Original Article

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Intervention Techniques and Embolic Agents in the Management of Intraabdominal Visceral Artery Hemorrhage

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Abstract

Background: There are significant morbidity and mortality in patients with acute gastrointestinal (GI) bleeding. As a multitude of pathologic processes results in GI bleeding, the diagnosis and management of GI bleeding are complicated, and it is intermittent in nature. Currently, in the evaluation and treatment of acute gastrointestinal (GI) hemorrhage, there are multiple imaging modalities and therapeutic interventions that are used. The aim is to study the Intervention techniques and embolic agents in the management of intra abdominal visceral artery hemorrhage at Narayana Medical College, Nellore. **Subjects and Method:** This was a prospective observational study done in the department of Radiodiagnosis, Narayana medical college, Nellore.20 patients with intra abdominal visceral artery hemorrhage were referred from gastroenterology, gastro surgery, and nephrology to our department from December 2018 to December 2019, diagnosed by CT angio to have intra abdominal visceral artery hemorrhage due to various conditions like pancreatitis, trauma, post procedures like biopsy or drainage. These cases were managed on an emergency basis by embolization of the bleeding visceral artery. **Results**: Out of 20 patients, 95% were males, and 5% were females. The age range in this study is 16-75 years, with the underlying cause being pancreatic pseudoaneurysms in 12, post-biopsy in 4, post-surgical in 2, and trauma in 2 cases. Coil embolization was done in 13 cases, glue embolization in 6 cases, gel foam embolization in 1 case. **Conclusion**: Intervention radiology management with embolization has now become the first line of treatment in visceral artery hemorrhages. Knowledge about vascular anatomy, collaterals, techniques of embolization, indications of each embolic agent, and adequate expertise is very essential for the interventional radiologist's ineffective management of these cases. When performed in time, these procedures are life-saving and precludes the need for surgery.

Keywords: Intervention techniques, abdominal visceral artery hemorrhage, Pancreaticpseudoaneurysms

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Introduction

There are multiple therapeutic interventions that are currently used in the treatment of acute abdominal hemorrhage. The abdominal aorta branches, the superior mesenteric artery (SMA), and celiac axis provide a rich and well-collateralized network of branch vessels that supply blood to the upper GI tract. Throughout the lower GI tract, the inferior mesenteric artery (IMA) and the Superior mesenteric artery (SMA)form a series of interconnected arcades that provide a collateralized supply.[1] These collateralization vessels protect the upper GI tract from ischemic insult and permit surgical and embolization procedures to be performed with a relatively low risk of ischemic injury. Due to collateral flow to the bleeding site, this collateral pathway decreases the efficacy of superselective embolization.

Contrast-enhanced multidetector-row helical computed tomography (MDCT) scanning has established itself as a "one-stop-shop" for a rapid, noninvasive, and accurate diagnostic method in suspected abdominal arterial bleeding.[2] In the evaluation of a patient with GI bleeding, CT angiography has a crucial role in the pre-procedure, as it provides clinically relevant information about the vascular supply to the bleeding site, the site of active GI bleeding, and the anatomic variation of the mesenteric vessels. This information helps to decrease the procedure times, the amount of contrast material used during angiography, and the number of digital subtraction angiographic exposures and allows faster catheterization of the bleeding vessels. It may also reduce radiation exposure to the operator in the angiography suite and the patient. CT angiography may also provide etiology of the GI bleeding in many cases, thus helping triage patients to surgery, conserva-

tive management, or embolotherapy. [1]

Aims and Objectives

To review the Intervention techniques and embolic agents used in the management of intra abdominal visceral artery hemorrhage at Narayana Medical College, Nellore.

Subjects and Methods

This was a prospective observational study done in the department of Radiodiagnosis, Narayana medical college, Nellore. 20 patients who presented to the emergency medicine department with intraabdominal hemorrhage, hematemesis, Malena, trauma, and shock, and are diagnosed by CECT to have intraabdominal visceral artery hemorrhage due to various conditions like pancreatitis, trauma, post procedures like biopsy were evaluated for emergency embolization. The age range in this study is 16-75 years. The underlying causes being pancreatic pseudoaneurysms in 12, post-biopsy in 4, post-surgical in 2, and trauma in 2 cases. Coil embolization was done in 13 cases, glue embolization in 6 cases, and gel foam embolization in 1 case.

Inclusion criteria

Patients who are diagnosed by CECT have Intraabdominal visceral artery hemorrhage.

Exclusion criteria

Mycotic pseudoaneurysms were excluded from our study.

