

Emergent Endovascular Management of Acute Arterial Bleeding after Initial Unsuccessful Surgical Control

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Abstract

Background: Hemorrhage and the complications thereof have traditionally been managed surgically but over the last two decades endovascular techniques have been increasingly used. These include coiling, liquid and particle embolization among others. These minimally invasive techniques now available locally are safe and cost effective. They are however yet to be fully adopted in acute emergency settings. **Methods:** Fifty two patients with acute bleeding from known causes and whose first surgical intervention was not successful in controlling the bleeding were referred for emergent endovascular embolization. **Results:** The causes of the bleeding included post traumatic bleeds from intra-abdominal organ injury, iatrogenic pseudoaneurysms, massive hemoptysis among others. There was 100% technical and clinical success rate in hemorrhage

control. None of the patients required a repeat endovascular procedure for bleeding control and no major complications were reported. **Conclusion:** Endovascular embolization was successful in controlling bleeding in all of the patients. It is effective, safe and available as a first line choice. It should be considered in all patients presenting with severe hemorrhage from known causes in the initial presentation.

Key words: Embolization, Interventional radiology, Vascular

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Introduction

Patients presenting with bleeding and associated complications of hypovolemia and shock continue to account for a major proportion of emergencies handled in emergency departments of most hospitals. These range from gastrointestinal and bronchial bleeds to bleeding from traumatic injuries of major intra-abdominal organs. Whereas these are managed appropriately within the various medical specialties, little attention has been paid to the novel endovascular options available for management of these patients in the region. This is largely because these services and trained personnel were not previously available. Endovascular treatment options are currently available are minimally invasive, cost effective, life saving and most instances a better option to major surgical interventions.

They include endovascular coiling, liquid embolization with onyx or histacryl, particle embolization with PVA particles or gel foam among others (3-6). This study reviews outcomes of patients with acute arterial hemorrhages from known causes who were treated emergently by endovascular techniques after initial unsuccessful surgical control.

Methods

All patients referred for embolization for acute arterial bleeds from a known cause and in whom initial surgical control was not successful were prospectively enrolled into the study over a four and half year period. Knowledge of availability of embolization services in the hospital by the referring physician was important as all referrals were from physicians who knew that the service was available.

Patients who underwent embolization at the initial suggestion of the attending Interventional radiologist and without an initial surgical intervention for bleeding control were excluded. The surgical control interventions included explorative laparotomies, therapeutic endoscopies and colonoscopies for gastrointestinal bleeds, therapeutic bronchoscopies among many others. Patients were received in the Interventional angiography unit having undergone initial resuscitation with IV fluids and in some cases blood transfusion by the primary physicians. This was after the initial surgical procedure had failed in controlling the bleeding or when the patient rebled a few hours to 72 hours after the surgery. In two patients rebleeds occurred a week after the initial surgical control procedure. Each patient then underwent a percutaneous femoral puncture to obtain a femoral arterial access and a 5F or 6F vascular sheath subsequently inserted. Right femoral arterial access was used in all patients, followed by 5F vascular sheath in forty patients and 6F vascular sheath in twelve patients. The various arterial territories with suspected source of bleeding were accessed with 4F, 5F C2, Rim or Simmons 1 guiding catheters, threaded over a .035 hydrophilic guiding wire. In fifteen of the cases with predominantly mesenteric and bronchial artery bleeds, a progreat micro catheter (0.027D, Terumo Japan) was utilized inside the guiding catheter to gain distal access in small segmental arteries not otherwise accessible. Obtained arterial vascular images were analyzed for angiographic evidence of bleeding which included findings of pseudoaneurysms, abrupt vessel cut off, arteriovenous fistulas (AVF) and contrast extravasation. Embolization was done with coils, gel foam particles, PVA particles, histacryl/lipiodiol mixture or absolute alcohol. A mixture of more than one embolic agent was used if necessary. Final post embolization DSA angiograms were carried out to confirm obliteration of the bleeding vessel and cessation of bleeding from the vascular territory.

