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ORIGINAL ARTICLE

Percutaneous Direct Needle Puncture and Transcatheter N-butyl Cyanoacrylate Injection Techniques for the Embolization of Pseudoaneurysms and Aneurysms of Arteries Supplying the Hepato-pancreato-biliary System and Gastrointestinal Tract

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ABSTRACT

Aims: The aim of this study was to evaluate the safety and clinical efficacy of percutaneous direct needle puncture and transcatheter N-butyl cyanoacrylate (NBCA) injection techniques for the embolization of pseudoaneurysms and aneurysms of arteries supplying the hepato-pancreato-biliary (HPB) system and gastrointestinal (GI) tract. **Subjects and Methods:** A hospital-based cross-sectional retrospective study was conducted, where the study group comprised 11 patients with pseudoaneurysms/aneurysms of arteries supplying the HPB system and GI tract presenting to a tertiary care center from January 2015 to June 2016. Four patients (36.4%) underwent percutaneous direct needle puncture of pseudoaneurysms with NBCA injection, 3 patients (27.3%) underwent transcatheter embolization with NBCA as sole embolic agent, and in 4 patients (36.4%), transcatheter NBCA injection was done along with coil embolization. **Results:** This retrospective study comprised 11 patients (8 males and 3 females) with mean age of 35.8 years ± 1.6 (standard deviation [SD]). The mean volume of NBCA: ethiodized oil (lipiodol) mixture injected by percutaneous direct needle puncture was 0.62 ml ± 0.25 (SD) (range = 0.5–1 ml), and by transcatheter injection, it was 0.62 ml ± 0.37 (SD) (range = 0.3–1.4 ml). Embolization with NBCA was technically and clinically successful in all patients (100%).

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No recurrence of bleeding or recurrence of pseudoaneurysm/aneurysm was noted in our study. **Conclusions:** Percutaneous direct needle puncture of visceral artery pseudoaneurysms and NBCA glue injection and transcatheter NBCA injection for embolization of visceral artery pseudoaneurysms and aneurysms are cost-effective techniques that can be used when coil embolization is not feasible or has failed.

Key words: Gastrointestinal bleed, N-butyl cyanoacrylate, pseudoaneurysms, transcatheter

INTRODUCTION

Visceral artery aneurysms are uncommon with a reported incidence of 0.01%–0.2% in autopsies.[1] Symptomatic visceral artery aneurysms are clinically important as rupture of these aneurysms is a potentially life-threatening situation. Twenty-two percent of all visceral artery aneurysms present as acute clinical emergency and about 8.5% of visceral artery aneurysm results in death because of rupture.[1] Even though visceral artery aneurysms have all three layers of arterial wall, they may undergo progressive dilatation with thinning of their walls and eventually form pseudoaneurysms which are prone for rupture.[1]

Pseudoaneurysms of arteries supplying the HPB system and gastrointestinal (GI) tract are prone to rupture and may present with life-threatening acute GI or internal bleeding requiring immediate management. These pseudoaneurysms develop as a result of inflammation, infection, trauma, neoplasm, or as a complication of surgical, endoscopic, and radiological interventions. Surgical ligation of the culprit artery proximal and distal to the pseudoaneurysm or resection of the pseudoaneurysm with or without partial resection of the end organ involved was the conventional treatment for these pseudoaneurysms. This has now largely been replaced by transcatheter embolization which has a high success rate and lower morbidity and mortality rates.[1,2] Metallic coils are conventionally the safe and preferred embolic materials for the management of GI bleed due to visceral artery pseudoaneurysms with reported technical success rates of 63%–100%.[3,4] However, a high incidence of rebleeding (3%–37%) has been reported with coil embolization.[3-6]

Liquid embolic materials such as N-butyl cyanoacrylate (NBCA) are now increasingly being used as additional embolic material in cases of failure of coil embolization and also as the sole embolic agent for GI bleeding due to visceral artery pseudoaneurysms with better clinical success rates and lower recurrence rates.[2,6,7] NBCA is usually injected through an intravascular microcatheter into the pseudoaneurysm or into the culprit arteries. NBCA polymerizes immediately on contact with anions in the blood and immediately occludes the vessel. Mixed with iodized oil (Lipiodol; Guerbet, Villepinte, France) which confers radio-opacity and increases polymerization time of NBCA, it can be delivered into distal vessels/collaterals which are inaccessible with the microcatheter. NBCA is effective even in cases with coagulopathy because it does not depend on the normal coagulation process for its therapeutic effect. However, use of NBCA as an embolic agent by transcatheter injection requires practice and experience in terms of volume, dilution, and rate of injection to avoid complications such as nontarget distal embolization, proximal reflux into nontarget vessels, and adhesion of catheter to the embolized vessel.[8,9]