Interventional Techniques

Approaches for the management of visceral artery pseudoaneurysms include 1) endovascular, 2) endoscopic, and 3) percutaneous. The endovascular approach is the most widely used and preferred method. [3]

For the embolization of a pseudoaneurysm, the endovascular method is the common initial choice. The endovascular method better defines the vascular anatomy and hemodynamics of blood flow through the pseudoaneurysm prior to embolization and thus, helps in avoiding non-target embolization. [4–6] Problems of endovascular embolization include difficult anatomy and difficulty in catheterization due to tortuous artery, short landing zone with the risk of non-target embolization, and inability to approach through a previously blocked artery in cases of recurrent pseudoaneurysms. [5]

Endoscopic or percutaneous techniques are usually reserved for failed endovascular approaches.

Results

Case 1: Case of Acute pancreatitis with splenic artery pseudoaneurysm. Coil embolization by sandwich technique [Figure 5-8].

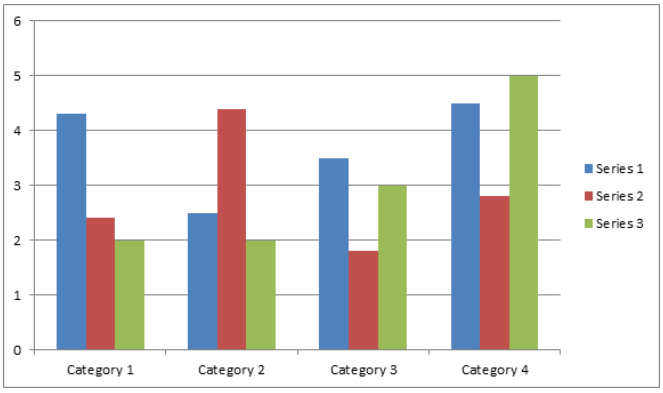

Figure 1: Age Distribution 16 to 25 -2, 26-35-8, 36-45-6, 46-55-2,56-65-1,66-75-1.

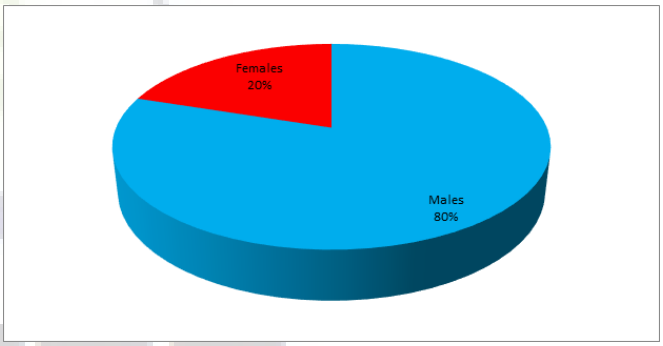

Figure 2: Sex Distribution

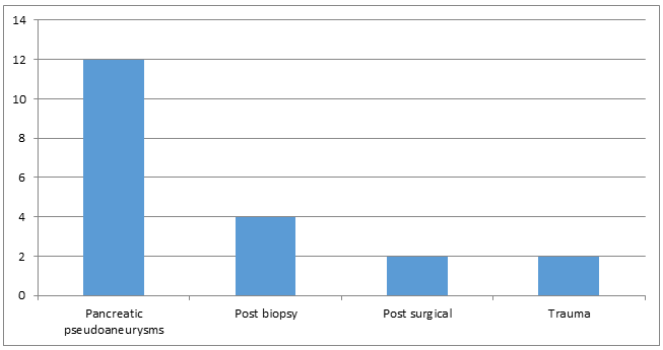

Figure 3: Causative conditions

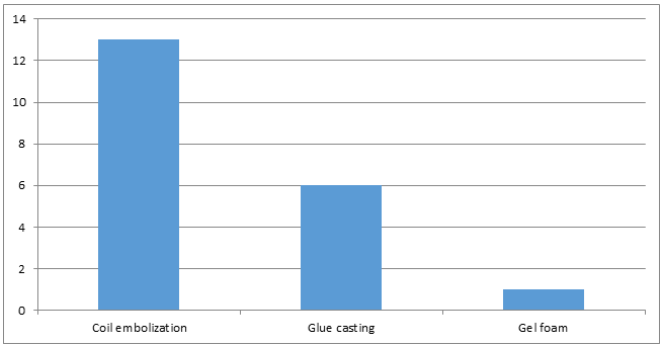

Figure 4: Type of embolization technique.

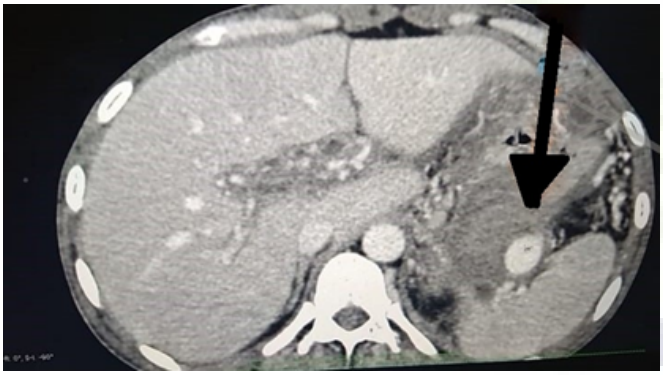

Figure 5: Axial CT SCAN demonstrating active extravasation from splenic artery pseudoaneurysm into the pancreatic pseudocyst

