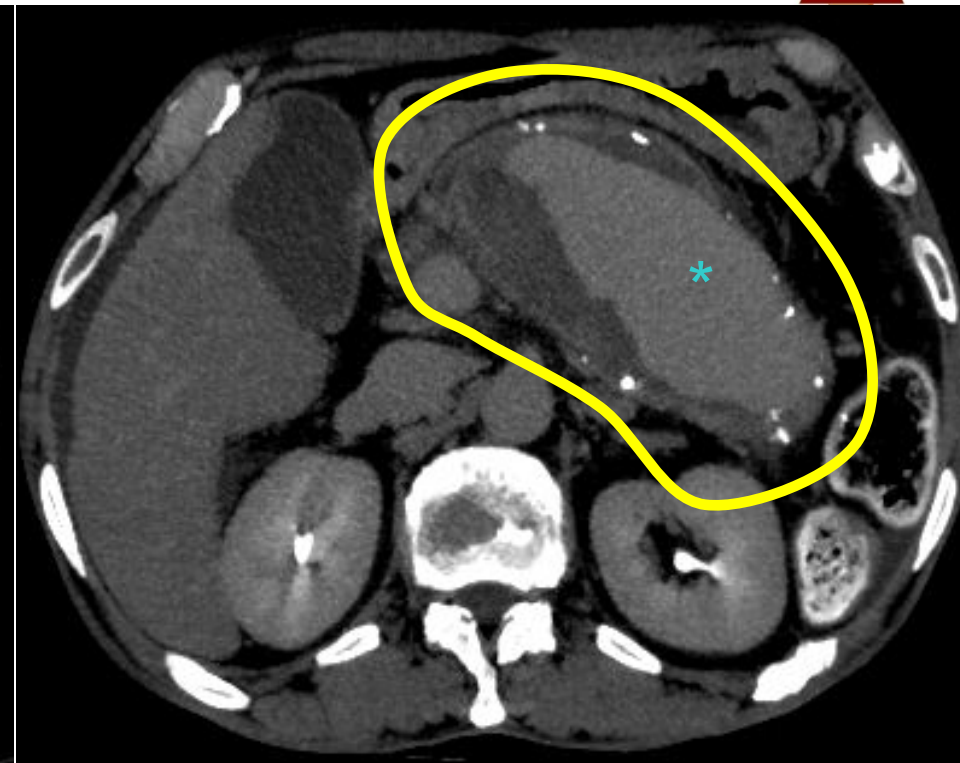


## Table 2

### Approaches for Treatment of Visceral Artery Pseudoaneurysm

Endovascular	Percutaneous	EUS
Most widely used	Failed endovascular	Failed endovascular
Preferred approach	Large, superficial pseudoaneurysm	For pseudoaneurysm seen on EUS
High success rates	Pseudoaneurysm with narrow neck	Gastroduodenal A
	Pseudoaneurysm in solid organs	Splenic A
	Ultrasonography/CT guidance	

A = artery, EUS = endoscopic ultrasonography

**Case 1 : 48 year Male, Chronic Pancreatitis with epigastric pain and melena**

Triphasic CT scan shows **large pancreatic pseudocyst** with increasing density on arterial and delayed phase suggestive of **pseudoaneurysmal bleed(\*)** within the cyst

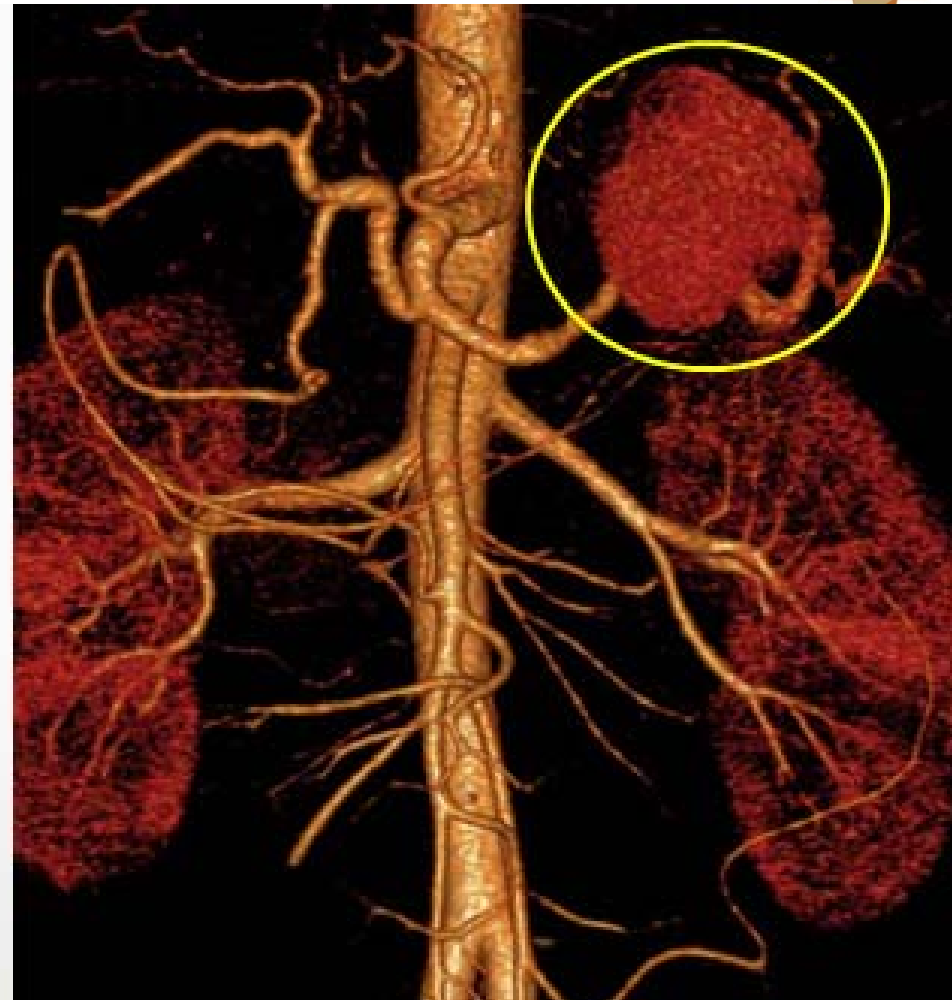
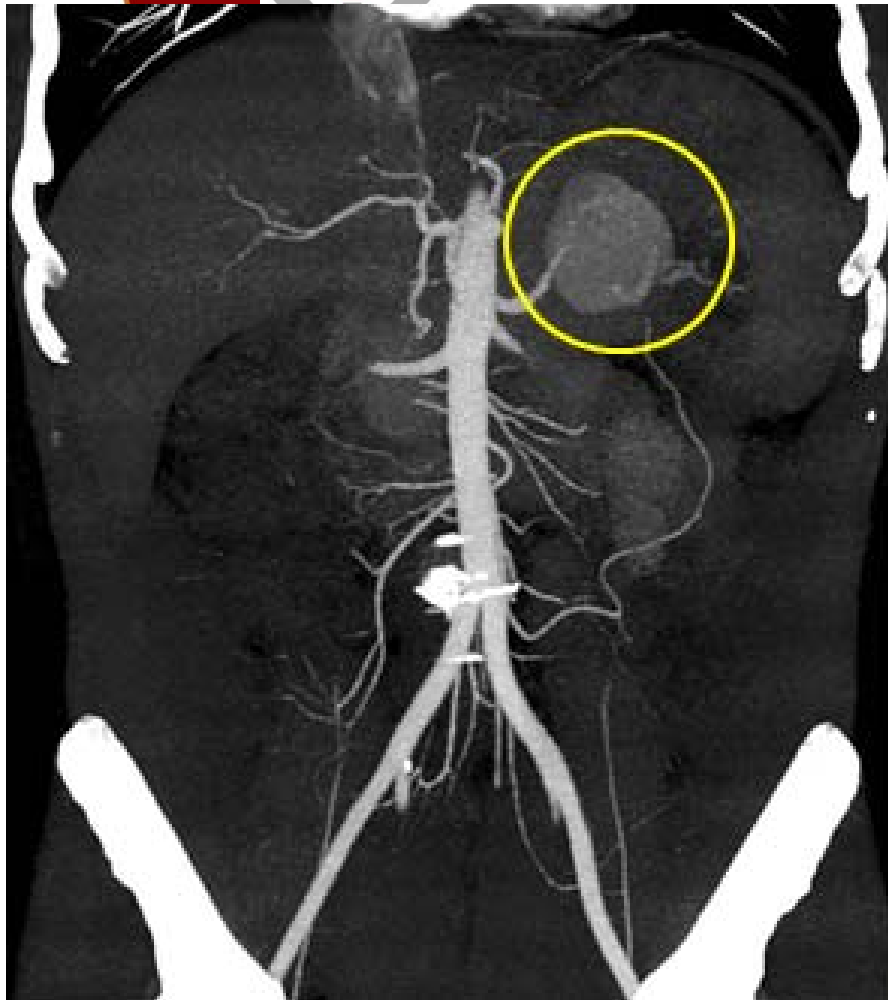
Case 1	Case 2	Case 3	Case 4	Case 5
Case 1 : Chronic Pancreatitis with epigastric pain and melena				

Case 1	Case 2	Case 3	Case 4	Case 5
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## Case 1 A : Chronic Pancreatitis with hemetemesis and abdominal pain



Volume rendered CT image shows a pseudo aneurysm arising from splenic artery





Celiac artery angiogram shows a large pseudo aneurysm(circle) arising from the mid part of the splenic artery