Direct percutaneous puncture with a needle and injection of NBCA for the management of visceral artery pseudoaneurysms has rarely been described in few studies involving a small number of cases or in case reports.[10-13]

We evaluate the safety and clinical efficacy of percutaneous direct needle puncture and transcatheter NBCA injection techniques for the embolization of pseudoaneurysms and aneurysms of arteries supplying the hepato-pancreato-biliary (HPB) system and GI tract.

SUBJECTS AND METHODS

After the approval from the Institutional Ethics Committee, a hospital-based cross-sectional retrospective study was conducted. The study group comprised 11 patients with pseudoaneurysms or aneurysms of the HPB system or GI tract, presenting to the Departments of Radiodiagnosis, Medical Gastroenterology, and Surgical Gastroenterology at a tertiary care center from January 2015 to June 2016.

The diagnosis of visceral artery pseudoaneurysm or aneurysm was made by multidetector computed tomography (CT) angiography in all cases using a Brilliance 64 slice CT scanner (Philips, Netherlands). Written informed consent was obtained from each patient or their relatives before embolization.

The indications for using NBCA as an embolic agent were:

A. Inability to access a pseudoaneurysm and the artery distal to it with a microcatheter due to
    1. Narrow caliber of feeding artery proximal to the pseudoaneurysm
    2. Previously coil-embolized artery proximal to a pseudoaneurysm
    3. Difficult catheterization of feeding artery.
B. Inability to access the distal artery across a large aneurysm
C. Failed coil embolization, and
D. Multiple collaterals distal to a pseudoaneurysm.

Arterial access was obtained in all patients through the femoral route using a 5 Fr vascular access sheath. Using a 0.35" hydrophilic guidewire (Radiofocus; Terumo Inc., Japan), and a Simmons 1 guiding catheter (Cook Inc., USA), the celiac trunk and superior mesenteric arteries (SMAs) were canulated under fluoroscopy. Where required, a 2.7 Fr Progreat microcatheter (Terumo Inc., Japan) was used to super-selectively access the culprit arteries. Angiograms were obtained to delineate the pseudoaneurysms/aneurysms and determine the treatment plan.

Figure 1: A 19-year-old male patient of extrahepatic portal venous obstruction with portal biliopathy presented with pericatheter bleeding 5 days after percutaneous cholecystostomy. Digital subtraction angiography images (a and b) show a peripheral left hepatic artery pseudoaneurysm (↗black arrow) with a tortuous and narrow caliber proximal artery. (c) 0.5 ml N-butyl cyanoacrylate: lipiodol (1:1) injection after percutaneous direct puncture of the pseudoaneurysm (↗black arrow) with a 20-gauge Chiba needle. Post N-butyl cyanoacrylate injection catheter angiogram in image (d) shows glue cast in the pseudoaneurysm (↗black arrow) with no residual filling of pseudoaneurysm.

Four patients (36.4%) underwent percutaneous embolization of pseudoaneurysms [Figures 1-3]. The pseudoaneurysms were accessed under ultrasound guidance with a 20-gauge Chiba needle (Cook Incorporation, USA). Few contrast injections were made into the pseudoaneurysms under fluoroscopy to determine the rate of injection and volume of NBCA: lipiodol mixture required for embolization of the pseudoaneurysm and to just cause minimal reflux into the culprit artery. The Chiba needle was then flushed a few times slowly with 1 ml of 5% dextrose, and then, under fluoroscopy guidance, the required amount and ratio of NBCA: lipiodol mixture were injected into the pseudoaneurysm. The Chiba needle was then removed. Catheter angiograms were taken to check for adequacy of embolization.