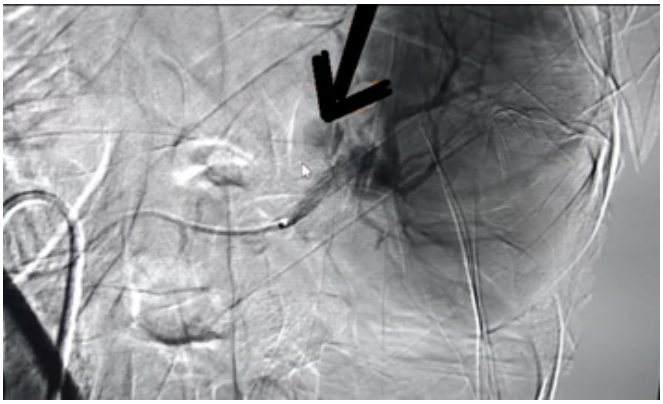

Figure 6: Diagnostic super selective catheter angiogram of a splenic artery demonstrating pseudoaneurysm

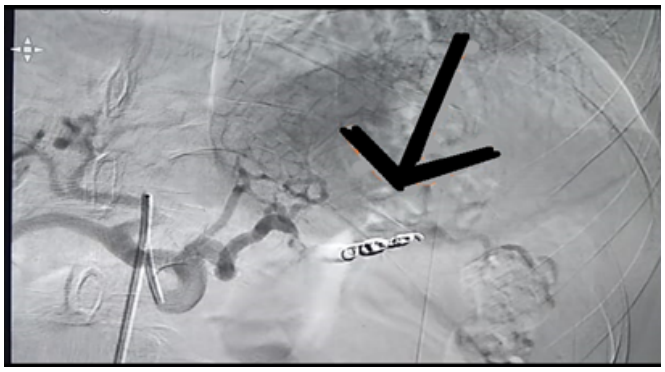

Figure 7: Coil embolization of splenic artery by trap door technique

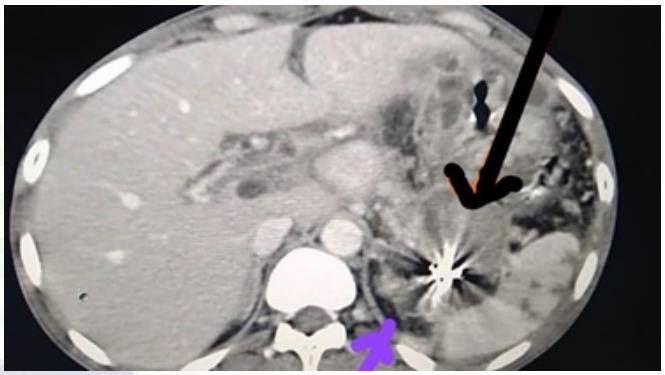

Figure 8: Follow up CT Scan demonstrating coils within the distal splenic artery with complete embolization and no active leak.

Case 2: 28 year male with Acute pancreatitis and left gastroepiploic artery pseudoaneurysm-Liquid embolization by glue [Figure 9-15].

Case 3: 41-Year-Old Male with Segmental Renal Artery Pseudoaneurysm Post Renal Biopsy-Proximal Artery Occlusion By coils [Figure 13-15].

Case 4: Case of large intraparenchymal and subcapsular hematoma with surface bleeders in the liver. Use of both particle embolising agents(Polyvinyl alcohol particles) and coils [Figure 16-18].

Case 5: Case of pancreatitis, Post LPJ with IPDA (Inferior pancreaticoduodenal artery) pseudoaneurysm – Managed by gel foam embolization. [Figure 19-22]

Discussion

For interventional management of a pseudoaneurysm, prior imaging is critical.[7,8] Computed tomography (CT), Ultra-

