aorta[5] and duodenal circular drainage. Yang et al[6] reported their experience with 42 cases of SMAS. Five patients in the series had a DJ initially that failed and patients had persistent vomiting. They recommend the duodenal circular drainage which is a complex procedure and interestingly has not been reported elsewhere in medical literature so far.[6] These procedures need specialised units with expertise which is not always available in a developing country like India and elsewhere. From the above discussion it is evident that DJ does not always result in complete symptom resolution in SMAS. The possible causes for persistent symptoms include ongoing atony, an underlying motility disorder and abnormal peristaltic pattern of duodenum. It is reported that in the duodenum there exist both direct and reversed peristalsis. Normally the direct peristalsis is greater than reversed peristalsis; however in long standing cases with SMAS, the reversed peristalsis is much greater than the direct peristalsis and despite the presence of a duodenojejunostomy, it is likely to lead on to persistent vomiting. Some of the options reported in the management of persistent vomiting are long term prokinetics, use of a gastric pacemaker, conversion to a roux-en-y DJ7 and gastric volume reduction surgery. However there are no large volume studies advocating its routine use. Given the rarity of SMAS, multiple operations described and variable results reported in medical literature, the authors believe that the most important aspects of surgical management of SMAS are patient satisfaction, symptom resolution, and maintenance of nutrition. In patients with persistent symptoms following DJ, there is very little literature published pertaining to their management. The options described are either experimental or involve complex surgical procedures performed in dedicated specialised units. These are not universally available due to lack of access, resource and financial constraints. We strongly believe that a simple addition of a TG and an FJJ at the time of the initial DJ in patients with SMAS (especially with long standing symptoms) has the advantages of a cost effective way of meeting the nutritional requirements and also in draining the gastric and duodenal contents in patients with on-going atony or reverse peristalsis until complete resolution is achieved.

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Arterio-biliary fistula: Interventional management of an unusual presentation

Percutaneous biliary drainage is commonly performed for biliary tract obstruction and is considered to be a safe procedure. Hemobilia is a complication of biliary

drainage, which is mostly transient and self limiting. Massive hemobilia requiring endovascular management is rare. This case report presents a case of biliary-arterial fistula and discusses the possible etiology, management required and ways to avoid vascular injury.

Case Report

A 39-year old patient was diagnosed with resectable hilar cholangiocarcinoma on pre-operative imaging. Pre-operative percutaneous biliary drainage (PTBD) catheter was placed on the left side. The patient was taken for surgery, and operative findings showed an unresectable disease. In the post-operative period, the patient developed bleeding through one of the surgical drains placed in the left sub-hepatic region. The bleeding was intermittent and was amounting to a maximum of 400 ml per day. Patient underwent a CT angiography, but it was reported as normal. On the subsequent days, the patient developed transient hemobilia and subsequent biliary catheter blockade. The bleeding from the surgical drain and biliary catheter was attributed to coagulopathy. The patient was taken for a check cholangiogram and a possible catheter exchange. The cholangiogram showed filling defects within a dilated biliary system. On close inspection, we noticed filling up of the right hepatic artery during the cholangiogram. A subsequent cholangiogram done in subtraction mode confirmed a biliary-arterial fistula (**Figure 1**). The patient was immediately taken up for endovascular management. DSA of the hepatic artery showed a pseudo-aneurysm arising from the right hepatic artery just distal to its origin (**Figure 2**). A micro-catheter was navigated beyond the pseudo-aneurysm and two micro-coils were deployed into the pseudo-aneurysm with part of the coil inside the proximal and distal arterial segments. A post-embolization run showed a completely knocked off right hepatic artery without filling up of the aneurysm (**Figure 2c**). The post-embolization cholangiogram also did not show any evidence of the fistula (**Figure 3a**).

Retrospective imaging review showed a subtle right hepatic arterial pseudo-aneurysm in relation to the biliary catheter (**Figure 4**), which was missed during the initial interpretation.

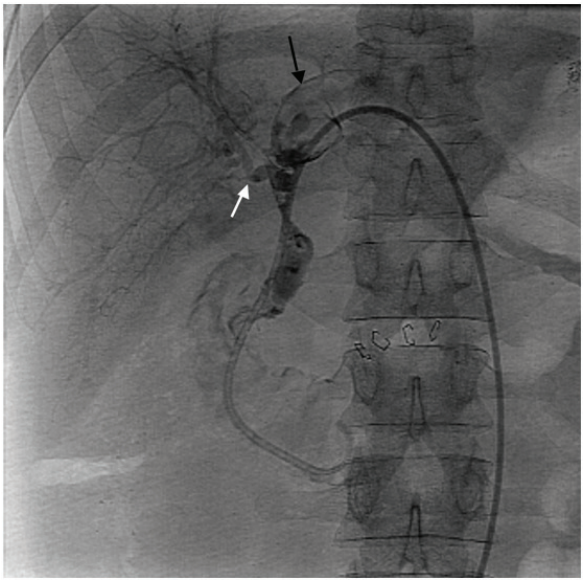

Figure 1: Cholangiogram is showing filling defects within the biliary system.