Seven patients (63.6%) underwent transcatheter embolization with NBCA: lipiodol mixture. Of these, NBCA was used as the sole embolic agent in 3 patients (27.3%) [Figures 4 and 5] and was used in addition to coils in 4 patients (36.4%) [Figures 6 and 7]. The pseudoaneurysm or its feeding proximal artery or distal collaterals were accessed with a microcatheter. The microcatheter was flushed a few times with 5% dextrose, and then, NBCA: lipiodol mixture was injected. The microcatheter was immediately pulled in all cases to prevent attachment to the culprit artery. NBCA: lipiodol was used in 1:3 ratio and 0.4–0.7 ml of the mixture was injected at a time. If the initial injection did not achieve occlusion of the vessel, further injection of similar concentration and volume was done with a new microcatheter. The rate and volume of NBCA: lipiodol mixture injected (inclusive of ≈ 0.3 ml dead space of microcatheter lumen) was determined by repeated contrast

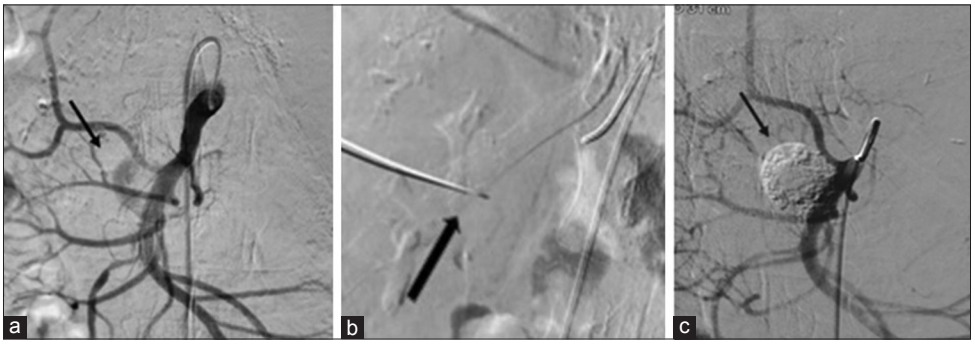

Figure 2: 34 year old male patient with acute on chronic pancreatitis presented with pain abdomen, (a) DSA image shows a large SMA branch pseudoaneurysm (↓black block arrow) arising close to its origin from the SMA. Image (b) shows percutaneous direct puncture of the pseudoaneurysm with a 20 Gauge Chiba needle (↑black block arrow). Image (c) post NBCA injection angiogram shows glue cast in the pseudoaneurysm (↓black block arrow) with no residual filling of the pseudoaneurysm and preserved lumen of SMA and its branches.

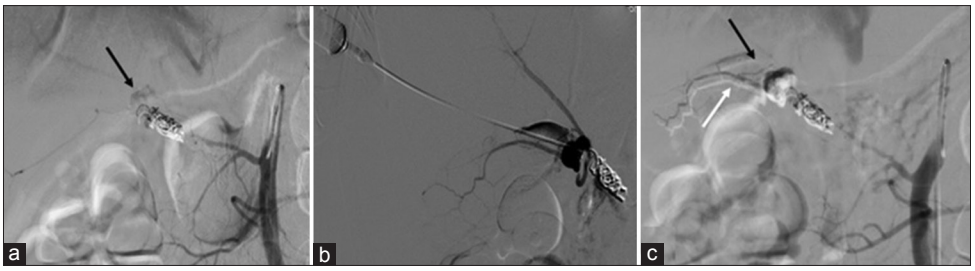

Figure 3: A 35-year-old male patient presented with massive upper gastrointestinal bleed 1 month after coil embolization of the replaced right hepatic artery proximal to a cystic artery pseudoaneurysm. (a) Superior mesenteric artery angiogram shows a persistent cystic artery pseudoaneurysm (↘black arrow) arising from a replaced right hepatic artery which was inadequately coiled initially. (b) Angiogram obtained after percutaneous needle puncture shows filling of the pseudoaneurysm. (c) Post N-butyl cyanoacrylate injection superior mesenteric artery angiogram shows glue cast in the pseudoaneurysm (↘black arrow) and minimal distal glue reflux into the cystic artery (↗white arrow).

Figure 4: A 18-year-old female with acute on chronic pancreatitis presented with severe upper gastrointestinal bleed with shock. Digital subtraction angiography image (a) common hepatic artery angiogram shows a small right gastric artery pseudoaneurysm (↙black arrow). (b) Superselective microcatheter angiogram after shows the right gastric artery pseudoaneurysm (↙black arrow). (c) Angiogram obtained after transcatheter N-butyl cyanoacrylate injection shows glue cast (↙black arrow) in the pseudoaneurysm and the right gastric artery proximal and distal to the pseudoaneurysm with minimal glue reflux into the hepatic arteries (↗ and ← white arrows) causing partial luminal occlusion.