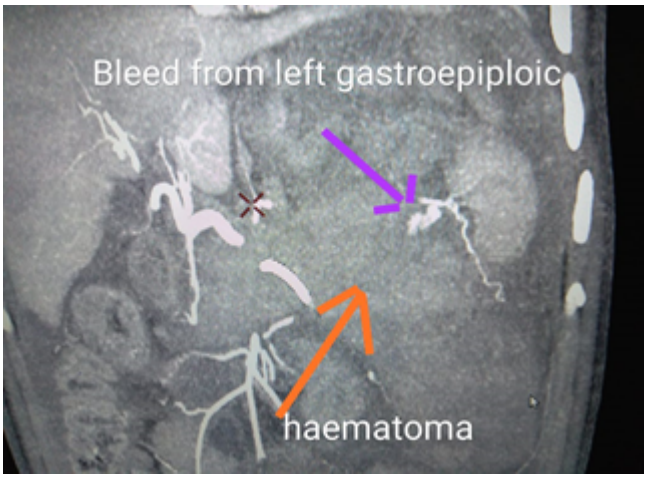

Figure 9: CECT shows bleed from left gastroepiploic artery & hematoma

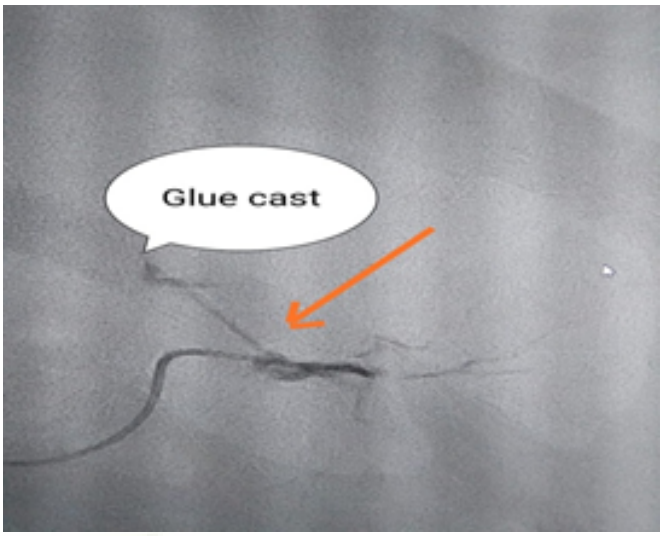

Figure 11: Superselective embolization of left gastroomental artery with liquid glue cast

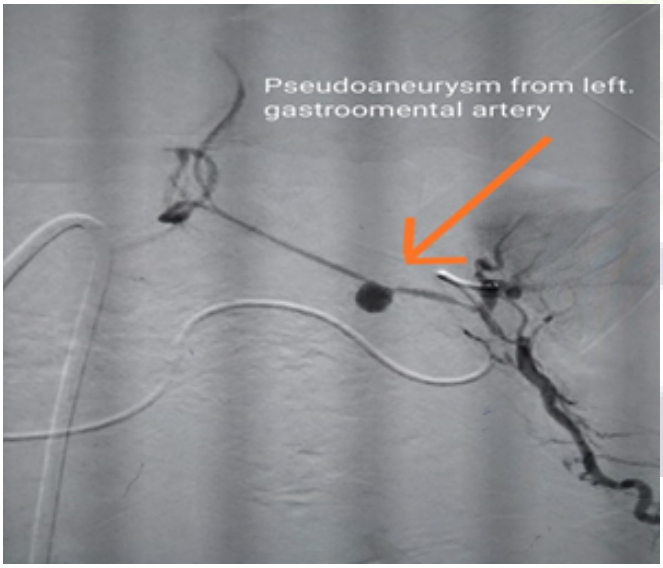

Figure 10: Splenic artery angiogram demonstrating Pseudoaneurysm from the left gastroepiploic artery

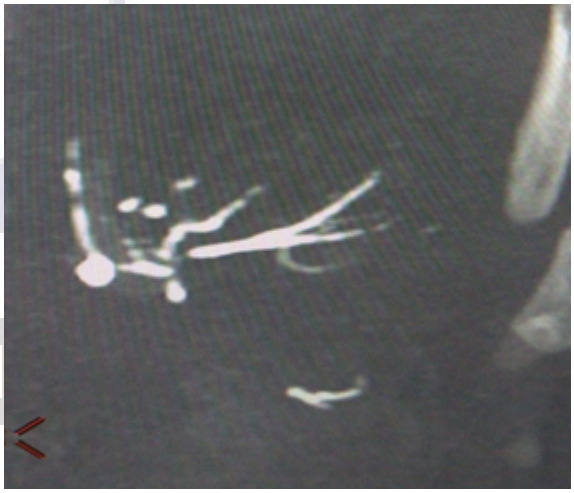

Figure 12: Post-procedure CT showing glue cast with non-target embolization of two segmental splenic vessels

sonography, and magnetic resonance imaging(MRI)are non-invasive imaging techniques that are most commonly employed for the detection and evaluation of pseudoaneurysms. Invasive digital subtraction angiography (DSA) is reserved for specific situations.

Ultrasonography is used as the initial screening tool and may detect large and superficially located pseudoaneurysms and those within the solid organs like the liver and spleen.[7,9] On the greyscale scan, a pseudoaneurysm typically appears as an anechoic lesion with thin walls, which fills with color, and on duplex color Doppler ultrasound, it shows the characteristic ”yin-yang” flow with a bidirectional waveform pattern.