Post embolization celiac artery angiogram shows glue cast (arrow) (inset) in the neck of pseudoaneurysm and splenic artery. In this case, pseudoaneurysm is embolised with glue and micro coils (red arrow)



# Coils



## Permanent mechanical embolic agents

Coils  
Detachable  
Non Detachable  
Plugs  
Vascular Occluders

## Risks

**Potential for recanalization** of the embolized sac if the coils are not tightly packed

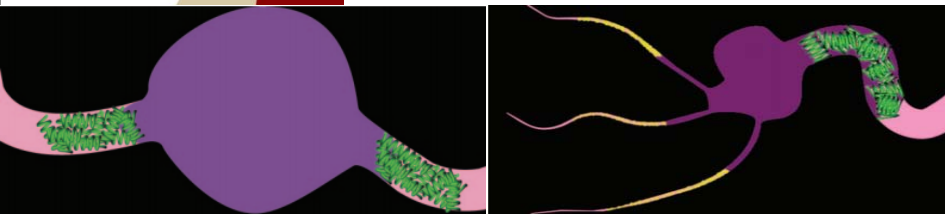
**Coil Migration**

## Principle of use

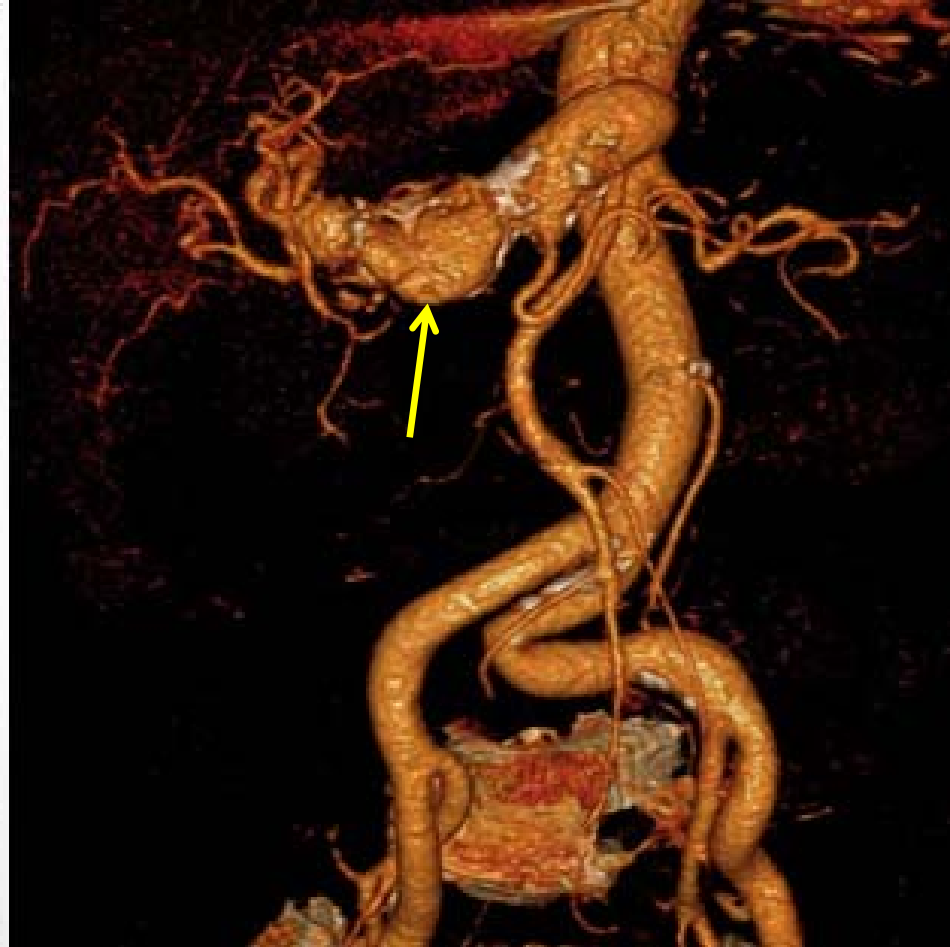
- **Narrow Neck** : Pseudoaneurysm may be embolized with catheter-directed delivery of coils (preferred) into the artery including neck (Sandwich Techinque)
- **Wide neck True aneurysm : Remodelling** by inserting a stent cage and then placing coils through the interstices of stent into the aneurysm

## Mechanism of Action - Coils

- Intimal injury
- Promotion of thrombus formation
  - **Coatings**: thrombin, gelatine, and polyurethane or **fibers**(synthetic materials Dacron, polyester polyamides, and natural fibers such as silk and cotton) to **improve thrombogenicity**
- Mechanical occlusion



## Case 2 : 85 year old with epigastric pain, multiple episodes of hematemesis



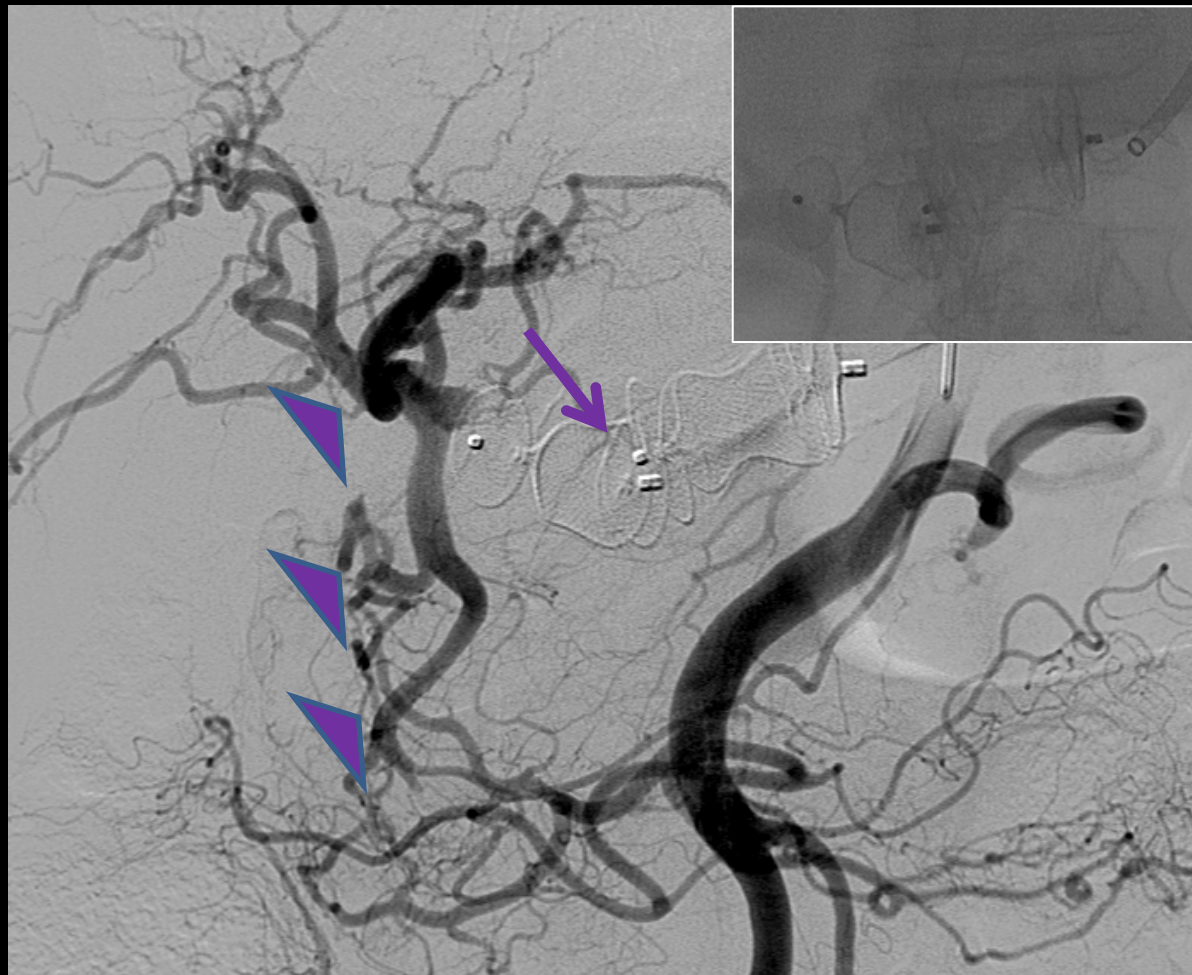
Reformatted CT images shows fusiform **dilated true aneurysm of the celiac axis (arrow)** with splenic and left gastric artery arising from it. GDA is arising from normal calibered CHA

Case 2 : 85 year old with epigastric pain, multiple episodes of hematemesis



Celiac artery angiogram shows fusiform aneurysm of celiac axis with nipple like protusion from it suggestive of bleeding site.