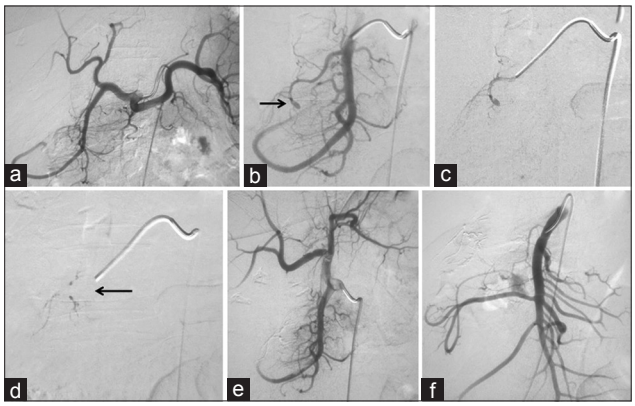

Figure 5: A 35-year-old female with persistent upper gastrointestinal bleed after endoscopic sphincterotomy and surgery for common bile duct stone clearance. (a) Celiac and (b) gastroduodenal artery angiograms show a pseudoaneurysm arising from a proximal branch of gastroduodenal artery (→black arrow). (c) Super selective angiogram shows the pseudoaneurysm. (d) N-butyl cyanoacrylate injection with glue cast in the pseudoaneurysm and the gastroduodenal artery branch proximal and distal to the pseudoaneurysm (←black arrow). (e and f) Check celiac and superior mesenteric angiograms show glue cast in the pseudoaneurysm with preservation of the lumen of the gastroduodenal artery and nonfilling of the pseudoaneurysm.

injections so as to fill the pseudoaneurysm with minimal reflux into the culprit artery.

Statistical analysis

Data were presented in terms of percentage and mean. Calculations were done using Microsoft Excel and SPSS programs (Statistical Package for the Social Science version 16, SPSS Inc., Chicago, USA).

RESULTS

This retrospective study included 11 patients (8 males and 3 females; mean age of 35.8 years ± 1.6 [standard deviation (SD)], age range = 18–63 years) with visceral artery pseudoaneurysm or aneurysm of arteries supplying the HPB system or GI tract with variable clinical presentation and severity. Pertinent patient's information is summarized in Table 1. The mean volume of NBCA: ethiodized oil (lipiodol) mixture injected by percutaneous direct needle puncture was 0.62 ml ± 0.25 (SD) (range = 0.5–1 ml) and by transcatheter injection, it was 0.62 ml ± 0.37 (SD) (range = 0.3–1.4 ml).

Technical and clinical success was seen in all 11 patients (100%) with no rebleeding or recurrence of pseudoaneurysm/aneurysm in any of the patients. No complications were seen in patients who underwent percutaneous direct puncture of pseudoaneurysms with NBCA injection. Complications were seen in 1 out of 7 (14.3%) patients who underwent transcatheter glue embolization. Inconsequential reflux of glue into

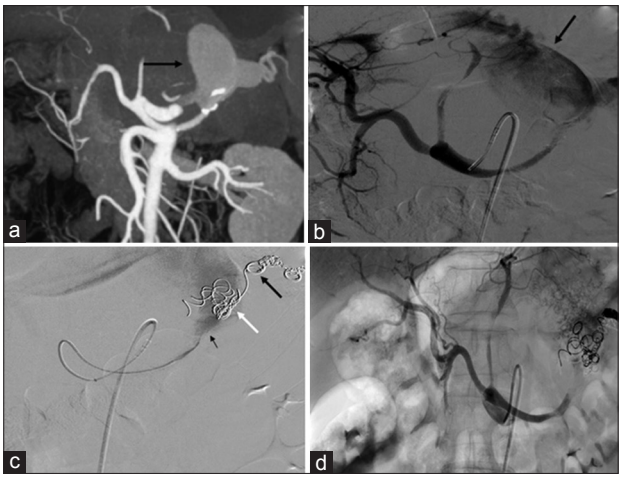

Figure 6: A 56-year-old male with hypertension. (a) Computed tomography angiogram and (b) digital subtraction angiography celiac angiogram shows a large aneurysm (↙black arrow) arising from splenic artery. (c) Splenic artery angiogram shows occlusion of the splenic artery distal to the aneurysm with coils (↖black arrow) with multiple migrated coils (↖white arrow) in the aneurysm with residual aneurysm sac (small ↖ black arrow). (d) Celiac angiogram obtained after transcatheter N-butyl cyanoacrylate: lipiodol (1:3) injection into the proximal splenic artery shows no filling of the aneurysm and occlusion of proximal splenic artery.