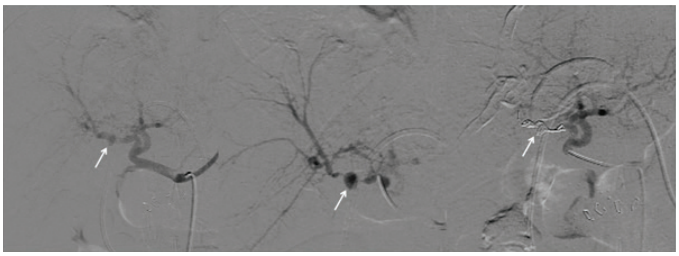

Figure 2: (a): Common hepatic artery and (b): right hepatic artery angiograms are showing a small pseudoaneurysm arising from the right hepatic artery in relation to biliary catheter.

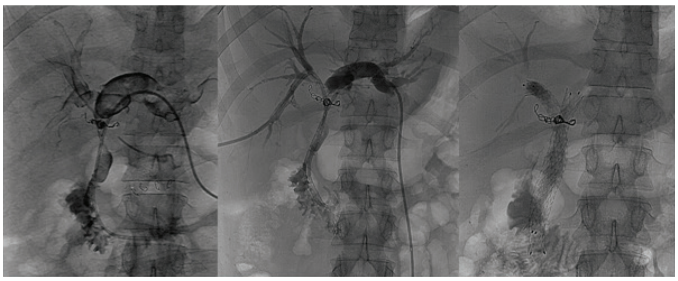

Figure 3: Post-embolisation cholangiogram (a): did not show filling of right hepatic artery. Follow-up images are showing bilateral biliary catheters (b): and stents (c).

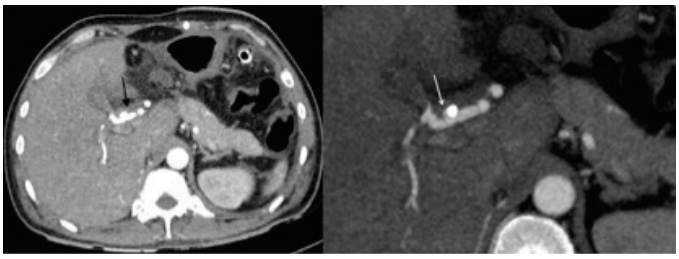

Figure 4: CT angiography arterial phase imaging (a): is showing a biliary catheter in relation to the right hepatic artery. Zoomed up image with a wide windowing (b): is showing a fine streak of contrast around the catheter, which was masked by the blooming around hyper-dense catheter on routine windowing.

The patient was closely followed up for recurrent bleeding. There was no bleeding from the PTBD or surgical drain; however, he developed cholangitis. Another PTBD catheter was inserted into the right system and the patient improved (**Figure 3b**). The patient was planned for discharge with bilateral metallic biliary stents. Bilateral biliary stents were successfully placed without any bleeding during or after the procedure (**Figure 3c**).

Discussion

Biliary drainage procedures are commonly performed for patients with biliary obstruction. Self-limiting transient hemobilia is common. It can be avoided by ensuring that the side-holes of the catheter are completely within the biliary system.[1] If the side-holes lie in the hepatic parenchyma, it would lead to continuous oozing of blood into the catheter. Vascular complications requiring interventions are rare. Quality improvement guidelines for PTBD published in 2010 report an average incidence of 2.5% and have suggested a specific threshold of 5%.[2] Vascular complications of PTBD include pseudo-aneurysm formation, biliary arterial fistula and biliary portal fistula.[3] Central bile duct puncture, perforations of bile duct by guide-wire, mechanical erosion by catheters and multiple needle passes for duct puncture have been described as mechanisms of vascular injury. There are studies indicating that a leftside PTBD has more incidences of vascular complications. It has been attributed to close relation of the left bile ducts with hepatic arterial branches.[3]

Biliary-arterial fistula has been described as a complication of various biliary interventional procedures such as PTBD, endoscopic cholangiography and intra-arterial infusion therapy.[1,4,5] Hemobilia is the most common presentation of biliary-arterial fistula hepatic and othervascular injuries. Biliary-arterial fistula has been described to present early, usually within a week after catheter placement. Pseudo-aneurysm formation is more commonly associated with delayed hemorrhage.[3]

Trans-arterial coil embolizationis most common and highly effective treatment for hepaticarterial injuries including biliary arterial fistula. One case report describes coil placement through biliary tree for biliary-arterial fistula.[6] Hepatic ischemia is a common complicationafter trans-arterial coil embolization and responds to conservative management.[3] Focal hepatic infarction is rare due to the fact that the liver has dual vascular supply through the portal vein and hepatic arteries with intra-hepatic collateral pathways.

Our case report is unique in the way that it shows a biliary-arterial fistula on a cholangiogram. To the best of our knowledge there is no such image in published literature. In our case, thepatient presented with delayed haemorrhage rather than the usual early haemorrhage seen in biliary-arterial fistula. Surgical manipulation of the tumor bed or introduction of infection might be contributing factors for arterial erosion and fistula formation. Our case also highlights the importance of the use of wide windowing during image interpretation of CT-angiographic studies (**Figure 4**), especially when high attenuation objects such as catheters lie within the area of interest.

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