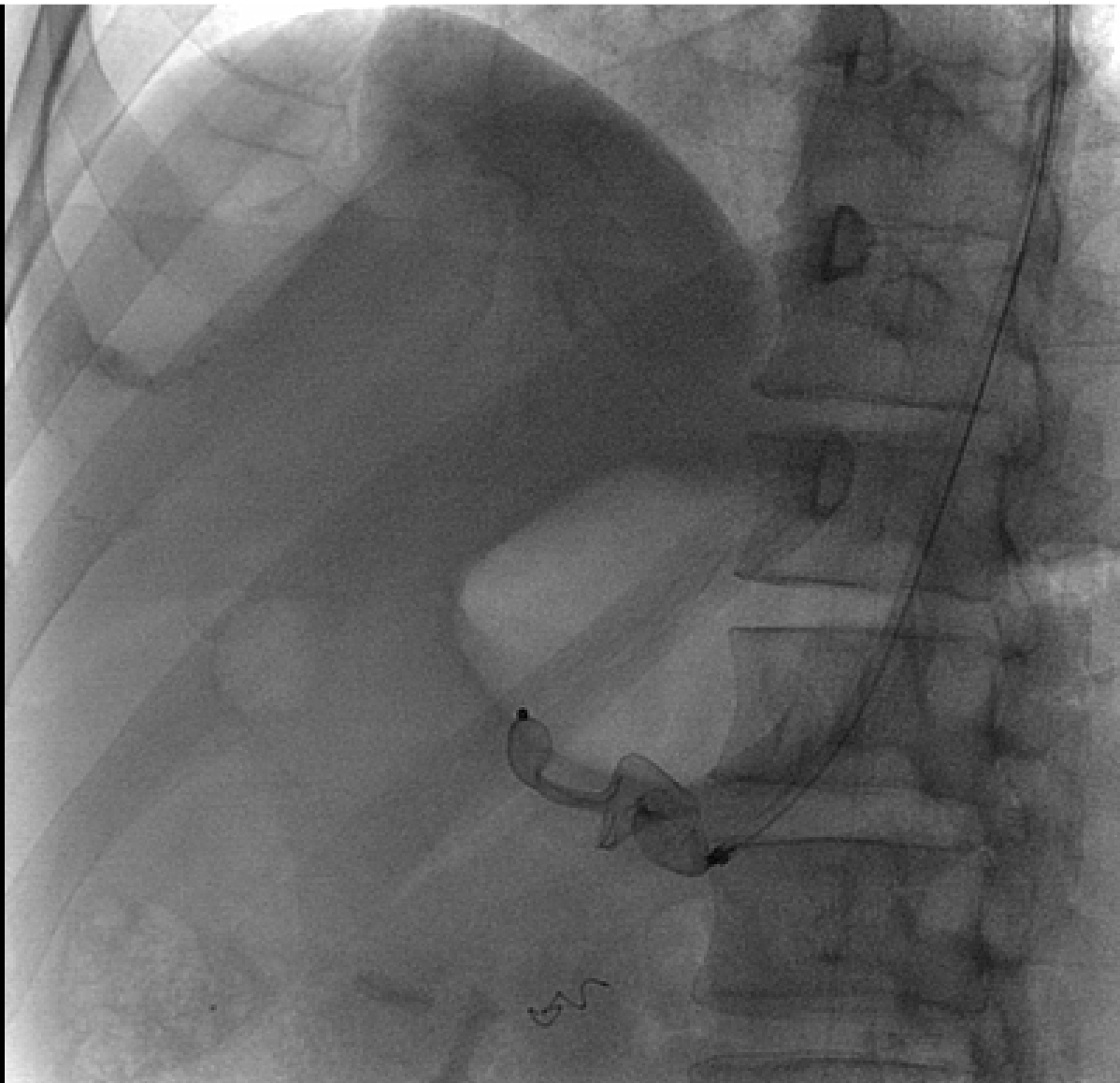
Post celiac artery aneurysm coiling. SMA angiogram shows filling of hepatic circulation via gastroduodenal arcade (arrow head). Vascular plugs are seen in celiac axis aneurysm site (arrow and inset).

Case 1	Case 2 A	Case 3	Case 4	Case 5
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**Case 2 : 62 year old with pain abdomen, on CT Angio CAA, normal GI vessel.**



Celiac artery angiogram through left transbrachial route shows fusiform aneurysm of celiac axis with left gastric , CHA and splenic arising from aneurysm.



Vascular plug deployment through long sheath ( Two vascular plug 16 mm x 2 cm) and 3 mm coil in collateral branch.





Post celiac artery aneurysm coiling. SMA angiogram shows filling of hepatic circulation via gastroduodenal arcade (arrow ). Vascular plugs and coils are seen in celiac axis aneurysm.



# Vascular Plugs



## Technique

The AVP (Amplatzer Vascular Plug) is a self-expanding nitinol wire mesh

Released by anticlockwise rotation of the delivery wire, which unscrews the plug from the wire. This creates a stainless steel scaffold system onto which a nest of coils can be built up. The device prevents distal embolization of coils.

## Advantages

**Reduces the time to occlusion** for transcatheter embolization

Maintaining **complete control** during positioning and delivery.

Provides full cross-sectional vessel coverage which **minimizes migration and recanalization potential**

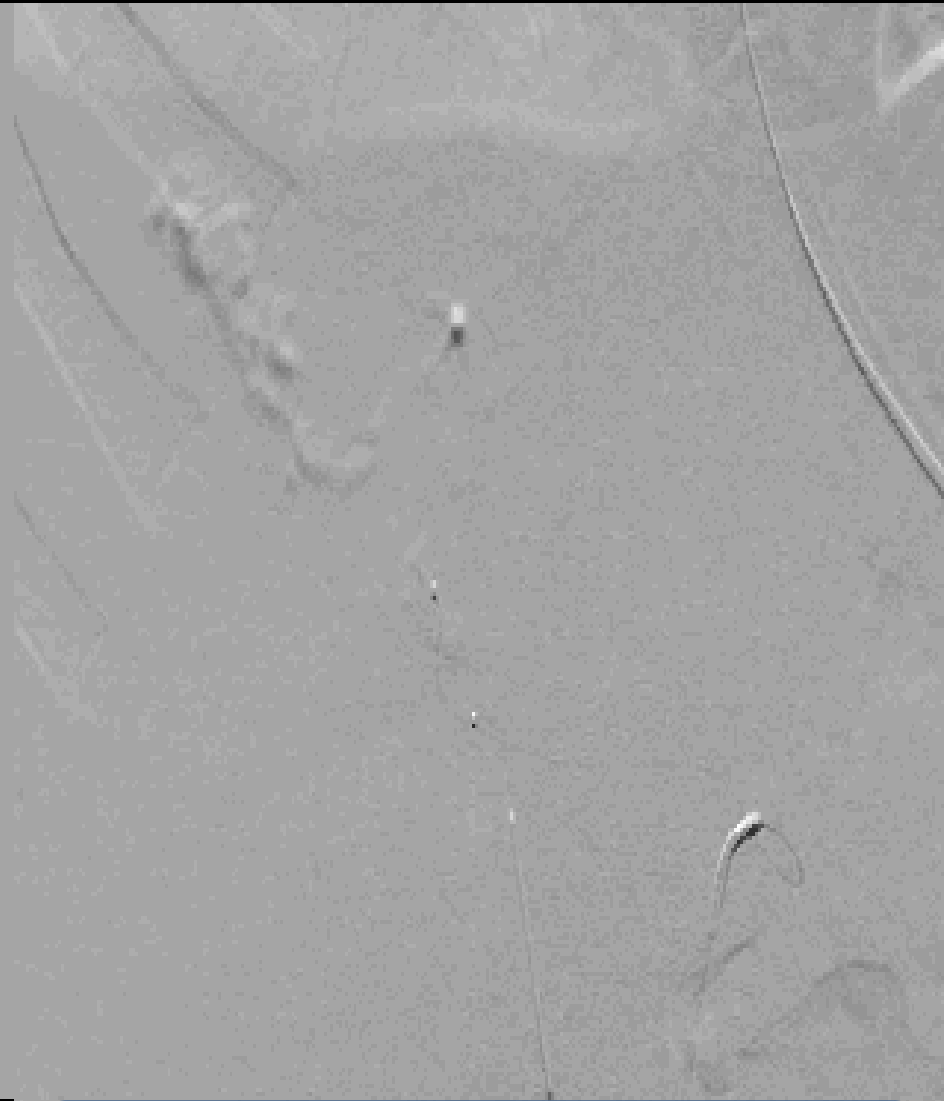
## Limitations

- Cylindrical device and needs a short segment of vessel (1.5–2 cm) with a constant diameter. **Tapered vessels may cause poor apposition** of the device
- AVP is **not suitable for occlusion of small vessels** in which total occlusion can be achieved with 1 or 2 coils. In such small vessels, coil embolization is less expensive

## Case 3 :23 Y M, History of trauma with hemoperitoneum and hemobilia

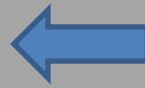


Celiac artery angiogram shows active bleed from right hepatic artery branch



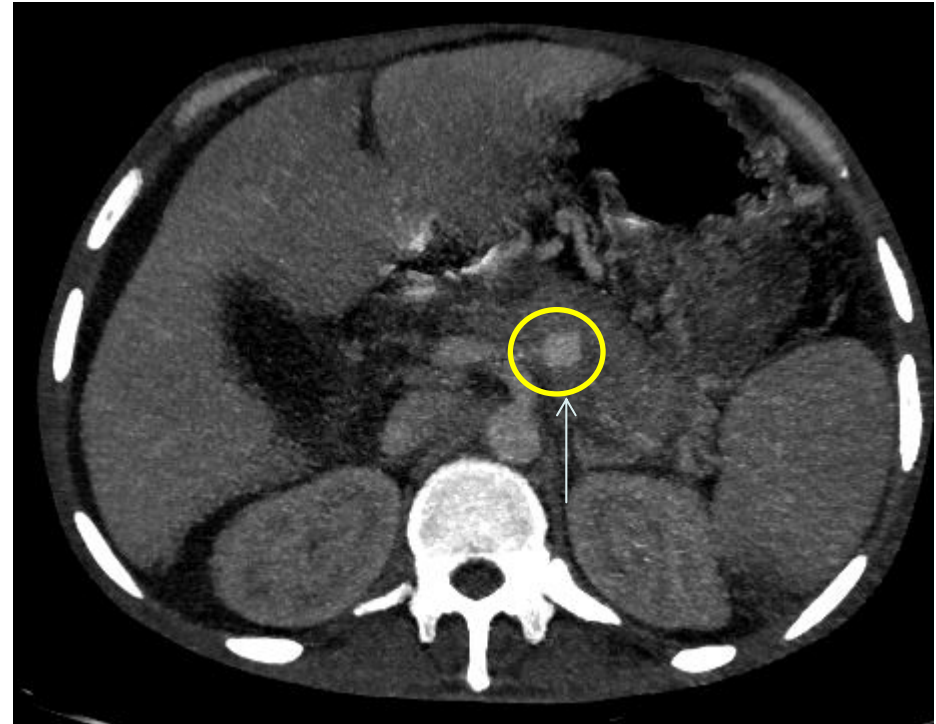
Selective angiogram shows a active bleed (arrow) from right hepatic artery branch.