the hepatic arteries occurred in 1 patient with the right gastric artery (RGA) pseudoaneurysm [Figure 4]. The mean duration of follow-up of patients in this study was 13.5 months ± 11.5 (SD). No recurrence of pseudoaneurysms occurred in the follow-up period. Table 2 shows frequency and sizes of aneurysms and pseudoaneurysms.

DISCUSSION

In this retrospective study, we studied percutaneous direct needle puncture and NBCA injection and transcatheter NBCA injection techniques for the embolization of pseudoaneurysms and aneurysms of arteries supplying the HPB system and GI tract.

Technical and clinical success rate in our study with direct needle puncture of pseudoaneurysms and NBCA glue injection were 100%, and no recurrences or complications were observed.

Vyas et al., embolized four blunt abdominal trauma-related hepatic artery pseudoaneurysms with percutaneous direct needle puncture of pseudoaneurysms and injection of NBCA: lipiodol mixture and observed similar results. In one of their cases, NBCA: lipiodol mixture had to be injected after failure of direct puncture and thrombin injection into the pseudoaneurysm.[10]

Kulkarni et al., used the same method for the management of a pancreatitis-related gastroduodenal artery (GDA) pseudoaneurysm which showed refilling from the inferior pancreaticoduodenal artery (IPDA) collaterals after coiling

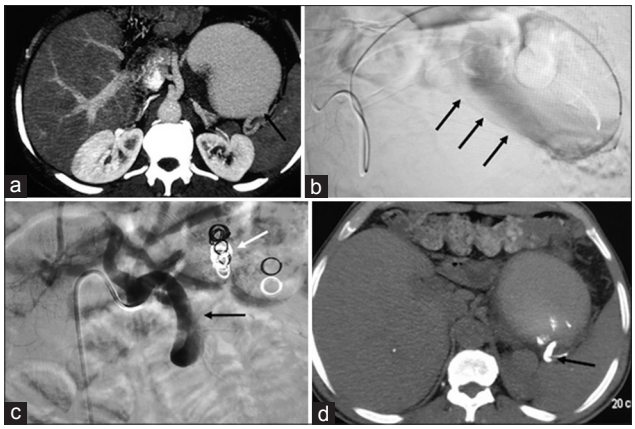

Figure 7: A 56-year-male with abdominal pain. (a) Axial computed tomography angiogram shows a large splenic artery aneurysm (↖black arrow). (b) Microcatheter angiogram through microcatheter in the aneurysm (↗black arrows) with inability to access the artery distal to the aneurysm. (c) Celiac angiogram after failed coiled embolization shows migration of coils (←white arrow) and after N-butyl cyanoacrylate shows glue cast in the midsplenic artery (←black arrow) with nonvisualization of pseudoaneurysm. (d) Postprocedure noncontrast axial computed tomography section shows glue cast (←black arrow) in the splenic artery distal to the pseudoaneurysm.

of the GDA proximal to the pseudoaneurysm had been done.[11] In our study, one patient was referred with a persistent bleeding cystic artery pseudoaneurysm due to refilling from inadequately coiled feeding replaced right hepatic artery (RHA) and from distal collaterals. As the pseudoaneurysm could not be accessed through the replaced RHA or through collaterals, direct puncture of the pseudoaneurysm and injection of NBCA: lipiodol mixture were done [Figure 3]. Minimal intended glue reflux was observed in the distal cystic artery.

Gulati et al., performed percutaneous direct puncture and injection of NBCA: lipiodol in 1:3 ratio into an IPDA pseudoaneurysm arising close to the IPDA origin with a balloon inflated in the SMA. They observed small glue reflux into the jejunal branches of the SMA and delayed occurrence of jejunal stricture after 8 months, for which the patient had to be operated.[12] In our two cases of jejunal branch of SMA pseudoaneurysms (one with short safe landing zone [Figure 2] and the other a peripheral jejunal branch pseudoaneurysm), calculated volume of NBCA: lipiodol was injected in 1:1 ratio to completely embolize the pseudoaneurysm and no reflux of glue was observed. We also did not require placing a balloon catheter in the SMA to stop reflux. Significant reflux did not occur in our cases probably due to higher concentration and calculated volume of NBCA used which caused immediate polymerization of glue in the pseudoaneurysm. Direct injection of NBCA into the pseudoaneurysm may lead to rupture of a friable-walled pseudoaneurysm due to increased pressure within the pseudoaneurysm.[11] We did not observe pseudoaneurysm rupture in any of our cases