Multidetector CT angiography (CTA) is the most commonly used and most sensitive non-invasive modality for the detection of pseudoaneurysms.[3,4,6] As some pseudoaneurysms with a narrow neck may not be seen on the arterial phase and opacify only in the venous phase, CT should include both arterial and venous phases. CTA demonstrates a well-defined contrast-filled sac with attenuation parallel to the adjacent main artery in both phases. Post-processing with maximum intensity projection and volume rendering better demonstrate

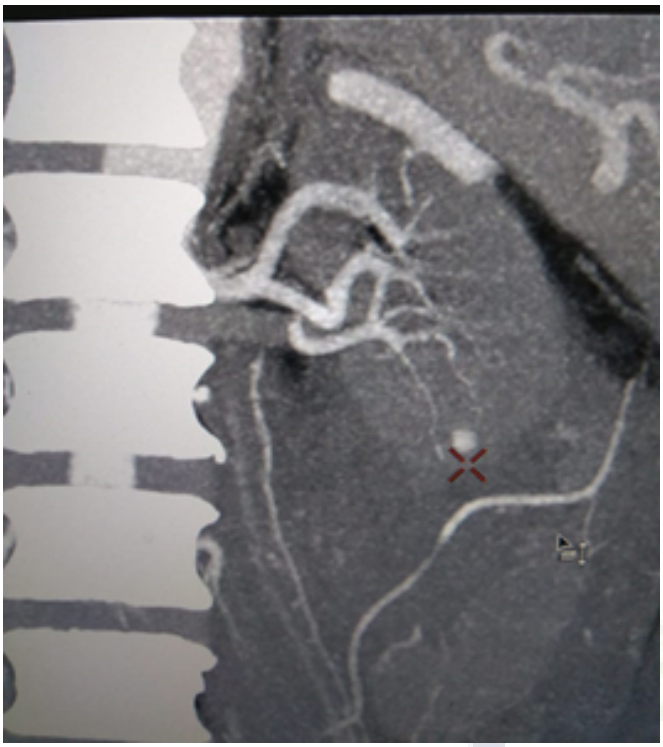

Figure 13: Coronal reformatted CT angiogram arterial phase demonstrating pseudoaneurysm from the inferior segmental polar branch of left renal artery

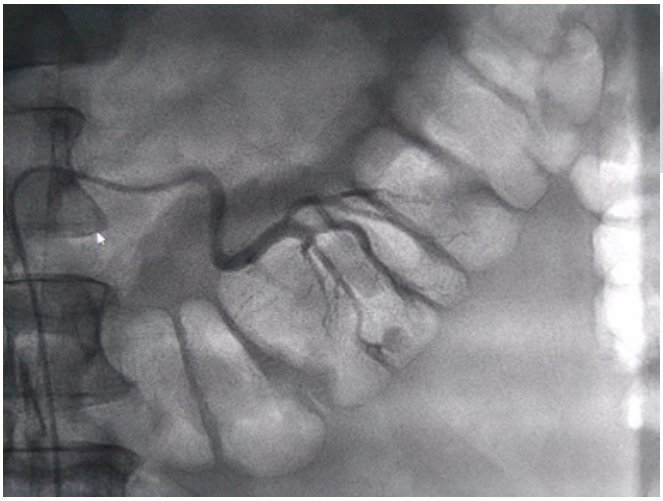

Figure 14: Left renal angiogram demonstrating the pseudoaneurysm

the pseudoaneurysm and its origin and improve detection.[4] The sac may show low attenuation areas depending on the extent of thrombosis, mostly in the periphery. In addition to

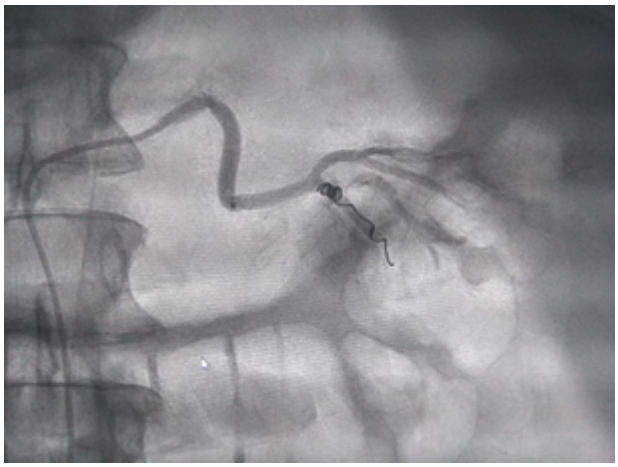

Figure 15: Post embolization of the pseudoaneurysm by proximal occlusion using pushable coils.