Glue injection in to the culprit branch



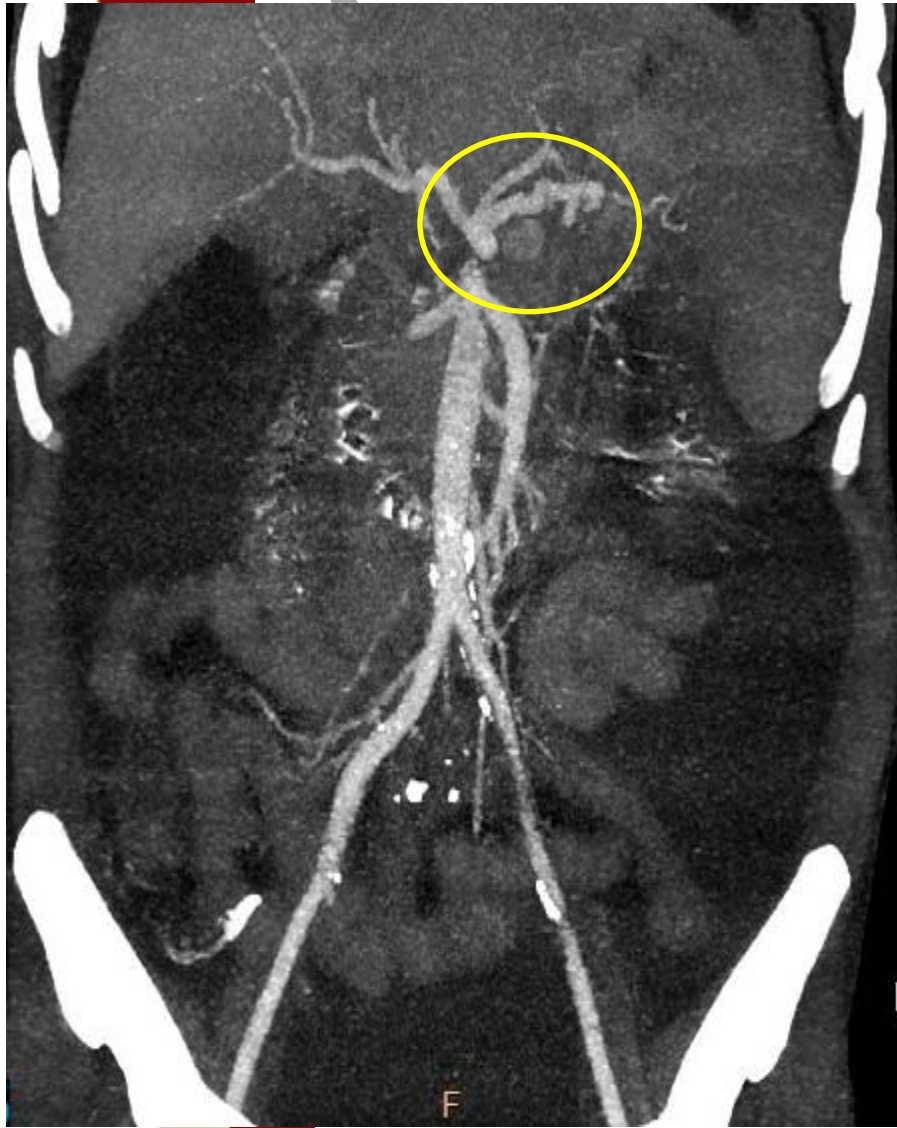
Celiac artery angiogram shows glue cast (arrow) in the psuedoanuerysm with normal perfusion in liver.

## Case 3 A : Chronic Pancreatitis with heamosuccus pancreaticus



Triphasic CT scan shows **pancreatitis** with increasing density on arterial and delayed phase suggestive of **pseudoaneurysm (arrow)** in relation with splenic artery





Reformatted CT images shows **pseudoaneurysm** inferior to splenic artery  
However no direct communication seen with main splenic artery.

Case 1

Case 2

Case 3 A

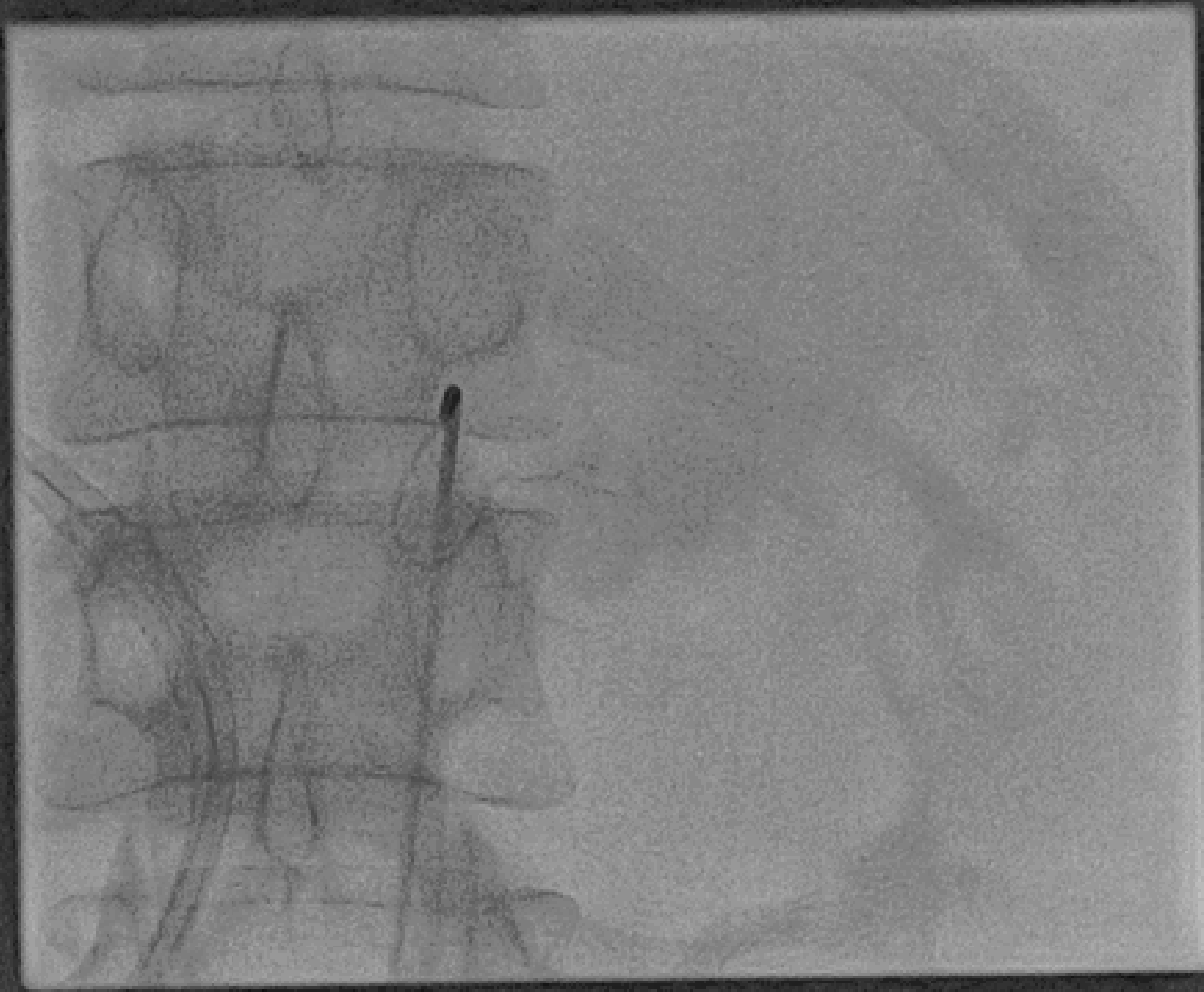
Case 4

Case 5



Celiac artery angiogram shows a pseudo aneurysm (arrow) arising from small pancreatic branch