Results

Fifty two patients underwent emergent endovascular embolization after initial surgical intervention had failed to stop the bleeding. There was on average at least two repeat surgical interventions for bleeding control, with

the highest repeats being for gastro intestinal bleeds. Patient ages ranged from 4-92 years with a mean age of 43 years. Of the thirty four patients who had initial hypovolemic shock at presentation, 90% underwent successful resuscitation with IV fluids and blood transfusions. Five patients (10%) continued resuscitation in the interventional suite and with the help of an anesthetist (Table 1). Gastro-intestinal and genito-urinary bleeds had the highest number with a total 48% of all the embolization procedures (Table 2). Angiographic evidence of cause bleeding was demonstrated in all cases, with pseudo aneurysm being the commonest cause (Table 3). Embolization was performed with coils in 16 patients, gel foam particles in 18, PVA particles in 6, histacryl/lipiodiol mixture in 6 and absolute alcohol in 6 (Figures1-6). A combination of more than one embolic agent was used in twenty four patients predominantly coils/gelfoam and coils/liquid agent combination. No major complications were encountered. In five patients hematoma formation at femoral puncture site was controlled by prolonged focal pressure application lasting up to thirty minutes. No repeat interventions for bleeding control were required in subsequent follow up in all the patients.

Table 1: Patient age distribution and hemoglobin levels

Age	Sex		Haemoglobin level (g/dl)		
	Male	Female	1-5	6-10	>10
1-30	2	1	-	3	-
31-50	28	12	8	25	7
51-100	6	3	2	5	2

Table 2: Location of bleeds

Location of bleed	No (%) n=52
Gastro intestinal	14(27%)
Genito-urinary	11(21%)
Liver	8(15%)
Bronchial	6(12%)
Limbs	4(8%)
Spleen	3(5%)
Neck	3(5%)
Central nervous system	3(5%)



Fig 1a

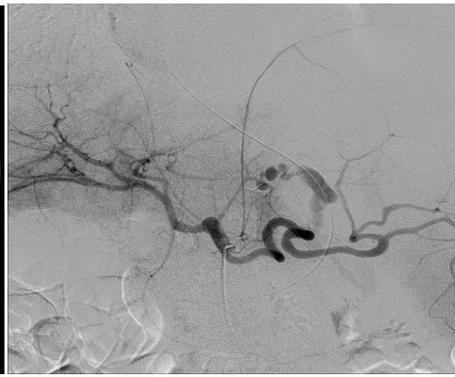


Fig 1b



Fig 1c

Figure 1a: Mass at gastric fundus enhanced in post contrast CT abdomen. 1b: Multilobulated pseudoaneurysm of the left gastric artery was demonstrated at celiac DSA angiogram. 1c: Left gastric artery super selectively coiled to occlusion.

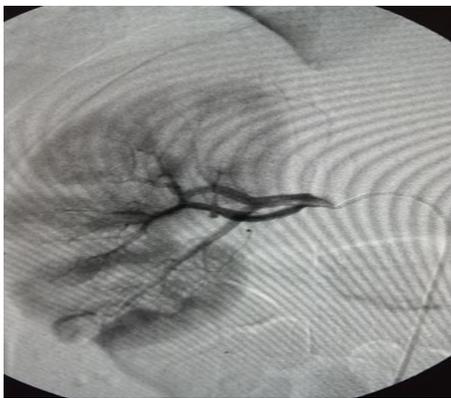


Fig 2a



Fig 2b

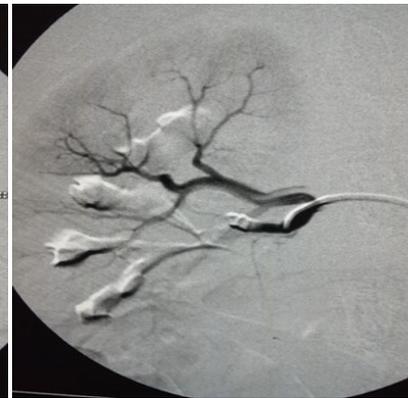


Fig 2c

Figures 2a-b: DSA angiograms demonstrating a small pseudoaneurysm from middle pole segmental branch of right renal artery. 2c: occluded with a 5mm embolization coil