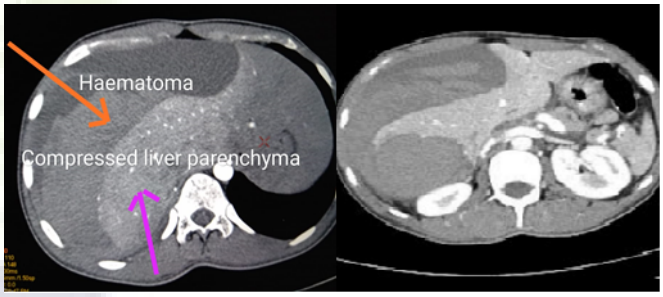

Figure 16: CECT axial image demonstrating a large subcapsular hematoma compressing the right lobe of liver parenchyma. The large intraparenchymal hematoma was also noted in segment VI.

the detection of a pseudoaneurysm, Multidetector CT Angiography provides a road map for intervention and depicts associated anatomical arterial variations.

For diagnosis, Digital subtraction angiography remains the gold standard.[7] In pseudoaneurysms, indications of DSA are 1) possible embolization of a pseudoaneurysm detected on imaging, and 2) under high clinical suspicion, detection of a pseudoaneurysm and normal findings on imaging. Digital subtraction angiography(DSA) has the advantage of real-time assessment of hemodynamics of the source vessel, expendability of donor inflow artery, and identification of collateral supply.[7] Digital Subtraction Angiography(DSA) can be used to identify pseudoaneurysms that are not seen in ultrasonography, MRA, and CTA with the advantage of the ability to perform concurrent therapeutic intervention.[7]

For a therapeutic purpose, embolization is defined as the deliberate occlusion of vessels. Various embolic materials

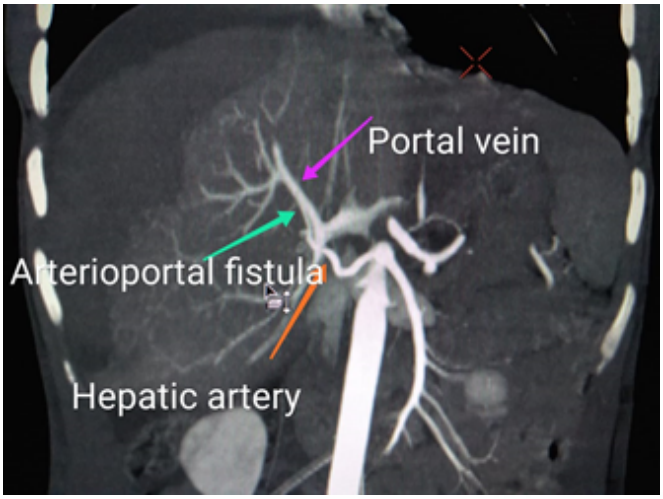

Figure 17: Coronal CT image arterial phase demonstrating arterioportal fistula

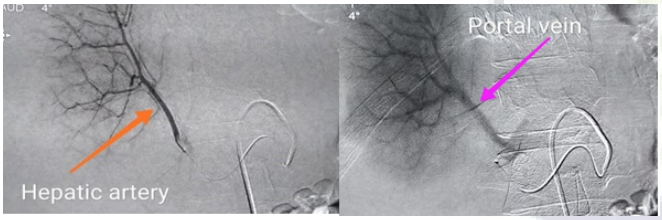

Figure 18: Super selective Hepatic angiogram through segment VIII branch demonstrating the arterioportal fistula

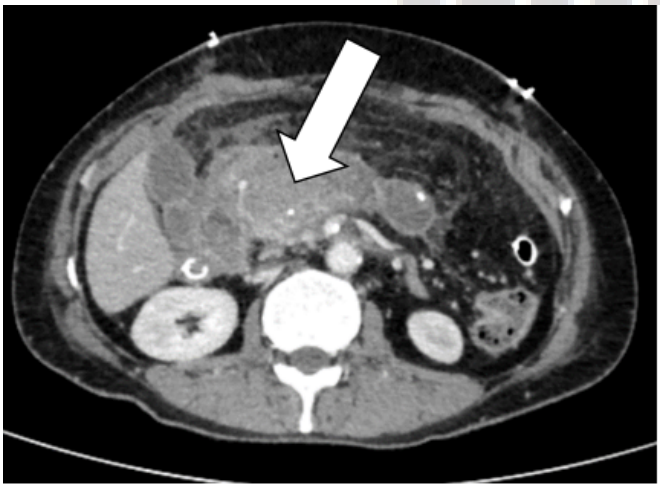

Figure 19: CT angiogram demonstrating active extravasation from the IPDA (site the bleed).

