

# Endovascular Management of Hepatic Artery

## Pseudoaneurysm

Marlina Tanty R.<sup>1</sup>, Hilwati H.<sup>1</sup>, A Sobri M.<sup>2</sup>

<sup>1</sup>Radiology Department, Faculty of Medicine, Universiti Teknologi MARA, Malaysia

<sup>2</sup>Radiology Department, Faculty of Medicine and Health Sciences, Universiti Putra Malaysia, Malaysia

### ABSTRACT

Hepatic artery pseudoaneurysms (HAP) is a result of injury to the hepatic artery and must be treated due to its high risk of rupture. Endovascular treatment of pseudoaneurysm is effective and minimally invasive. We describe four cases of HAPs that presented with gastrointestinal (GI) bleed. The HAPs developed as a consequence of surgery for carcinoma, infection, trauma due to motor-vehicle accident and biliary instrumentation. Diagnoses were made using CT and conventional angiography. Embolisations were done either to the pseudoaneurysm or the parent artery using glue, Onyx or coils via microcatheter systems. Post-embolisation runs showed no opacification of the pseudoaneurysms and the GI bleed resolved with no recurrence. The final outcome differs according to each patient's underlying illness. We highlight our experience in the endovascular management of HAP using various embolic agents and in particular, Onyx. To the best of our knowledge, this is the first reported case of Onyx embolization of HAP.

**KEYWORDS:** angiography; embolisation, therapeutic; Onyx 18

### INTRODUCTION

Hepatic artery pseudoaneurysm (HAP) is increasing in number due to advancement in imaging modalities, increasing number of minimally invasive biliary procedures and non-operative management of blunt abdominal trauma.<sup>1</sup> CT angiography (CTA) is a valuable tool in the diagnosis of pseudoaneurysm with a sensitivity of 95.1% and specificity of 98.7%.<sup>2</sup> However, conventional angiography remains the gold standard for the diagnosis of pseudoaneurysms.<sup>3</sup> Pseudoaneurysms may be asymptomatic and are detected incidentally. Nonetheless, they are clinically significant due to the high risk of rupture. Transcatheter embolisation using various embolization agents is now the first line treatment for most visceral artery aneurysm.<sup>4</sup>

We describe our experience in the endovascular management of HAP using various embolization

agents and in particular, Onyx, in a series of four cases. Onyx is a non-adhesive liquid embolic agent introduced in 2007 and are now widely used for endovascular treatment of intracranial aneurysms. To the best of our knowledge this is the first reported case of transcatheter Onyx embolization of HAP.

#### Case 1 - Embolisation using glue followed by Onyx

A 52-year-old male with history of Whipple's procedure and multiple laparotomies for periampullary carcinoma presented with melaena and fresh bleed from jejunal fistula. Oesophagoduodenoscopy (OGDS) was normal. Urgent CTA revealed an actively bleeding pseudoaneurysm at the proper hepatic artery (HA) measuring 25x18mm (Figure 1a). Selective hepatic angiogram confirmed the findings of a ruptured pseudoaneurysm measuring 14 x 16mm and arising from proper HA near the origin of the left HA. The pseudoaneurysm was cannulated using FasTracker 325 microcatheter (Boston Scientific) and 2.5 ml of 25% histoacryl glue was injected in the pseudoaneurysm. Post-embolization run showed no active contrast extravasation.

Patient redeveloped upper gastrointestinal bleed the next day and repeat hepatic angiogram

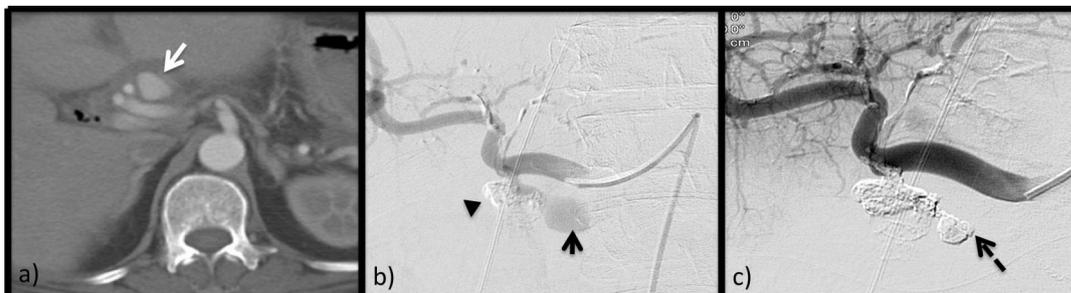
#### Corresponding Author:

Dr. Hilwati Hashim,  
Radiology, Faculty of Medicine,  
Universiti Teknologi MARA,  
Sungai Buloh Campus, Jalan Hospital,  
47000 Sungai Buloh, Selangor, MALAYSIA.  
Tel: 00-60-3-61265338  
E-mail : hilwa167@salam.uitm.edu.my

demonstrated revascularization of the HAP (Figure 1b). The remaining pseudoaneurysm sac was too small with a very high flow within; hence, Onyx is the embolic agent of choice. A total of 1.5mls of Onyx-18 was injected via FasTracker 325 microcatheter to close the pseudoaneurysm communication (Figure 1c). Small amount of Onyx was allowed to reflux into the proper HA to ensure it is sealed completely. Due to the effect of the Onyx,

the reflux results in layering effect in the HA instead of causing occlusion.