Fig 3a

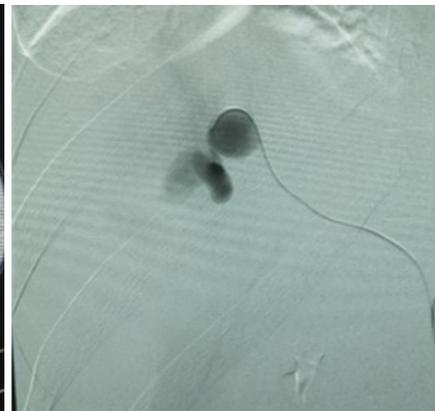


Fig 3b

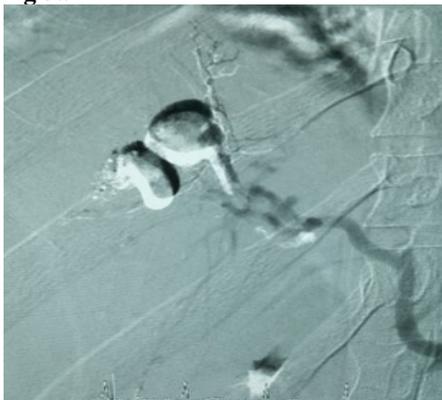


Fig 3c



Fig 3d

Figures 3a: Hemoperitoneum seen in CT abdomen in patient with traumatic liver laceration. 3b: DSA angiograms of the right hepatic artery show a large pseudoaneurysm from segment 7 arterial branches. 3c-d: Obliterated vessels using liquid histacryl mixed with lipiodol.

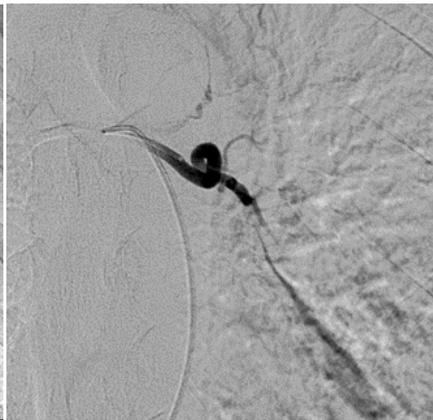
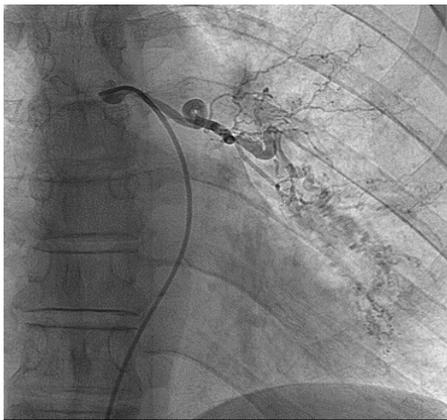


Fig 4a: Left bronchial artery DSA angiograms showing neovascularization of the terminal branches with angiographic blush of the affected left lingular segment of the lung in pulmonary tuberculosis patient with massive hemoptysis. **4b:** The artery was embolized to occlusion with gel foam particles and hemoptysis subsequently completely ceased.

Fig 4a

Fig 4b

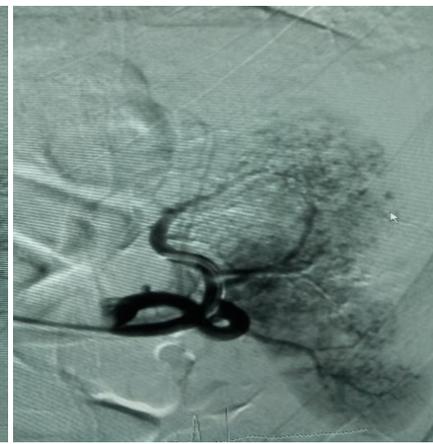


Fig 5a

Fig 5b

Fig 5c

Fig 5a: CT abdomen showing grade 3 splenic laceration in patient after a road traffic crash. **5b:** DSA angiograms of the splenic artery showing 'abrupt cut off sign' to the upper pole segmental artery indicative of bleeding. **5c:** Vessel embolized to occlusion with gel foam particles with bleeding control.