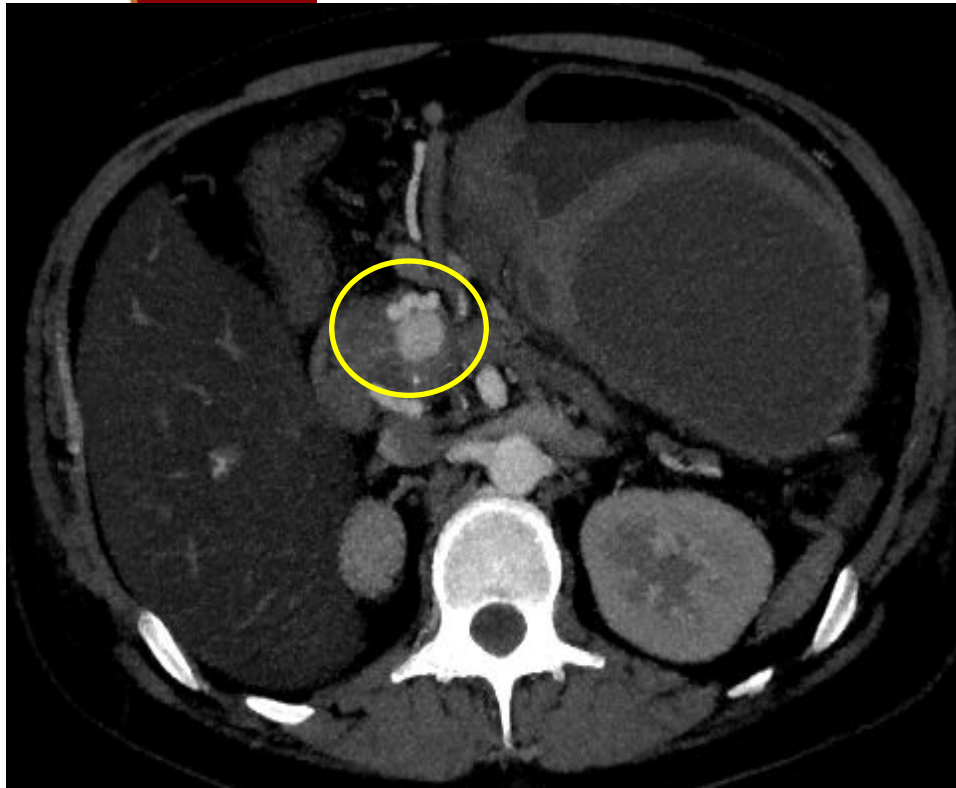


Glue injection into the pseudoaneurysm and distal branches



Post embolization Celiac artery angiogram shows glue cast in the pseudoaneurysm with normal flow in CHA and splenic artery.

## Case 3 B : Chronic Pancreatitis with malena and significant Hb drop



Triphasic CT scan shows **pancreatitis** with increasing density on arterial and delayed phase suggestive of **pseudoaneurysm (arrow)** in gastroduodenal arcade with celiac artery ostial stenosis



Reformatted CT images shows **pseudoaneurysm** in gastroduodenal arcade possibly from branch of arc of Bühler

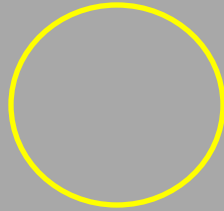
Case 1

Case 2

Case 3 B

Case 4

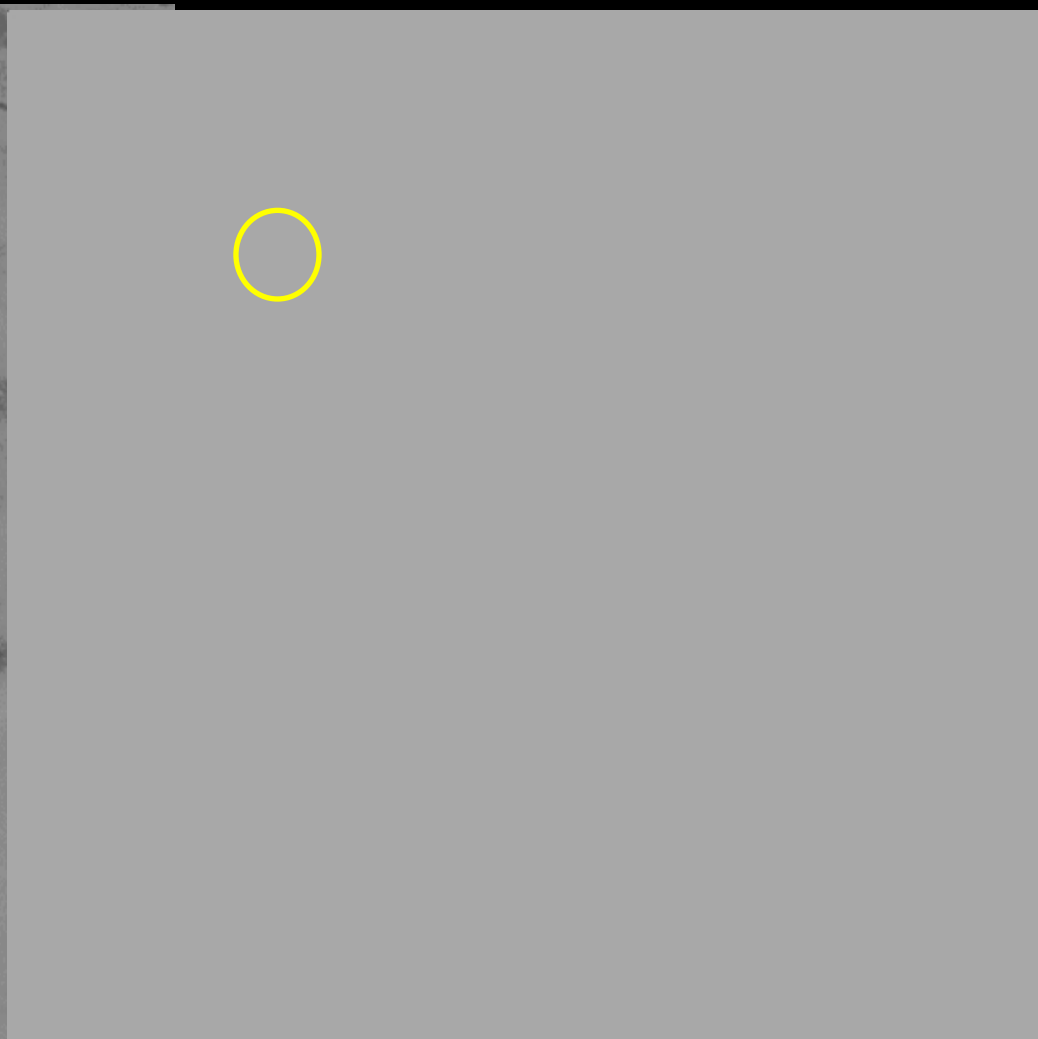
Case 5



Superior mesenteric artery injection shows the pseudo-aneurysm and intact pancreaticoduodenal artery arcade (PDAA), both arising from same SMA branch vessel. Celiac artery narrowing with reverse flow seen in CHA on celiac artery cannulation

Pre-embolization catheterization through reverse route showing microcatheter in inflow segment of the aneurysm





Deployment of Hilal coil, Migration of first coil noted( in liver area) after another coil placement in inflow supply Glue injection done in aneurysm and outflow.

Case 1

Case 2

Case 3 B

Case 4

Case 5



Postcoiling image documents glue cast in aneurysm and outflow channel and arteriogram demonstrates exclusion of aneurysm with patent PDAA and filling of hepatic and splenic circulation.





# Glue



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## Liquid Embolic Agents

Sclerosant agents :

Absolute alcohol, sodium tetradecyl sulphate (STD)

### Glues

N-butyl cyanoacrylate (NBCA)

Elastic polymers

Ethylene vinyl alcohol/dimethyl sulfoxide (OnyxR)

Iodized poppy seed oil droplets

Lipiodol

## Used in

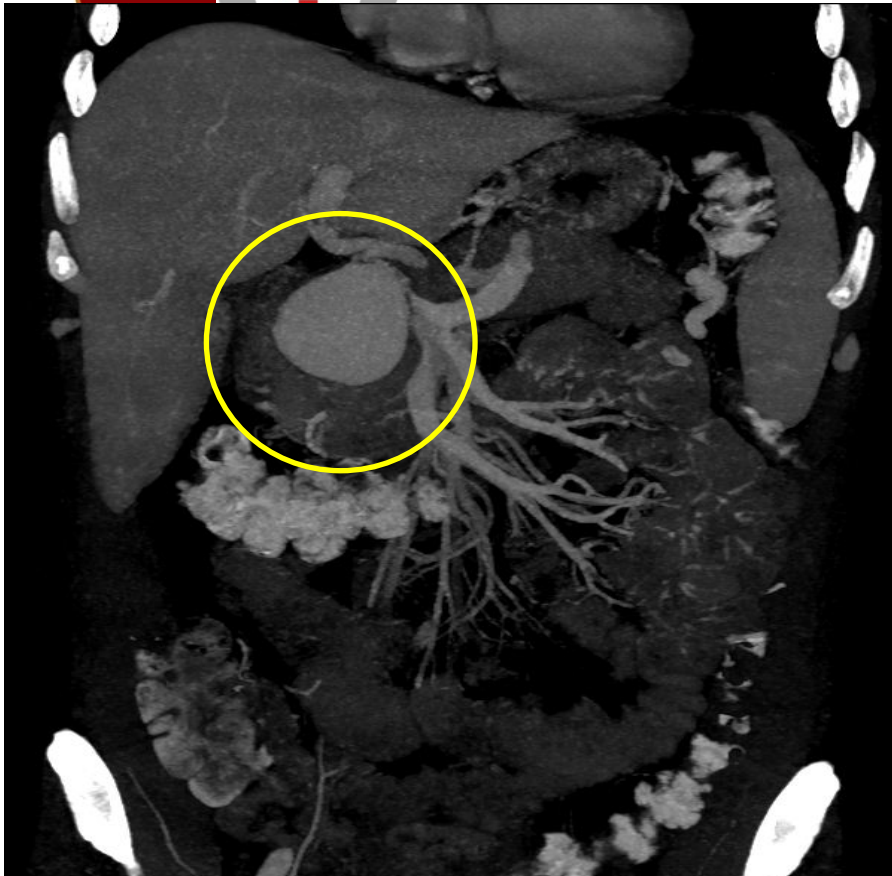
- Treating large, high-flow lesions, such as AVMs
- Thoracic duct ablation for postoperative chylothorax
- Trauma
- Upper gastrointestinal bleeding