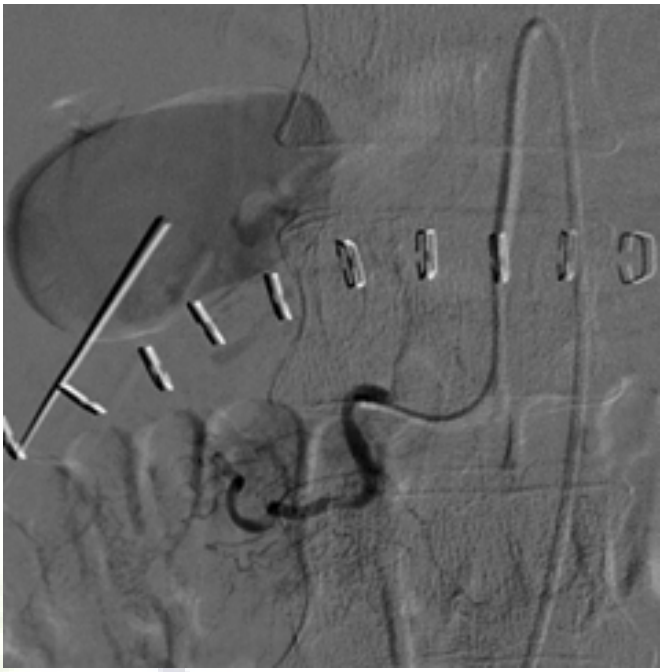

Figure 20: Selective angiogram of IPDA does not demonstrate any active leak or pseudoaneurysm. Gelfoam embolization was performed.

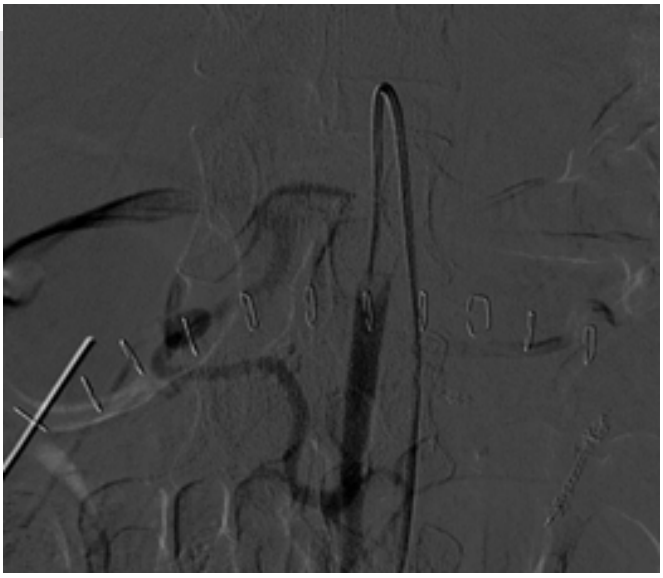

Figure 21: Post embolization angiogram suggesting complete occlusion of IPDA.

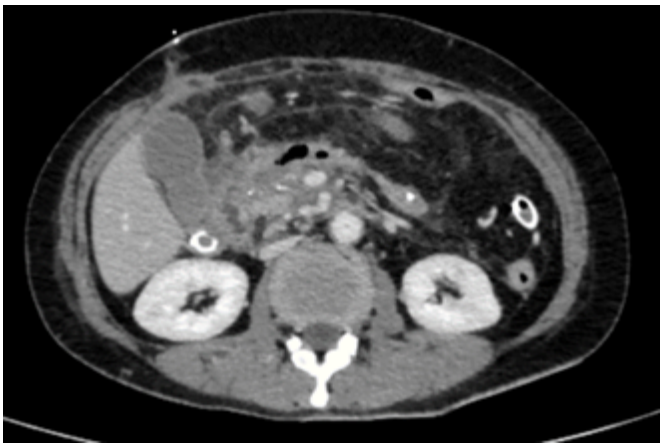

Figure 22: Post embolization CT demonstrating no pseudoaneurysm or leak. Symptomswere resolved, and the patient was discharged in a stable condition.

have been used for this purpose. The choice of embolic material depends on many factors, including whether the occlusion is permanent or temporary, the level of vascular occlusion, and the desired size of the vessel being occluded.[10]

Embolization agents can be classified into permanent embolic, which may be either solid or liquid, and temporary embolic. Solid permanent embolic materials like polyvinyl alcohol (PVA), platinum coils, tris-acryl gelatin microspheres. Liquid embolic materials include N-butyl cyanoacrylate (NBCA), Onyx (an ethylene-vinyl alcohol copolymer; Ev3 Endovascular, Inc. Plymouth, MN), and absolute alcohol.[10]

Micro coils (complex helical fibered platinum coils) are available in various lengths and range from 2 to 12 mm in diameter. Once deployed in a distal artery, coils cause thrombosis of the bleeding vessel by decreasing the perfusion pressure. These coils can be precisely deployed and are highly radiopaque. Compared to PVA particles, Coils are easy to use and have a lesser threat of ischemia, which may disseminate to the smaller vessels. As per recent literature, micro-coils are the embolic agents of choice.[11] For the embolization of pseudoaneurysms, coils are usually preferred.

In cases where the above techniques fail, embolization can also be done by closing off the neck of the pseudoaneurysm by placing a stent graft across the feeder vessel.