Following the embolization, the patient was stable with no new symptoms of gastrointestinal bleed. In view of the history of malignancy, the patient requested for self-discharge from hospital for end-of-life care at home.



**Figure 1:** (a) Axial contrasted CT of the abdomen demonstrated a well-defined hyperdensity at the region of the porta hepatis (white arrow) measuring 2.5 x 1.8cm representing HAP. (b) Pre-embolization run of the hepatic artery angiogram demonstrated an active bleed from the pseudoaneurysm (arrow) which is arising from the proper hepatic artery. Glue cast was seen in the previous HAP that was embolised one day before (arrowhead). (c) Post-embolization demonstrating Onyx within the sac with no opacification of the pseudoaneurysm (dashed arrow).

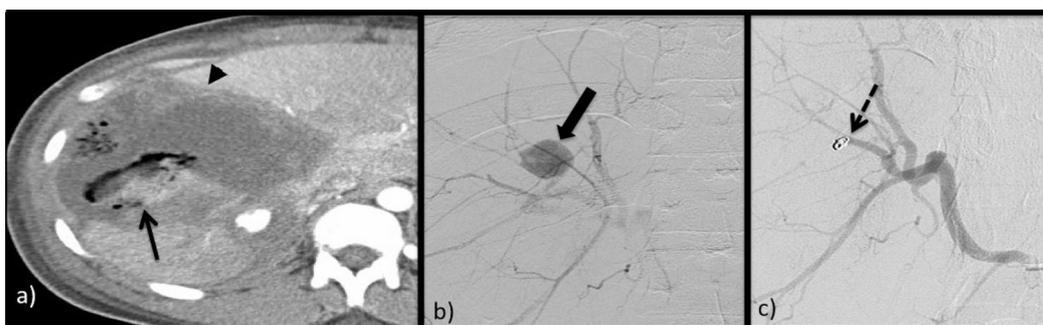
### Case 2 - Embolisation using coils

A 20-year-old male presented with a Grade III and IV liver lacerations after a motor-vehicle accident. Exploratory laparotomy and liver packing was performed. Post-operative CT at day 12 showed a pseudoaneurysm measuring 15 x 17mm arising from a posterior branch of the right HA with surrounding haematoma of the liver (Figure 2a). Multiple air pockets are noted within the haematoma, which was likely due to post-operative changes. No significant contrast extravasation was seen in the delayed phases.

of the parent artery was unsuccessful, it was decided to insert 2 coils (Cook) measuring 3 x 2mm at the middle branch of the right HA itself. Selective angiographic run post-coiling showed no contrast opacification of the pseudoaneurysm, with no more flow in the upper, middle and inferior branches of the right HA (Figure 2c).

Selective hepatic angiogram using a FasTracker microcatheter identified a pseudoaneurysm that arises from the middle branch of the right HA (the parent artery) (Figure 2b). However, as cannulation

Following the embolization, there were no new symptoms to suggest recurrence of pseudoaneurysm. Although the parent artery was embolised, there were no symptoms to suggest complications has arisen from it such as liver failure or biliary tree fibrosis. The patient continued to receive care for other injuries sustained during the accident and was subsequently discharged after a few months.



**Figure 2:** (a) Axial contrasted CT of the abdomen demonstrated a HAP measuring 1.5 x 1.7mm (black arrow) with surrounding haematoma (arrowhead). (b) Pre-embolization run of the hepatic artery angiogram demonstrated pseudoaneurysm arising from the middle branch of the right hepatic artery (thick arrow) (c) No opacification of the pseudoaneurysm noted post coiling (dashed arrow).