## Mechanism of Action - GLUE

**Polymerizes** into a solid material upon contact with any ionic media such as contrast, body fluids or tissues

The rate of polymerization and thereby the depth of polymer penetration into a vascular structure can be controlled by diluting the glue with nonionic fluids (eg. Lipiodol)

# Case 4 : 44 year Male, Acute Biliary Pancreatitis (Post ERCP) with hemobilia



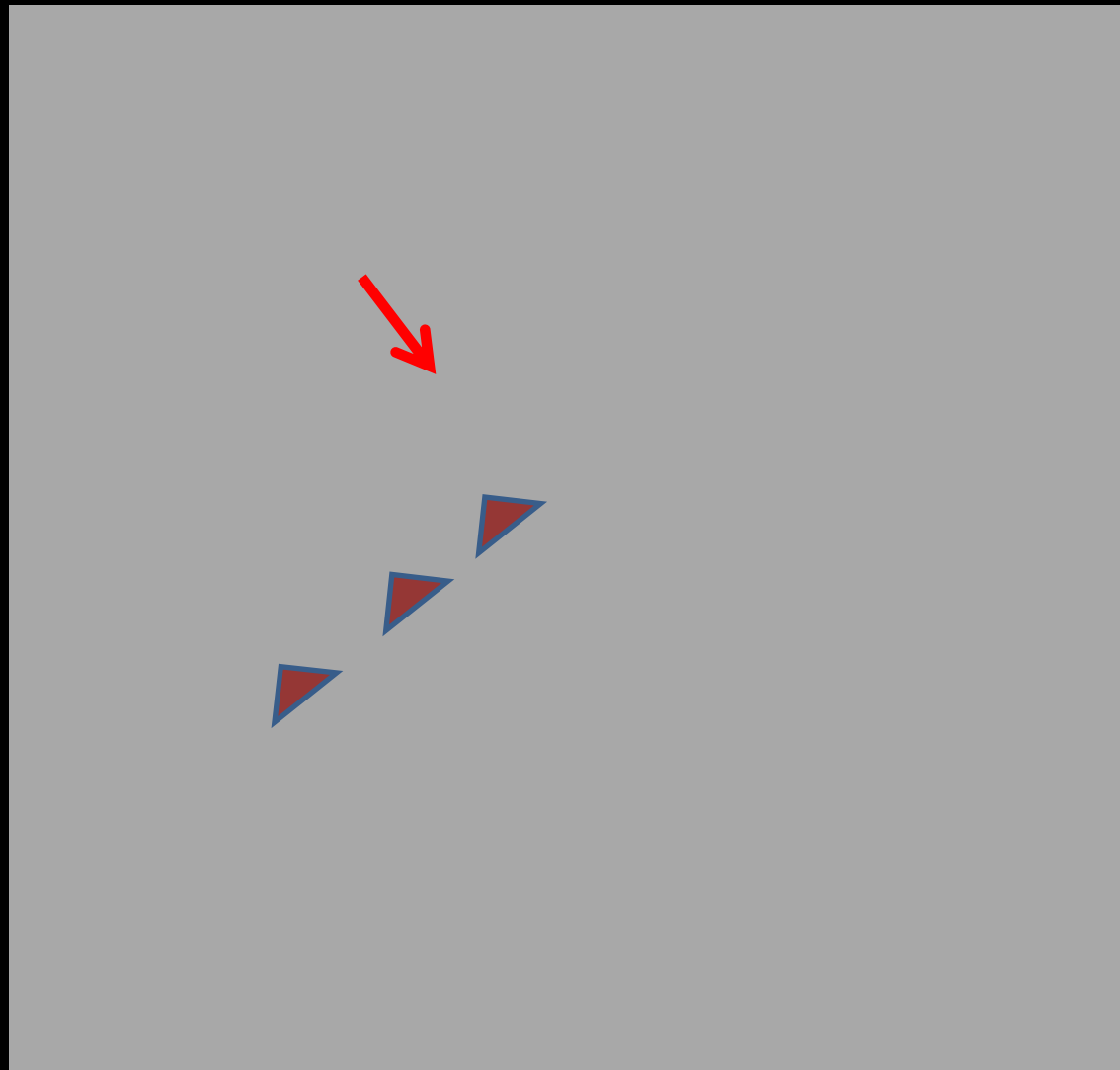
- USG : Pancreatitis with choledocholithiasis with dilated CBD
- ERCP : Mild dilatation of proximal CBD with external compression of lower 1/3<sup>rd</sup> of CBD

Reformatted CT images show large pseudoaneurysm arising from GDA

## Case 4 : 44 year Male, Acute Biliary Pancreatitis (Post ERCP)



Celiac artery angiogram shows a large GDA pseudoaneurysm without distal circulation (arrow showing neck)



Post embolisation celiac artery angiogram – pseudo aneurysm is embolised with 5000 unit of **thrombin** percutaneously (**arrow head showing needle**) and **micro coil**(**arrow**) in the neck of GDA.



# Percutaneous Thrombin Injection



## Technique

Under CT or (preferably) ultrasonographic (US) guidance, thrombin is injected until there is cessation of flow

Coils may be used in conjunction if required as in our case

## Used in

Femoral artery pseudoaneurysms

Small peripheral traumatic pseudoaneurysms of the liver, spleen, or kidney

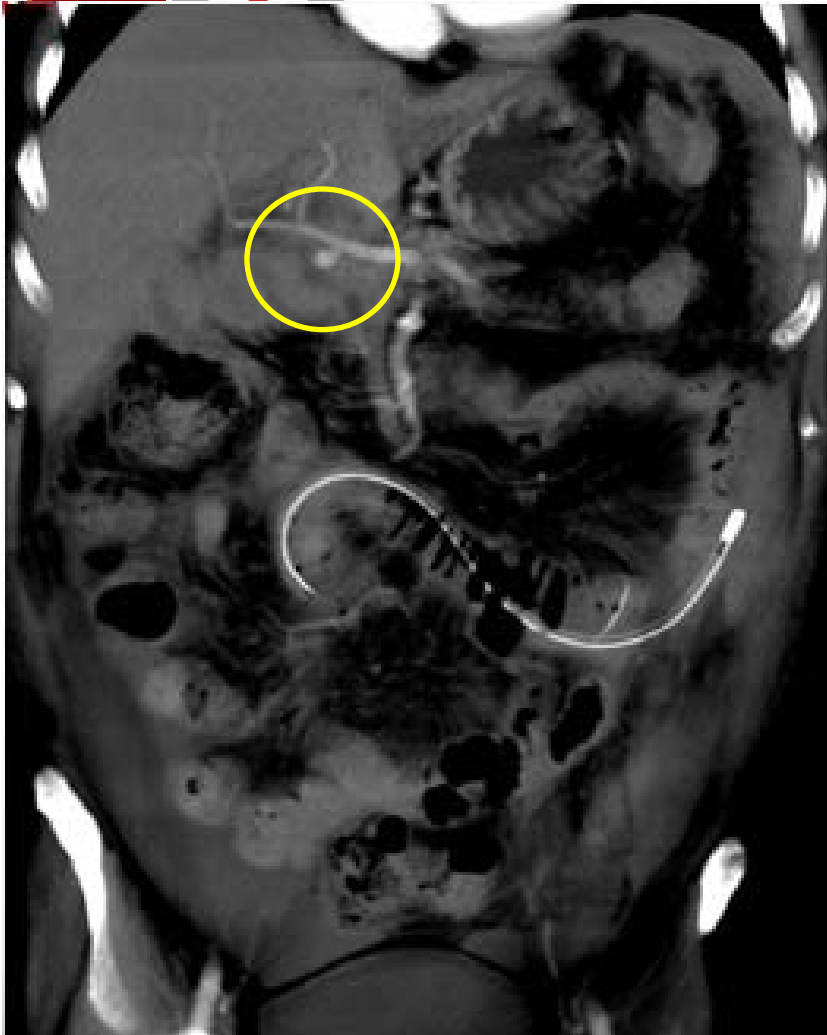
Pancreaticoduodenal aneurysms

## Limitations

Used in percutaneously accessible pseudoaneurysm

*Ghassemi A, Javit D, Dillon EH, Dilton EH. Thrombin injection of a pancreaticoduodenal artery pseudoaneurysm after failed attempts at transcatheter embolization. J Vasc Surg 2006;43:618–622*

