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Endovascular Arterial Embolization for Management of Acute Gastrointestinal Hemorrhage: A Retrospective Cross-Sectional Study

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ABSTRACT

Introduction: Role of interventional radiology is now becoming fundamental in management of acute gastrointestinal hemorrhage. Overall improvements in hardware ranging from microcatheters, microwires and newer embolic agents have resulted in high success rates worldwide. This study aims to assess and reflect the outcomes of endovascular arterial embolization for managing acute gastrointestinal hemorrhage.

Methods: This was a single center retrospective cross-sectional descriptive study carried out at Nepal Mediciti Hospital. Patients who underwent endovascular arterial embolization for management of non-variceal acute gastrointestinal hemorrhage from January 2019 to July 2024 were included in study. Demographic details of patients, source of arterial bleeding, vascular pathology, embolic agent utilized were recorded. Technical and clinical success rates of the procedure and related complications were documented. Data entry was done in Epi-Info version 7.2.2.6 and analysis was done in EZR version 1.36.

Results: Arterial pseudoaneurysm (44.4%) was the most common etiology of gastrointestinal bleeding, and the most common culprit artery was gastroduodenal artery. Gelfoam was the most commonly used embolic agent, used in 18 cases (50%); followed by n-butyl cyanoacrylate (NBCA) glue in 17 cases (47%), microcoil in 15 cases (41.6%) and 99% ethanol in a single case (2.7%). Combination of couple of these agents was required in 15 out of 36 settings. Technical success rate was 94.4%, while clinical success rate was 91.6%. Re-bleeding after embolization was observed in 8.3% and 30-day mortality was 3%.

Conclusions: Endovascular arterial embolization is a minimally invasive, safe and effective measure for management of acute gastrointestinal hemorrhage.

Keywords: *Aneurysm; Arteries; Cyanoacrylates; Ethanol*

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INTRODUCTION

Non-variceal gastrointestinal bleeding is often a sudden, life-threatening condition. In 85% of cases, bleeding arises from upper gastrointestinal tract which includes esophagus to ligament of Treitz, and rest from lower gastrointestinal tract. Endoscopy is the method of choice for diagnosis and treatment of gastrointestinal bleeding. Endoscopy may not be feasible if patient is poor surgical candidate or in case of unprepared colon or briskly bleeding patient; in whom endovascular arterial interventions are required. Therapeutic arterial embolization in gastrointestinal hemorrhage dates back to 1974 when autologous clot formed on oxidized cellulose was used to arrest lower gastrointestinal hemorrhage. Since then, improvement in hardware used in interventional radiology ranging from microcatheters, microwires and newer embolic agents have resulted in high success rates in managing gastrointestinal bleeding. The objective of this study is to assess outcome and complications of arterial embolization for managing acute gastrointestinal hemorrhage at a tertiary health care center.[1,2,3]

METHODS

This was a single center retrospective cross-sectional descriptive study carried out at department of Diagnostic and Interventional Radiology, Nepal Mediciti Hospital. All the patients who underwent endovascular arterial embolization for management of non-variceal acute gastrointestinal hemorrhage from January 2019 to July 2024 were included in the study. The study was commenced after approval letter was received from institutional review committee of the institute (Ref No: IRC-RP-2081/82-06).

All embolization procedures were performed by interventional radiologist in angiographic suite. Preprocedural imaging with computed tomography angiography (CTA) were carried out to localize the bleeder. Under local anesthesia (Lignocaine 2%), arterial access was gained with puncture by 18G needle, and secured by 5 French (Fr) vascular sheath. Diagnostic angiogram run was taken with 5 Fr diagnostic catheter either Cobra C1 or Simmons Sim1 via celiac trunk, superior mesenteric artery or iliac artery as directed by preprocedural CTA. Superselection of culprit arterial branch was done with microwire and microcatheter, and embolization was performed through the microcatheter. Embolizing agents utilized were gelfoam slurry, embolic microcoils, n-butyl cyanoacrylate (NBCA) glue and 99% ethanol as an individual agent or in combination. Gelfoam slurry was prepared in iodine based non-ionic contrast agent Iohexol. Pushable embolic microcoils were used which were deployed with use of microwire or saline flush. NBCA glue was prepared with lipiodol in ratio of 1:2 or 1:3; and microcatheter was flushed with dextrose solution prior to transcatheter glue injection. Endpoint of embolization was resolution of gastrointestinal hemorrhage in check angiogram run. Vascular sheath was removed post procedure and hemostasis was maintained with 15 minutes manual compression at puncture site.