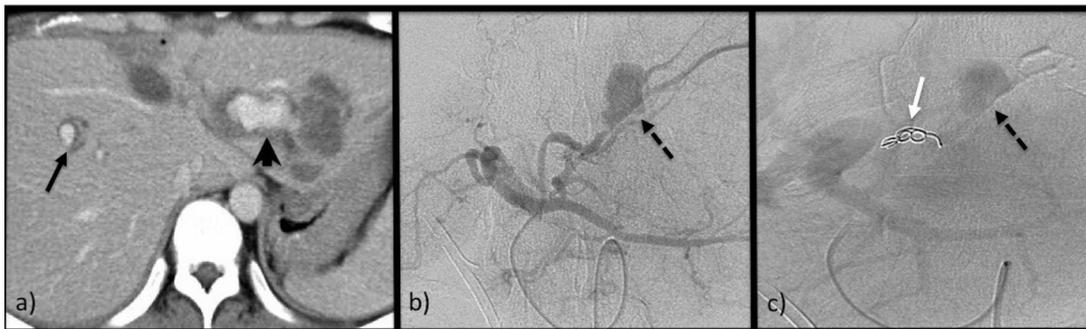
### Case 3 - Embolisation with gelfoam followed by coils

A 15 year old male presented with fresh melaena and hypotension. He had a history of sphincterotomy and CBD trawled due to aschiasis that has caused ascending cholangitis and complicated by persistent haemobilia. An exploratory laparotomy was done where gastrostomy to drain the clots and cholecystectomy was done. CT abdomen post-surgery demonstrated active contrast extravasation into the intrahepatic ducts, common hepatic ducts, CBD and duodenum and a pseudoaneurysm in the distal branch of the right HA (Figure 3a).

Selective right HA angiogram showed minor contrast extravasation in the right HA. Prophylactic embolization of the right HA was performed using gelfoam. No contrast extravasation was noted in the post-embolization run.

Three days later, patient developed severe epigastric pain with fresh blood in the drain. A repeat CT showed significant contrast opacification of the common hepatic duct, CBD and duodenum and a right HAP. Selective hepatic angiogram identified a 3mm pseudoaneurysm at one of the distal branches of the right HA (Figure 3b). FasTracker 325 microcatheter was used for selective cannulation of the anterior branch of right HA (parent artery). A 2mm x 40mm vortex coil followed by 2mm x 20mm 2D fiber coil were deployed to embolise the pseudoaneurysm by occluding the parent artery. Post-embolisation run demonstrated reduced flow within the pseudoaneurysm (Figure 3c).

Following embolization, his vital signs improved and there were no further symptoms of gastrointestinal bleed. He continued to receive post surgical care until he was stable enough to be transferred back to a peripheral hospital at his hometown.



**Figure 3:** (a) Axial contrasted CT of the abdomen demonstrated active contrast extravasation into the intrahepatic ducts (arrow) and pseudoaneurysm at the distal branches of right hepatic artery (arrowhead). (b) Angiogram demonstrated the pseudoaneurysm (dashed arrow) arising from the anterior branch of the right hepatic artery (c) post coiling run showed the coils (white arrow) within the donor artery and partial occlusion of the aneurysm (dashed arrow).

### Case 4 - Embolisation with glue

A 76-year-old female underwent laparotomy for a suspicious mass in the neck of gallbladder. Attempted surgical resection of the mass was abandoned due to massive haemorrhage. During laparotomy, the right HA was ligated and retrograde insertion of 12cm 10Fr biliary stent was done. On the sixth day post-surgery, the patient had an upper gastrointestinal bleed. OGDS showed clots in the ampulla alongside the biliary stent. CT showed haematoma communicating with the biliary system and two pseudoaneurysms of the right HA within the haematoma, which was further confirmed with hepatic angiogram. Renegade Hi-FLO microcatheter (Boston scientific) was used to cannulate the distal right HA branches until the neck of the aneurysm.

1.5ml of Histoacryl 30% (Glue) was injected under fluoroscopy guidance for both pseudoaneurysms. Post-embolization run showed no opacification of the pseudoaneurysms.

Following the embolization, there were no new symptoms of gastrointestinal bleed. However, she was too weak for further active surgical intervention. Her family then requested for self-discharge. At the point of writing, no further information is available for this patient.

### DISCUSSION

HAP is the second most common visceral artery aneurysm (1). HAPs are usually iatrogenic but can

also be caused by intra-abdominal infection and trauma. There has been an increase in the reported cases of HAPs in the last two decades which is mainly due to the increasing use of percutaneous and laparoscopic biliary procedures, increasing number of liver transplantation and non-operative management of blunt abdominal trauma.<sup>1</sup> The HAPs in our patients developed as a consequence of surgery for carcinoma, infection, blunt abdominal trauma due to motor-vehicle accident and biliary instrumentation.