The technique of deploying the coil depends upon the site of the pseudoaneurysm and the nature of the blood vessel involved. In vessels like a splenic artery, hepatic artery, or GDA, usually, embolization is performed by trap door or sandwich technique, where the coils are deployed starting from site distal to the pseudoaneurysm to proximal site. This is to prevent the reflux filling of the pseudoaneurysm from the collaterals.[3,4] [Figure 5-8] In vessels like the renal artery, which is an end artery, proximal occlusion of the feeder vessel is enough for obtaining hemostasis.

NBCA is a safe, rapid, and effective embolic material, which may be lifesaving in emergent situations,[12] and it has several advantages. Through the simultaneous embolization of collateral vessels connected to the bleeding focus, a single injection of N-butyl Cyanoacrylate may provide complete hemostasis. When it comes in contact with blood due to its fast polymerization, it allows for rapid and permanent embolization. As the vessel occlusion is independent of the coagulation process, it is useful in patients with coagulopathy.

Glue embolization is usually performed when it is difficult to access the feeder vessel of an aneurysm through a microcatheter [Figure 9-12].

Polyvinyl alcohol and Gelfoam are also commonly used for embolization. There are certain disadvantages. Because of poor visualization during fluoroscopy, both agents are more difficult to control than micro-coils. An additional disadvantage of particles is that As the particles may reach intramural circulation beyond the level of collateralization, polyvinyl alcohol particles cause bowel infarction, or the particles may reflux into nontarget arteries.[13]

PVA particles can be used specifically in cases where a pathological lesion has ruptured because they reach up to the microcirculation and block the abnormal vessels, leading to effective hemostasis [Figure 16-18].

Gelfoam is a temporary embolization agent, which is usually used for preoperative embolizations. It also has a role in tract embolizations post-biopsy. It can be used in conditions of CT/ DSA negative angiograms, where embolization of highly suspicious vessels can be performed to achieve immediate hemostasis [Figure 19-22].[13]

In the management of bleeding, Careful attention to the hemodynamic status of the patient is of utmost importance. Heart rate and rhythm, oxygen saturation, and blood pressure are continuously monitored.

In a study by Yasir Jamil Khattak et al., 46 patients were treated for visceral pseudoaneurysms; the most common pseudoaneurysms was a renal artery in 43.39%, followed by a hepatic artery in 26.41%. In this study, platinum coils of various lengths and diameters were used for endovascular treatment. The technical success rate was 93.47%.[14]

In the study by Sato N et al. on coil embolization of bleeding visceral pseudoaneurysms following pancreatectomy, 81 patients undergoing pancreatic head resection, ten patients developed massive arterial hemorrhage after surgery, all underwent angiography, and 8 of them were managed by trans catheter arterial embolization.[15]

In a study by Tulsyan N et al., 48 patients (mean age, 58 years) underwent endovascular management of VAPA

or VAA. Overall, 28 (58%) of the interventions were for pseudoaneurysmal pathology. In 65% of patients, treatment was required for symptomatic disease, including rupture, pain, gastrointestinal bleeding, and/or hemobilia. Out of 48 patients, 22 (46%) underwent urgent or emergent procedures.[16]

In a study by Bartosz Zabicki et al., 15 patients included in the study were diagnosed with pseudoaneurysms of visceral arteries as a complication of chronic pancreatitis. The diagnosis was made using contrast-enhanced computed tomography, followed by angiography. Coil embolization was performed in five patients. A stent graft was used in one patient. Liquid embolic agents were used in seven cases, of which five patients were treated with thrombin injection and two with Squid. A combination of techniques was used in two patients.[17]

In our study, 20 patients who presented with intraabdominal hemorrhage, hematemesis, Malena, trauma, and shock and are diagnosed by CECT to have intraabdominal visceral artery hemorrhage were subjected to emergency embolization.

In splenic artery, GDA, and gastroepiploic artery pseudoaneurysms, the embolization was performed to sandwich the pseudoaneurysm and to obliterate the distal vessel, to prevent refilling of the pseudoaneurysm from distal circulation.

In the case of renal artery pseudoaneurysm, the goal was only proximal occlusion of the feeder vessel to achieve adequate embolization as renal vessels are end arteries.

We used PVA particles in a case of a hepatic lesion with multiple bleeders to embolise the entire vasculature till the microcirculation.

Gelfoam embolization was performed in a single case of post-Whipple's surgery, inferior pancreaticoduodenal artery bleed, wherein CT angiogram revealed pseudoaneurysm in close relation to the vessel, but DSA of the vessel was normal. On the table, embolization of the vessel was performed with gel foam, and the surgical drain was observed. On follow-up, the drain was clear, the CT angiogram was normal, and the patient was discharged in stable condition.

Conclusion

Intervention radiology management with embolization has now become the first line of treatment in visceral artery hemorrhages. Knowledge about vascular anatomy, collaterals, techniques of embolization, indications of each embolic agent, and adequate expertise is very essential for the interventional radiologist in the effective management of these cases. When performed in time, these procedures are life-saving and precludes the need for surgery.

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