Demographic details of patients, source of arterial bleeding or culprit vessel, vascular pathology, embolic agent utilized as a single agent or in combination were recorded as per proforma. Technical success was determined as angiographic disappearance of extravasation of contrast or occlusion of pseudoaneurysm or other embolized vascular pathology. Clinical success was defined as disappearance of the original symptoms of bleeding after endovascular procedure. Re-bleeding was defined as decrease in hemoglobin of 1 gram per deciliter (gm/ dl) or more within 24-hours of embolization or decrease of 3 gm/dl or more during the hospital stay post embolization prior to discharge. Complications related to embolization procedure, need for second setting of embolization, need for surgical intervention and patient improvement or mortality were documented.

Data entry was carried out in Epi-Info version 7.2.2.6 and analysis was done in EZR version 1.36, both of which were licensed freeware.

RESULTS

Total of 36 settings of embolization were carried out amongst 33 patients; with three patients requiring second setting of embolization. Among the patients enrolled in the study, 17 (51.5%) were male and 16 (48.5%) were female. Youngest patient was 34 years of age while oldest was 85 years. Median age of patients in the study was 65 years with interquartile range of 17.5 years.

The most common etiology of gastrointestinal bleeding encountered in our study was arterial pseudoaneurysm (Figure 1) in 16 cases (44.4%), followed by active contrast extravasation in gastrointestinal lumen (Figure 2) in 15 cases (41.7%). Other cases were angiodysplasia in three patients and one case each of intrahepatic arterio-biliary shunt and intrahepatic arterioportal shunt. Among 36 instances of gastrointestinal hemorrhage, the most common culprit artery was gastroduodenal artery (seven cases). Other sources of bleeding were branches of celiac trunk, superior mesenteric artery and internal iliac artery (Table 1). Gelfoam was the most commonly used embolic agent, used in 18 (50%) out of 36 settings; which was followed by n-butyl cyanoacrylate (NBCA) glue in 17 cases (47%), microcoil in 15 cases (41.6%) and 99% ethanol in a single case (2.7%). Combination of couple of these agents was required in 15 out of 36 settings; microcoil and gelfoam being the most commonly used combination in six cases, followed by microcoil and NBCA glue in five, NBCA glue and gelfoam in three cases. NBCA glue and alcohol combination was required for embolization in a single case.