Table 1: Summary of 11 patients with visceral artery pseudoaneurysm and aneurysms embolized with N-butyl cyanoacrylate

Case number	Age (years)/sex	Clinical presentation and imaging findings	Underlying cause of PSA	Vessel embolized	Embolic material used	Reason for using NBCA as embolic agent	Complications	Follow-up
1	19/male	EHPVO with portal biliopathy and distended gall bladder with fever. PCC done to relieve the distended gall bladder. Patient had fresh pericatheter bleeding 10 days after PCC. CTA showed an 11 mm × 9.5 mm left hepatic artery pseudoaneurysm adjacent to PCC catheter and hemorrhage in the gall bladder lumen	Iatrogenic - after PCC	Left hepatic artery	0.5 ml NBCA: lipiodol (1:1) injected by direct puncture	Peripheral PSA with tortuosity and narrow caliber of feeding artery	None	21 months. No recurrence of bleeding. Underwent splenectomy and is on repeated endoscopic biliary stent exchanges for portal biliopathy
2	35/male	Hemobilia with transpapillary upper GI bleeding with Hb drop below 7 g/dL. Patient had massive upper GI bleed 1 month ago due to a cystic artery PSA for which initial coil embolization of the replaced RHA was done proximal to the PSA at another hospital. CTA showed an 11.9 mm × 7.6 mm residual cystic artery PSA filling through the inadequately coiled replaced RHA	Cholelithiasis	Cystic artery	0.5 ml NBCA: lipiodol (1:1) injected by direct puncture	Inability to access the PSA and artery distal to it due to previously coil embolized feeding RHA	None	25 months. No recurrence of bleeding. Underwent cholecystectomy
3	20/male	History of BTA with jejunal perforation. Developed burst abdomen postoperatively with development of abdominal sepsis and an enterocutaneous fistula. Reoperated multiple times and placed on loop ileostomy and FJ. Developed severe peri FJ and stoma site bleeding with Hb drop to 6.3 g/dL. CTA showed a 15.2 mm × 13.4 mm peripheral PSA arising from a jejunal branch of the SMA	Iatrogenic - at feeding jejunostomy site	Jejunal branch of SMA	0.5 ml NBCA: lipiodol (1:1) injected by direct puncture	Peripheral PSA with narrow caliber of feeding artery	None	5 months. No recurrence of bleeding
4	34/male	Recurrent pain in the upper abdomen for 18 months with increasing frequency over the last 2 months. CTA of abdomen showed pancreatic calcifications, dilated MPD, and peripancreatic fluid collections with a partially thrombosed PSA of size 47 mm × 46 mm in relation to the SMA	Acute on chronic pancreatitis	Jejunal branch of SMA	1 ml NBCA: lipiodol (1:1) injected by direct puncture	PSA arising from a jejunal artery very close to its origin from the SMA which was difficult to catheterize	None	6 months. No history of GI or abdominal bleeding
5	56/male	Known hypertensive patient had mild abdominal pain for 3 years and bilateral pedal oedema. Was being investigated for pedal oedema. USG of the abdomen showed a large retro gastric vascular mass. No history of GI bleeding. CTA showed a large 134 mm × 109 mm splenic artery aneurysm	Hypertension	Splenic artery	Coils + 0.7 ml NBCA: lipiodol (1:3)	Distal coiling achieved with inability to coil splenic artery proximal to the aneurysm due to rapid flow causing migration of coils into the aneurysm	None	29 months. No recurrence of aneurysm on follow-up CTA

Contd...

Table 1: Contd...