## Case 5 : 71 year Male, Post Whipple's surgery with melena and hematemesis



PMER

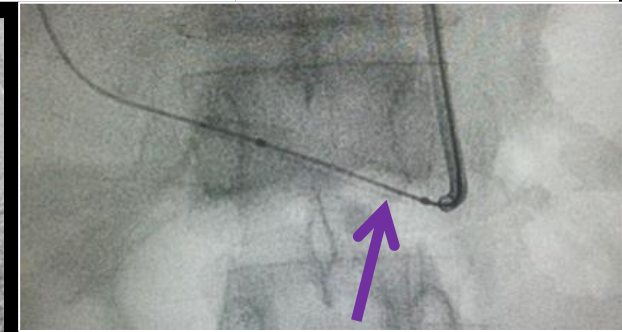
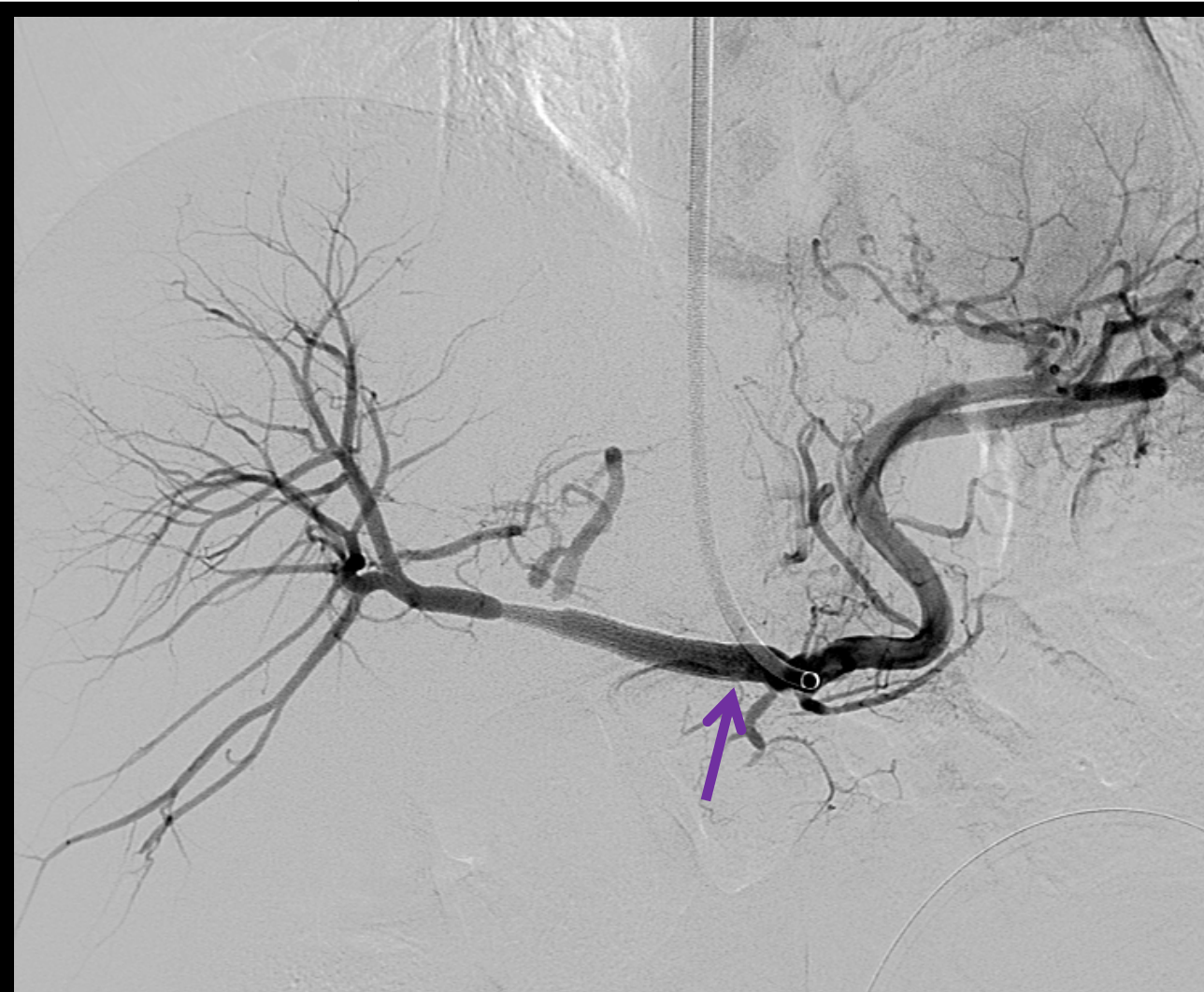
Triphasic CT scan shows a small pseudo aneurysm arising from GDA stump.

## Case 5 : 71 year Male, Post Whipple's surgery with melena and hematemesis



Common hepatic artery(CHA) angiogram through transbrachial artery route shows a small **pseudoaneurysm(arrow)** from GDA stump.





Post stenting celiac artery angiogram. GDA stump pseudoaneurysm is *excluded* by placing a **covered metallic stent**(**arrow and inset**) in CHA. Left hepatic artery is filled by collateral from RHA



# Stent Graft



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## Technique

Placement of a stent to **EXCLUDE** the pseudoaneurysm

Requires a higher profile and a stiffer delivery system than does catheter-directed coil embolization

## Used in

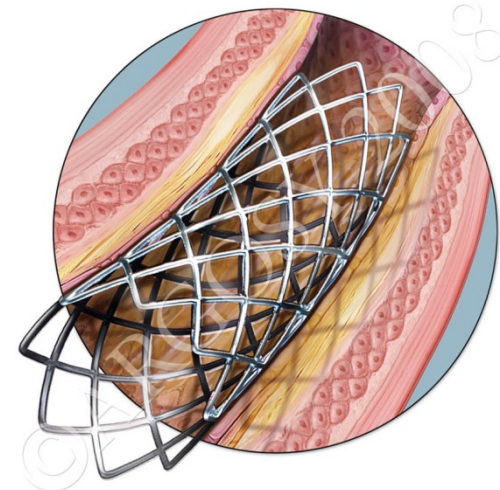
Preferred in arteries **with reduced tortuosity and large diameter**

Visceral pseudoaneurysms, which are usually smaller and located off small and tortuous donor arteries, pose a particular challenge for stent-graft placement

## Risks

In small arteries they pose a higher risk of thrombosis

Relatively contraindicated in mycotic pseudoaneurysms due to potential stent-graft infection





- 42 year Female presented with
- Swelling over face and bilateral lower limb
- S.cr- 4.5
- Renal biopsy was done.
- Post biopsy patient complaint of Hematuria
- Hb drop of 2 gm noted in next 24 hours
- Patient referred to IR department for further management.

**Case 1**

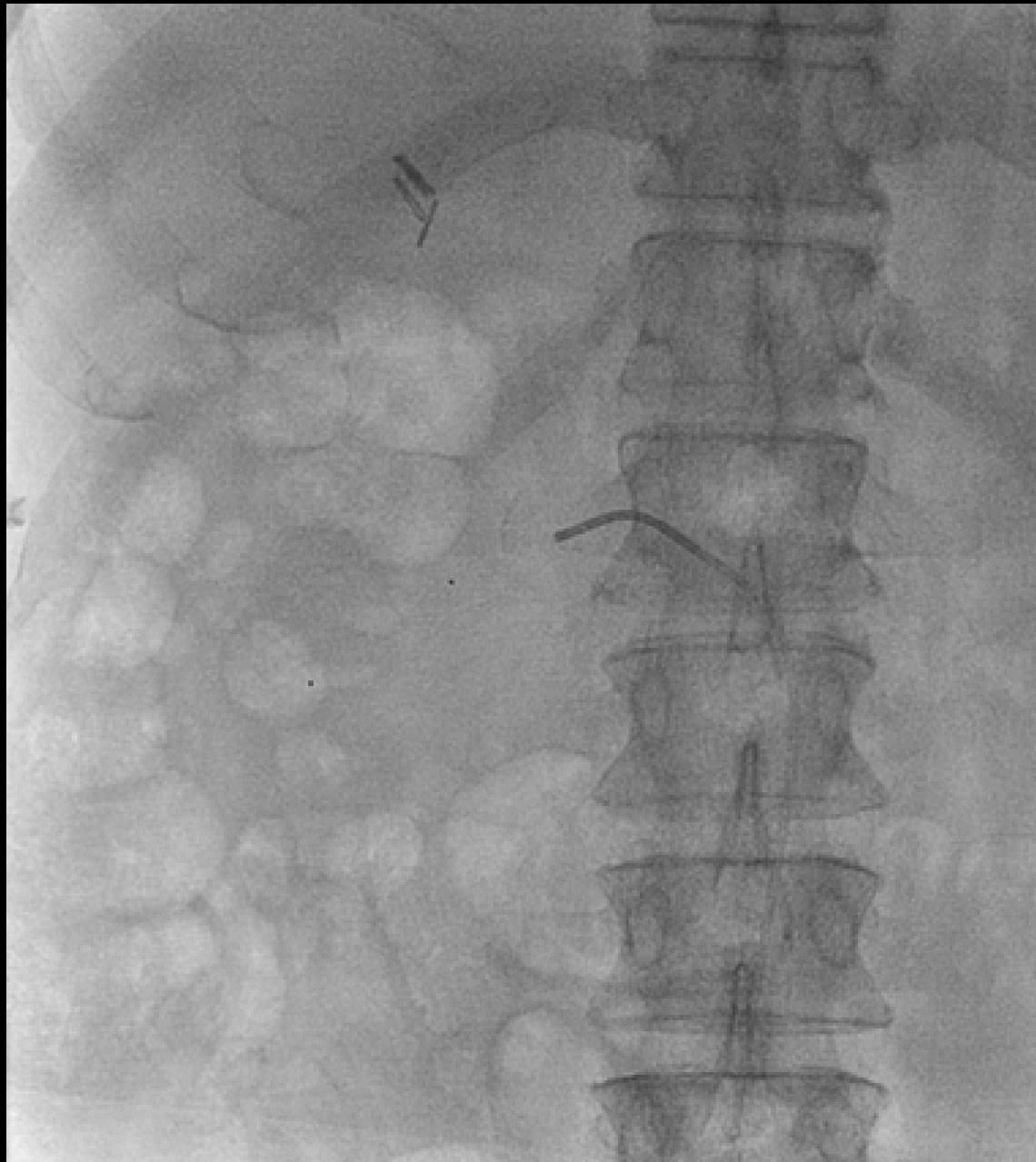
**Case 2**

**Case 3**

**Case 4**

**Case 5 b**





**Case 1**

**Case 2**

**Case 3**

**Case 4**

**Case 5 b**



# TAKE HOME MESSAGE



**NO “one size fits all” solution to embolization**, and success is dependent on tailoring the procedure to suit for the unique problems presented by each patient