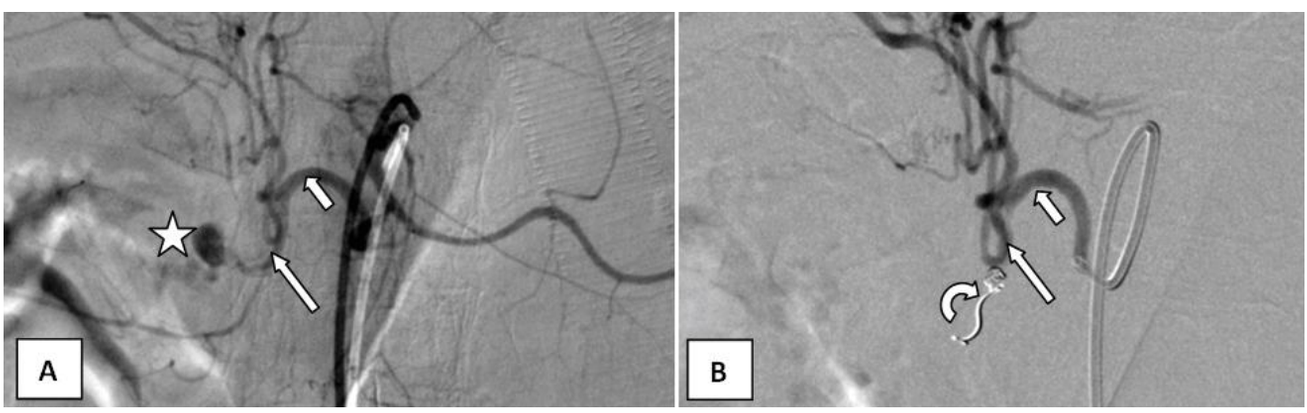

Figure 1: (A) *Pre-embolization digital subtraction angiography (DSA) run through celiac trunk showing pseudoaneurysm (asterisk).* ***(B)*** *Post-embolization DSA image showing the deployed microcoil (curved arrow) with no contrast flow into pseudoaneurysm. (Short arrow) denotes common hepatic artery and (long arrow) denotes gastroduodenal artery.*

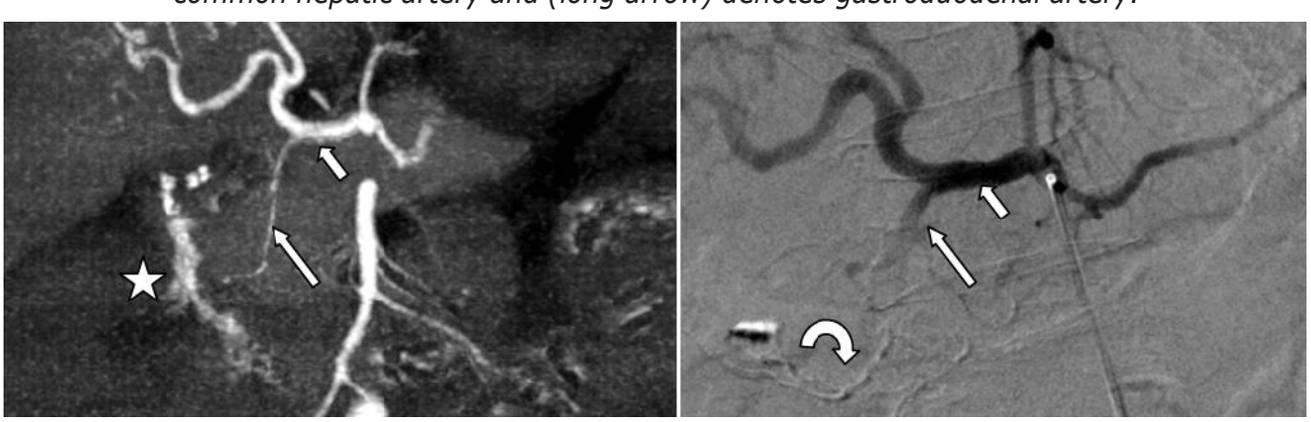

Figure 2: (A) *Coronal reformatted maximum intensity projection computed tomography angiogram image showing active contrast extravasation into duodenal lumen (asterisk).* ***(B)*** *Digital subtraction angiography image showing post-embolization glue cast (curved arrow). (Short arrow) denotes common hepatic artery and (long arrow) denotes gastroduodenal artery*

Table 1: Source of arterial bleeding in patients undergoing endovascular arterial embolization.

Artery	Branch	Frequency	Total
Celiac trunk	Gastroduodenal	7	25
	Left gastric	5	
	Right hepatic	4	
	Short gastric	3	
	Common hepatic	2	
	Hepatic artery proper	2	
	Celiac trunk origin	1	
	Left hepatic	1	
Superior mesenteric artery	Ileocolic	3	10
	Ileal	2	
	Jejunal	2	
	SMA origin	2	
	Right colic	1	
Right internal iliac	Middle rectal	1	1

A case of arterioportal shunt was a result of complication of microwave ablation for hepatocellular carcinoma, which was managed with microcoil and NBCA glue embolization (Figure 3). One patient presenting with gastrointestinal hemorrhage due to arterio-biliary shunt involving left hepatic artery was secondary to biliary intervention who had previously undergone percutaneous transhepatic biliary drainage (PTBD).