Case number	Age (years)/sex	Clinical presentation and imaging findings	Underlying cause of PSA	Vessel embolized	Embolic material used	Reason for using NBCA as embolic agent	Complications	Follow-up
6	34/male	Previous history of acute pancreatitis. Presented with recurrence of abdominal pain and melena. UGIE showed bleeding from the papilla. CTA showed a 34 mm × 26 mm midsplenic artery PSA. Hb 8 g/dl at time of presentation	Pancreatitis	Splenic artery	Coils + 0.5 ml NBCA: lipiodol (1:3)	Inadequate coiling of the splenic artery across the pseudoaneurysm	None	32 months. No recurrence of bleeding.
7	24/male	Hematemesis, melena, pain abdomen, abdominal distension, and hypovolemic shock with Hb of 3.9 g/dL at presentation. History of BTA 4 months ago with segment VII liver laceration. CTA showed a 40 mm × 30 mm replaced RHA PSA	BTA with segment VII liver laceration	Replaced RHA	0.7 ml NBCA: lipiodol (1:3) + coils	Multiple collaterals distal to pseudoaneurysm. After initial glue injection to occlude distal collaterals, coiling of the proximal RHA was done	None	14 months. No recurrence of bleeding
8	56/male	Dull-aching pain in left side upper abdomen of 4 months duration. Occasional episodes of melena. Hb = 11 g/dL at the time of presentation. CTA showed a large 130 mm × 100 mm splenic artery aneurysm with peripheral calcification	Not known	Splenic artery	Coils + 2 injections of 0.7 ml NBCA: lipiodol (1:3)	Failure to access the artery distal to the large aneurysm with inability to coil the artery proximal to aneurysm due to rapid flow with migration of coils into aneurysm	None	12 months. No recurrence of melena or abdominal pain
9	18/female	Hematemesis, melena, hypovolemic shock with Hb 5.1 g/dL. History of previous recurrent episodes of acute pancreatitis. CTA showed peripancreatic pseudocyst with a 5 mm × 8 mm RGA pseudoaneurysm	Pancreatitis	RGA	0.4 ml NBCA: lipiodol (1:3)	Inability to access PSA and artery distal to it due to narrow caliber of feeding artery	Proximal inconsequential glue reflux	2 months. No recurrence of bleeding
10	63/female	Hematemesis and melena with Hb of 7.1 g/dL, jaundice, fever. History of cholecystectomy 1 month ago. CTA showed a 12 mm × 7.3 mm RHA pseudoaneurysm	Iatrogenic bile duct and vascular injury during cholecystectomy	RHA	0.4 ml NBCA: lipiodol (1:3)	Inability to access pseudoaneurysm and artery distal to it due to narrow caliber of proximal artery	None	1 month. Underwent endoscopic stenting of CBD. No recurrence of bleeding
11	35/female	Hematemesis, melena, hypovolemic shock and Hb = 7.1 g/dL. History of ERC with sphincterotomy for CBD stone extraction 1 month ago. Developed severe bleeding from the papilla for which she was operated (transduodenal sphincteroplasty with CBD stone clearance and cholecystectomy). CTA showed a 7.6 mm × 3.4 mm GDA branch pseudoaneurysm	Iatrogenic - ERC and sphincterotomy induced	Small branch of GDA	0.3 ml NBCA: lipiodol (1:3)	Inability to access the pseudoaneurysm due to narrow caliber of feeding artery. Multiple collateral arteries to the pseudoaneurysm from the pancreaticoduodenal arteries	None	2 months. No recurrence of bleeding

EHPVO: Extrahepatic portal venous obstruction, PCC: Percutaneous cholecystostomy, Hb: Hemoglobin, NBCA: N-butyl cyanoacrylate, PSA: Pseudoaneurysm, GI: Gastrointestinal, CTA: CT angiogram, RHA: Right hepatic artery, BTA: Blunt trauma abdomen, FJ: Feeding jejunostomy, SMA: Superior mesenteric artery, MPD: Main pancreatic duct, USG: Ultrasonography, UGIE: Upper gastrointestinal endoscopy, RGA: Right gastric artery, CBD: Common bile duct, ERC: Endoscopic retrograde cholangiography, GDA: Gastro duodenal artery, CT: Computed tomography

Table 2: Source and frequency of visceral artery pseudoaneurysms and aneurysms

Name of source artery	Frequency	Percentage (%)	Sizes of pseudoaneurysms/aneurysms (mm)
Splenic artery	3	27.3	34 × 26, 130 × 100, 134 × 109
RHA	2	18.2	40 × 30, 12 × 7.3
LHA	1	9.1	11 × 9.5
Cystic artery	1	9.1	11.9 × 7.6
Jejunal branch of SMA	2	18.2	46.2 × 47, 13.4 × 15.2
RGA	1	9.1	8 × 5
Small proximal branch of GDA	1	9.1	7.6 × 3.4

RHA: Right hepatic artery, LHA: Left hepatic artery, SMA: Superior mesenteric artery, RGA: Right Gastric artery, GDA: Gastroduodenal artery

as a calculated minimal volume of NBCA: lipiodol mixture was injected.