Eventhough pseudoaneurysms may be asymptomatic and are detected incidentally, they are clinically significant due to the high risk of rupture. Tessier et al reported that pseudoaneurysm size is not a predictor of rupture and in consequence recommended that all pseudoaneurysms be treated regardless of size and symptoms.<sup>5</sup> HAP may rupture into the gut, biliary system, abdominal and pelvic spaces. They may also manifest as sentinel bleeding from a drain site, or as hematemesis, melena and subcapsular hepatic hematoma.<sup>6</sup> In our patients, all but one patient presented with symptoms of upper gastrointestinal bleed indicating rupture. Two of these patients may have had the HAPs silently for years as a post-surgical complication before they present as acute life-threatening haemorrhage secondary to rupture.

CTA is a valuable tool and has an advantage over other imaging modality, as it is not operator dependent, has shorter acquisition time and allows global overview of the vasculature and detection of other injuries. Soto et al reported that CTA has sensitivity of 95.1% and specificity of 98.7% in detecting proximal extremities pseudoaneurysm.<sup>2</sup> Nonetheless, conventional angiography remains the gold standard for diagnosis as it allows real-time haemodynamic assessment of a vascular bed including identifying collateral vessels and expendability of donor artery which is crucial for treatment planning.<sup>3</sup> The diagnoses of HAPs in all our patients were made via CTA, which demonstrated the size, site and the relationship of the HAPs to the adjacent structures, and were further confirmed by conventional angiography.

Although traditionally surgery is the treatment of choice for pseudoaneurysm, endovascular treatment, which includes stent placement and embolization, have gained popularity and is currently placed at the

top of the treatment algorithm.<sup>7</sup> Embolization techniques include coil placement and injection of endoluminal thrombin, glue, PVA, particles, Onyx or gelfoam. These techniques offer distinct advantage as it is minimally invasive, allow shorter hospital stay and better peri-operative period due to less pain and wound complication.<sup>1</sup> Selection of an optimal endovascular method are individualized and depends on the anatomical location, size of the aneurysm's neck, the expendability of the donor artery and the presence of collateral supply.<sup>6</sup>

Arterial patency can be preserved in saccular type aneurysm where the characterization of the neck allows embolization to be confined to the sac. This technique is usually performed using coils, glue or Onyx and is most suitable in narrow-necked aneurysms. Aneurysms with a wider neck, on the other hand, are more suitably treated via placement of covered-stent across the neck.<sup>6</sup>

When preserving arterial patency is not a priority, treatment is usually via embolization of the parent artery. In the case where collateral supplies are present, embolization has to be performed proximal and distal to the pseudoaneurysm, as occlusion of both the "front and back doors" will prevent the risk of retrograde recanalisation at a later stage. Coil embolization is the frequent method employed for these cases as it provides a highly effective, safe and durable embolisation.<sup>7,8</sup>

The first case illustrates the use of Onyx to embolise a pseudoaneurysm arising in the proper HA. Onyx was used as the initial embolization with 25% glue was unsuccessful and it was absolutely crucial to preserve the patency of the HA proper. Onyx (ethylene-vinyl alcohol polymer) is a non-adhesive liquid embolic agent. It achieves aneurysm exclusion by filling the aneurysm sac with a spongy elastic solid polymer that conforms closely to the wall of the sac. Onyx is a valuable alternative when other materials have failed particularly in cases when parent artery patency need to be preserved. It has been widely used in the treatment of intracranial aneurysm. Bratby et. al and Vargas et. al have reported the usage of Onyx in visceral artery aneurysm involving the inferior pancreaticoduodenal, renal and left gastric arteries.<sup>9,10</sup> To our knowledge this is the first reported case of HAP embolization using Onyx.

For the second and the third case, as the preservation of the arterial patency is not a priority, coils were used to embolise the afferent artery. Coil embolization of visceral artery aneurysms is well described, with initial success rates ranging from 70% to 95%.<sup>1,8</sup> Coils can be used to occlude the parent artery or pack the aneurysm sac. Occlusion is effective when there is no collateral supply to the aneurysm and when the artery can be sacrificed without end-organ damage.<sup>9</sup>

Glue was used to treat the HAPs in the fourth case. Although glue is essentially a safe liquid embolization agent, in inexperienced hands, the rapid early polymerization of glue can stick the delivery catheter to the vessel wall. This will make future surgical repair difficult, should it become necessary.<sup>9</sup>

## CONCLUSION

HAPs are potentially lethal. Treatment is mandatory to prevent rupture. The advances in embolization techniques and embolic agents mean that most lesions in the majority of patients can be treated safely and effectively.

**Conflict of interest:** On behalf of all authors, the corresponding author states that there is no conflict of interest.

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## Abbreviations:

- HAP: Hepatic artery pseudoaneurysm  
 HA: Hepatic artery  
 CTA: CT angiography  
 NBCA: N-butyl cyanoacrylate  
 PVA: polyvinyl alcohol  
 OGDS: Oesophagoduodenoscopy