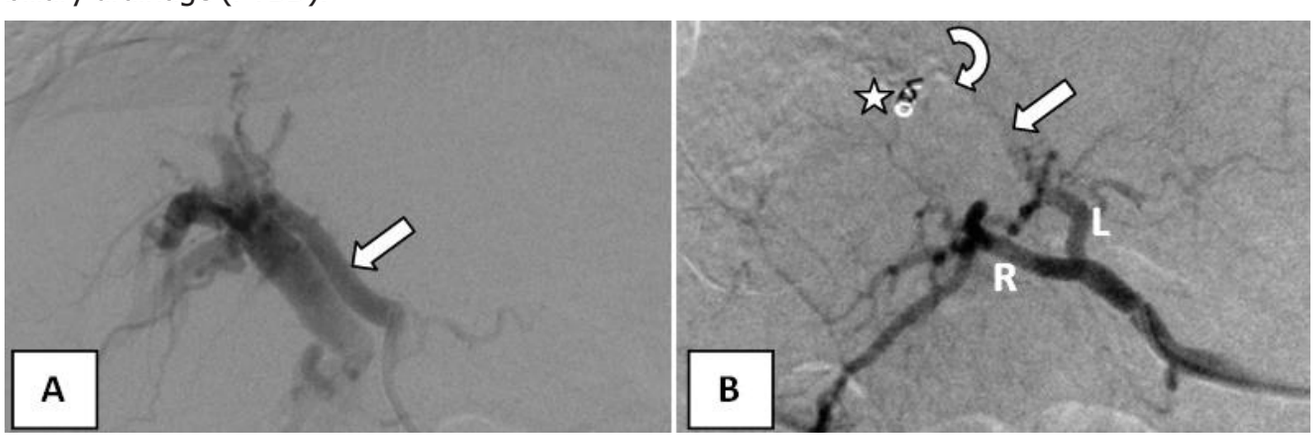

Figure 2: (A) *Coronal reformatted maximum intensity projection computed tomography angiogram image showing active contrast extravasation into duodenal lumen (asterisk).* ***(B)*** *Digital subtraction angiography image showing post-embolization glue cast (curved arrow). (Short arrow) denotes common hepatic artery and (long arrow) denotes gastroduodenal artery*

Re-bleeding post-embolization occurred in three patients (8.3%). Migration of microcoil into the pseudoaneurysm sac was seen in two patients (13.3% among 15 settings of use of microcoils) who had to undergo second setting of embolization after a couple of days. One patient had to undergo second setting of embolization due to pseudoaneurysm arising at a different arterial location; first jejunal artery and then right hepatic artery. One patient who was embolized for jejunal bleed for angiodysplasia did not show clinical improvement even after

successful embolization of the bleeder and had to undergo surgical management. Therefore after including interventions for re-bleeding, the technical success rate was 94.4%, while clinical success rate was 91.6%. No puncture site related complication or instances of non-target embolization were encountered. Thirty day mortality was observed in the eldest patient of 85 years which was as a result of multiorgan failure due to malignancy.

DISCUSSION

Acute gastrointestinal bleeding is a potentially life-threatening condition that requires immediate assessment, resuscitation and intervention. Endoscopic diagnosis and intervention remain the treatment of choice for gastrointestinal bleeding. However, colonoscopy during active lower gastrointestinal hemorrhage is often limited by the presence of blood in the colon and an inability to identify the bleeding source. Computed tomography angiography (CTA) is highly sensitive and specific for bleeding with a reported sensitivity of 85% and specificity of 92%. Tagged red blood cell nuclear medicine scan to localize the bleeding is another option in case of negative CTA and hemodynamically stable patient. Role of interventional radiology in management of acute gastrointestinal bleed comes into play in cases in which endoscopy may not be feasible; patient is a poor surgical candidate or failed endoscopy in cases of unprepared colon or heavy bleeding.[4,]