The present study had a technical success rate and clinical success rate of 100% for transcatheter embolization using NBCA as was seen by Izaki et al., (n = 12),[3] Madhusudhan et al., (n = 31),[6] Won et al., (n = 10)[14] in their studies on use of NBCA for embolization of visceral artery pseudoaneurysms. Song et al.,[2] reported 92.3% (12 of 13 patients) technical success rate for transcatheter embolization of GI arterial, splenic artery, and hepatic arterial pseudoaneurysms using NBCA. Madhusudhan et al.,[6] reported 9.7% recurrences (3 out of 31 patients) within 30 days of transcatheter embolization which were managed by repeat embolization. Song et al.,[2] Izaki et al.,[3] and Won et al.,[14] reported no recurrences. No recurrence of bleeding was seen in our study.

Complication rates varied from 0% to 16.6%[2,3,6,14] in earlier studies that employed transcatheter NBCA injection for the management of visceral artery aneurysm and pseudoaneurysms. Song et al.,[2] and Won et al.,[14] did not experience any complication in their cases. Madhusudhan et al.,[6] observed complications in 3 out of 31 (9.7%) cases including proximal glue reflux with hepatic arterial occlusion and raised transaminases, distal reflux with splenic infarct requiring splenectomy, and catheter adhesion in 1 case each. Izaki et al.,[3] reported complications in 2 out of 12 procedures (16.6%) which included distal overflow with inconsequential partial embolization of the middle colic artery in 1 patient and proximal reflux with inconsequential partial occlusion of the middle colic and first jejunal arteries in 1 patient.

We observed minor complications in 1 out of our 7 (14.3%) patients of transcatheter embolization in the form of inconsequential hepatic arterial reflux in 1 patient with RGA pseudoaneurysm [Figure 4]. The higher incidence of complications in our study was related to small number of patients in our study. Jae et al.,[9] advocated trial injections with iodinated contrast material to understand the flow dynamics before embolization so that nontarget embolization can be avoided. They also suggested that only a small amount (0.2–0.6 ml) of NBCA: lipiodol mixture was sufficient to achieve occlusion of bleeding site, feeding, and collateral arteries.[9]

Madhusudan et al., advocated a modified technique of sequential slow injection of 0.1–0.3 ml NBCA injection followed by flushing the microcatheter with dextrose. This is repeated if required without having to use a new microcatheter.[6] Won et al., advocated a packing technique using NBCA: lipiodol in 1:1 or 1:2 ratio when access to the pseudoaneurysm and stable catheter position was achievable to avoid prolonged polymerization of glue and prevent migration of embolic material. When access to the pseudoaneurysm was not possible, they advocated an isolation technique using NBCA: lipiodol in 1:3 ratio.[14]

Limitation

Our study included only 11 patients. We look forward to doing a prospective study in future including a larger sample size to assess the safety, efficacy, indications, and technique for embolization of visceral artery pseudoaneurysms and aneurysms using NBCA.

CONCLUSIONS

We advocate that embolization of visceral artery pseudoaneurysms by percutaneous direct needle puncture and NBCA injection is a cost-effective technique in cases with inability to reach a microcatheter to the pseudoaneurysm or beyond it, inability to catheterize the artery feeding the pseudoaneurysm with a microcatheter or in cases of persistent/collateralized pseudoaneurysms when coil embolization has been done only proximal to the pseudoaneurysm. Transcatheter NBCA embolization for visceral artery pseudoaneurysms and aneurysms requires practice and experience to avoid complications. Small volumes of NBCA (preferably <0.6 ml) should be injected through the microcatheter at a time. It should be used in situations where coil embolization is not possible or has failed. It is useful when a pseudoaneurysm/aneurysm and/or the artery distal to it are inaccessible with a microcatheter (due to narrow proximal artery or a large pseudoaneurysm/aneurysm), when a pseudoaneurysm has multiple distal collaterals, or when rapid flow causes loss of coils into large aneurysms or pseudoaneurysms.

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Conflicts of interest

There are no conflicts of interest.

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