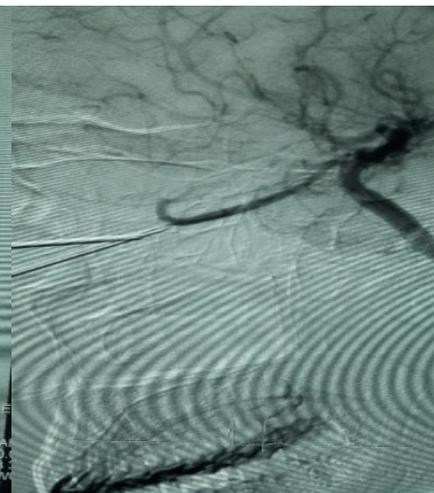
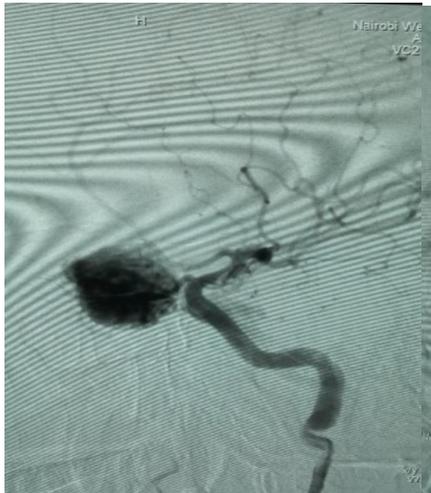


Fig 6a

Fig 6b

Fig 6c

Figure 6a: DSA angiogram of the left ophthalmic artery showing a hypervascular hemangioma and sole supply from the same artery in an 18 year old male with ptosis. **6b-c:** Transvenous embolization with absolute alcohol was done with complete tumor devascularization and control of bleeding

Discussion

Endovascular embolization for bleeding control has been widely used in the last few years and gaining ground in the region. Any bleeding artery can be accessed and occluded by endovascular techniques, making this the first choice method for bleeding control, unless an additional curative surgical procedure is required (1, 2). Because of lack of appropriate facilities and trained personnel in the past, this option was largely limited and patients continued to undergo traditional surgical approaches as demonstrated by the fifty two cases. These patients were referred to embolization service when the bleeding could not be stopped or when surgery was likely to result in loss of an organ (e.g. splenectomy).

Right femoral arterial puncture is the preferred route by many interventionists and was the exclusive mode in the study. Other vascular access routes can be radial, brachial and even direct carotid or subclavian arterial punctures in certain cases (). The bleeding artery is usually localized at DSA angiography with characteristic appearance of a pseudo aneurysm with obvious contrast leakage, an associated arteriovenous fistula or angiographic blush (3). Most traumatic cases were associated with a pseudo aneurysm which leaked due to the false sac causing significant hemorrhage. A few of the patients had subtle angiographic signs of bleeding like abrupt arterial cut off in a case of splenic laceration, and irregular tuft of arterioles and capillaries secondary to neovascularization in a case of severe hemoptysis from pulmonary tuberculosis. Embolization for gastro intestinal bleeding and others follow a similar approach (4).

Choice of embolic material is dependent on arterial territory being embolized, size of target vessel, primary pathology causing the bleeding, among other factors (). Coils are preferable in cases of pseudoaneuysms since the main arterial branch can be preserved. Particle embolization with gel foam or PVA particles may be indicated in cases of multiple feeder arteries to a hypervascular bleeding tumor. Histacryl and onyx, both liquid embolic agents are indicated in cases where there is need for higher rate of complete hemostasis (5, 6). In some cases there is use of more than one embolic agent (7).

The embolization procedure is stopped once bleeding control is confirmed angiographically. Repeat embolization can be done if rebleeding occurs. This is uncommon but has been observed in arterial bleeds from pelvic fractures (8). Multidisciplinary management of primary cause of the bleed continues thereafter after endovascular control of the bleeding is achieved.

Conclusion

Endovascular management was successful in controlling bleeding in all of the patients after initial unsuccessful surgical intervention. It is effective, safe, affordable and available as a first line choice. It should be considered initially in all patients presenting with arterial bleeding.

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