A review study done by Mittal et al. in 2023 has shown that arterial interventions in gastrointestinal bleeding have significantly improved with advances in catheter variety and embolic materials demonstrating minimal complications and better clinical outcome. The treatment of gastrointestinal hemorrhage depends largely on the location and underlying pathology. The classic embolic agent of choice for hemorrhage in the gastrointestinal tract is the microcoil which is deployed distally in the vasa recta of the offending arterial branch, effectively achieving hemostasis while sparing collateral circulation and thereby minimizing the risk of bowel ischemia. Liquid agents like n-butyl cyanoacrylate (NBCA) glue and particle embolic agents play increasing roles in the treatment of upper gastrointestinal tract hemorrhage, which possesses a rich collateral circulation. An advantage of liquid embolic agents is immediate hemostasis, which is especially needed in hemodynamically unstable patients and patients with coagulopathy. Use of combination of these embolic agents has also been seen in various studies. In our study, gelfoam was the most commonly used embolic agent, used in 50% cases; which was followed by NBCA glue in 47%, microcoil in 41.6% and 99% ethanol in 2.7%; with combination of couple of these agents used in 15 out of 36 settings. The main reason of more frequent use of gelfoam and NBCA glue over microcoil was their affordability as patients had to bear complete expenses of the procedure on their own.[4,5,6,7,8,9]

A review study done by Ramaswamy et al. in 2014 concluded that rapid stabilization can be achieved with endovascular angiography and transcatheter embolization, which was also considered safe and an effective alternative to surgery. In our study as well, only a single patient had to undergo surgical management post embolization (2.7%) due to failure of clinical improvement.[10]

High technical as well as clinical success rates of embolization were observed in our study which was 94.4% and 91.6% respectively; similar to other studies in the literature. A study be Vorcak M. et al. in 2022 demonstrated the overall technical success rate was 96.8%, and the clinical success rate was 88.5% regarding endovascular arterial embolization for gastrointestinal bleeding with a data set of 10 years. In another analysis that included 15 published studies (a total of 829 patients) focusing on arterial embolization in upper gastrointestinal bleeding, the technical success rate was 93% (62–100%), the clinical success rate was 67% (52–94%). The results of embolization in the lower gastrointestinal tract bleeding showed a technical success rate above 90%, a clinical favorable outcome rate of 86% in a study done by Krajina A et. al in 2020.[2,11,12]

Re-bleeding after embolization was observed to be 8.3% in our study. Among 33 patients, 30-day mortality was 3% in our study (1/33); the only case of mortality was as a result of multiorgan failure due to malignancy. A study by Loffroy R.et al in 2020 documented the risk of re-bleeding was 33% (9-66%), and the 30-day mortality was 28% (4-46%). Re-bleeding rate depended significantly on the presence of comorbidities. In addition to the number of comorbidities, other studies have identified additional risk factors for early recurrent hemorrhage, including coagulopathy, prolonged time from bleeding to angiography, and a higher number of transfusions. A study done by Yap et al. in 2013 that assessed the complications following transcatheter arterial embolization documented bowel ischemia in 4% and coil migration in 3% of cases. In our study, amongst 15 settings of use of microcoils, migration was observed in two patients (13.3%).[11,13,14]

Also, there are literature evidences in support of empirical embolization of gastroduodenal artery in cases of upper gastrointestinal bleed that has failed endoscopic therapy or in cases of upper gastrointestinal bleed that are occult in CTA with results not differing from embolization of proven hemorrhage. Recent findings suggest the potential benefits of preventive embolization in bleeding duodenal ulcers in patients at significant risk of re-bleeding. However, in our study there was no such occurrence of empirical embolization.[15,16,17]

The limitations of our study include a single center retrospective design and a low sample size. The results of our study regarding success rates, re-bleeding and complications however are comparable to other larger studies as mentioned above.

CONCLUSION

Endovascular arterial embolization offers prompt and effective management for gastrointestinal bleeding with high technical and clinical success rates. Improvement in equipment used in interventional radiology along with availability of newer embolic agents have contributed to lower rates of complications, need for surgical intervention and mortality rates in managing gastrointestinal hemorrhage.

CONFLICT OF INTEREST

None

SOURCES OF FUNDING

None

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