**Transcatheter embolization represents the treatment of choice in all GI bleeds (VAA)**

**Before starting any embolization procedure, UNDERSTAND :**

- Pathophysiology of the underlying condition
- Vascular anatomy relevant to the clinical scenario : Anatomical position of the aneurysm, proximal and distal supply and type of aneurysm.
- Different types of embolic agents and how to use them
- Likely therapeutic outcomes of the various therapies

**Advantages over conventional surgical treatment**

- Precise location of the aneurysm and assessment of collateral flow
- Minimal invasiveness for poor surgical risk patients
- Easier approach in those aneurysms in which surgical exposure would be difficult





# References

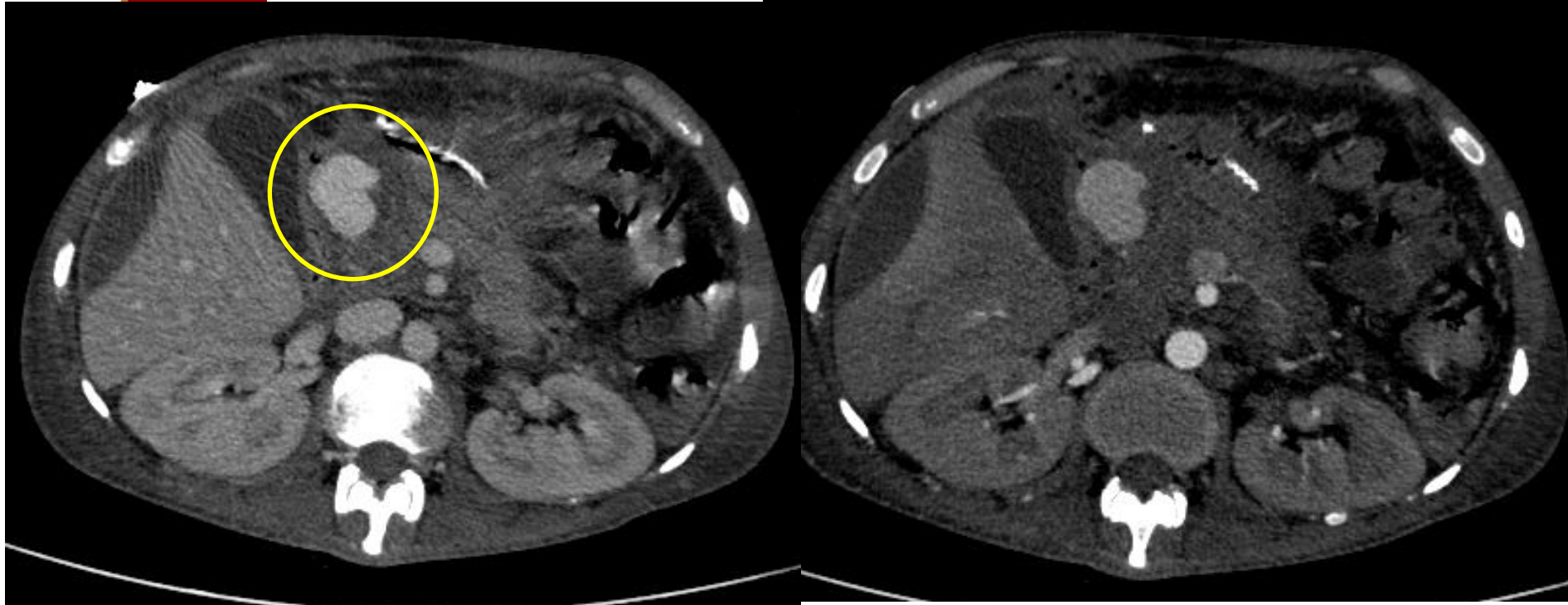


- Huang Y-K, Hsieh H-C, Tsai F-C, Chang SH, Lu MS, Ko PJ. Visceral artery aneurysm: risk factor analysis and therapeutic opinion. Eur J Vasc Endovasc Surg 2007;33(3): 293–301.
- Sachdev U, Baril DT, Ellozy SH, et al. Management of aneurysms involving branches of the celiac and superior mesenteric arteries: a comparison of surgical and endovascular therapy. J Vasc Surg 2006;44(4):718–724.
- Tulsyan N, Kashyap VS, Greenberg RK, et al. The endovascular management of visceral artery aneurysms and pseudoaneurysms. J Vasc Surg 2007;45(2):276–283.

## Extra Case: difficult to embolize

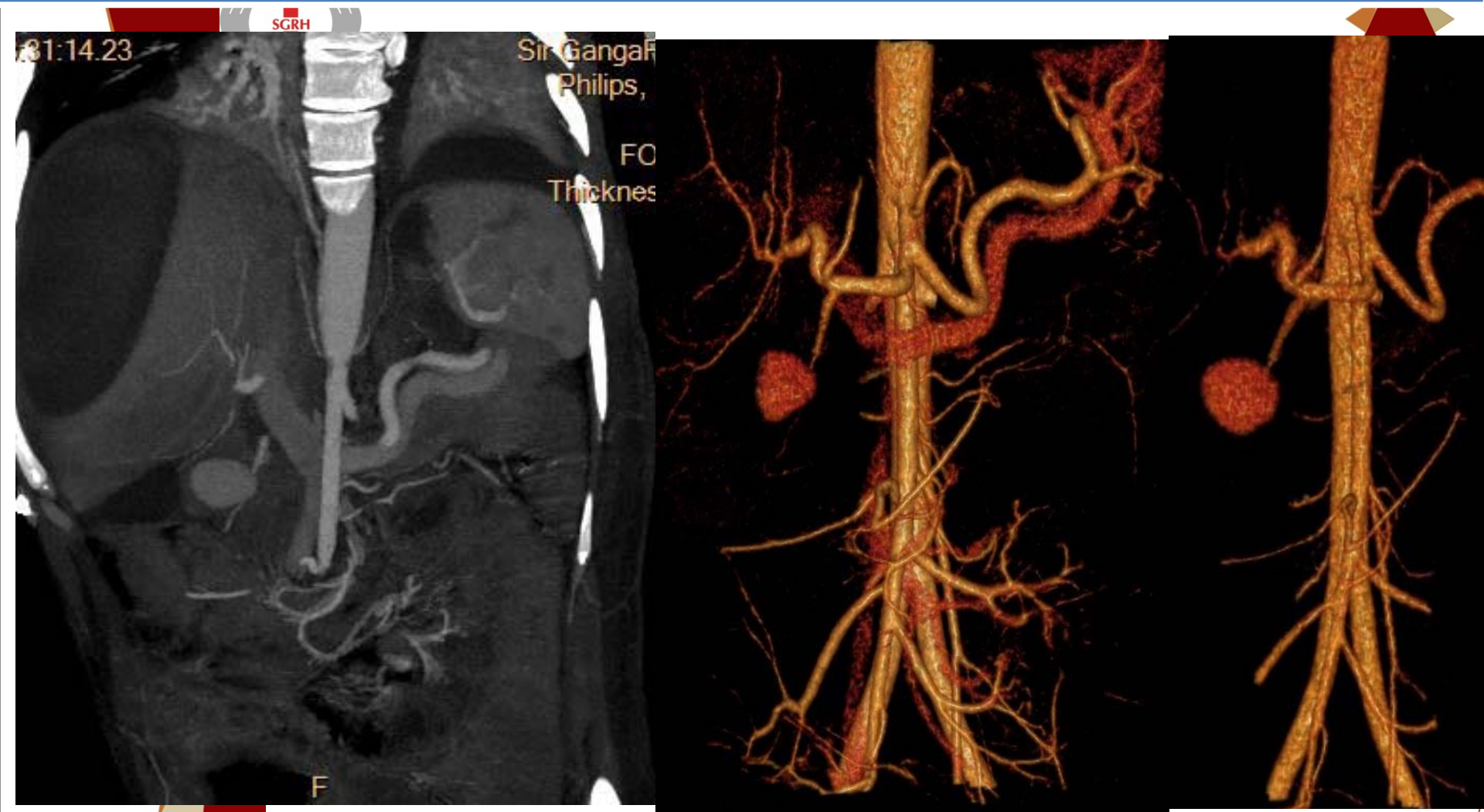
37 Yr Alcoholic with pancreatitis Presented with melena and hematemesis

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Triphasic CT scan shows **pancreatitis** with increasing density on arterial and delayed phase suggestive of **pseudoaneurysm (marked)** in relation with duodenum

## Extra Case: difficult to embolize



Reformatted CT images show large pseudoaneurysm arising from GDA .

## Extra Case: difficult to embolize



## Extra Case: difficult to embolize



## Extra Case: difficult to embolize



## Extra Case: difficult to embolize