Trans-catheter arterial embolization in the management of upper gastrointestinal hemorrhages

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Aims and objectives

1. Acute gastrointestinal hemorrhage is a severe emergency with high mortality rates, especially in the case of elderly patients [1-3]. Despite the incidence of upper gastrointestinal bleeding (due to reduction of the incidence of peptic ulcer disease) has been steadily decreasing in the last few decades, there is no experience of reduction in both mortality and rebleeding rates [4]. The incidence of gastrointestinal bleedings ranges between 20 and 150 per 100,000 adults per year [5, 6] and the upper hemorrhages are approximately six times higher than that of lower gastrointestinal tract [7].

2. Clinical presentations of non-variceal Upper GastroIntestinal Bleeding (UGIB) include: hematemesis, melena, hematochezia, anemia and/or hemodynamic instability [8]. Although progress in the diagnosis and therapy of acute gastrointestinal bleedings has been made in the last several years, it still remains a difficult challenge. Endoscopy has become the main basis for the diagnosis and treatment of UGIB, and high risk patient should undergo emergency endoscopy within 24 hours. Endovascular techniques, such as trans-catheter arterial embolization, are now recognized as safe in controlling bleeding refractory to endoscopic treatment.

3. The objective of the present study was to evaluate the efficiency of the percutaneous arterial embolization for upper gastrointestinal hemorrhages and its correlation with endoscopic treatment (esophagogastroduodenoscopy EGDS).
Methods and materials

This study focused on 41 upper gastrointestinal hemorrhages treated with percutaneous trans-catheter arterial embolization after a first assessment with esophagogastroduodenoscopy and/or contrast-enhanced MultiDetector-CT study (MDCT). All these UGIB developed in 31 patients who were referred to our department between January 2008 and February 2012. Multifocal hemorrhages were found in 12 patients. Age and sex of patient examined were as follows: age, 72±12.7 years (range 38-91 years); male/female 58%/42%, and 3 patients were previously treated with anticoagulant therapy.

Clinical presentation was hematemesis in 9 patients, melena in 11 patients, hematemesis and melena in 5 patients; 6 patients developed gastrointestinal hemorrhages as complications during their hospital stay for other pathologies (i.e. jaundice, massive loss of body weight, abdominal pain, respiratory and renal failure). 14 patients presented hemodynamic instability at their hospital admission: 7 with arterial hypotension and 7 with blunt hemorrhagic shock.

Blood hemoglobin, platelets and International Normalized Ratio (INR) of the patients were recorded to evaluate the clinical condition of the patients. Mean values were as follows: hemoglobin 8.4 mg/dL (range 4.3-13.8), platelets 237x10^3 (range 34-706) and INR 2.00% (range 1.04-5.1).

All patients were firstly examined with EGDS and/or contrast-enhanced CT (MDCT). 26 patients underwent EGDS: in 15 patients the bleeding site was pointed out, and 4 of them benefited from endoscopic treatment.

Indications for percutaneous arterial embolization were clinical relevance of hemorrhage and persistency of gastrointestinal bleeding.

Radiological methods:

Some patients needed a further evaluation with CT scan that was performed after IV injection of 100-120 mL of iodinated non-ionic contrast material. CT signs of hemorrhage are extravasation of contrast medium in the duodenal lumen, thickening of gastric walls with increase in density and presence of juxta-pancreatic hematomas. 5 patients underwent CT scan examination, but no EGDS, because of the presence of symptoms not reliable for gastrointestinal hemorrhage or the presence of bad hemodynamical conditions. In all these cases CT findings pointed out the hemorrhages or their causes (cancer in most of cases).
All patients were referred to the Interventional Radiology Unit for a diagnostic Digital Subtraction Angiography (DSA) and possible percutaneous arterial embolization in presence of bleeding vessels.

Vascular access was obtained by placement of a 5-French sheath with Seldinger technique in the common femoral artery. Vascular anatomic features were carried out through catheterization of the abdominal aorta with a pigtail catheter.

After a panoramic angiography with a selective catheterization of celiac (figure 1a; 3a) and upper mesenteric artery, a superselective catheterization of the affected vessels was performed (even through a 3-French co-axial microcatheter system) to demonstrate the active bleeding, seen as a contrast material extravasation (figure 1; 3c) or intraluminal contrast pooling (figure 3b). Indirect angiographic signs of gastrointestinal bleeding include: presence of aneurysms or pseudo-aneurysms (figure 3a; 3b), visualization of submucosal vessel and early venous drainage (angiodisplasia), mucosal or extramucosal hyperemia, neovascularity, intramural contrast pooling (figure 3b) or arterial wall abnormalities.

The embolic agents we used in order to occlude the arterial bleeding sites included platinum coils and microcoils (figure 2; 4), gelatin sponge and polyvinyl alcohol microspheres (diameter 150 up to 450 µm). Embolic agents were chosen according to anatomic features of bleeding arteries, such as vessel size and location.

Another requirement for the successful performance of trans-arterial embolization is the complete knowledge of vascular anatomy, i.e. anatomical variants and collateral pathways. Blood supply in the case of UGIB can often be in form of arcades or double blood supply, and this requires different embolization techniques. The "front-door-back-door" technique (figure 2), consists of coiling the vessel the whole way retrogradely through first passing the bleeding site and then coiling retrogradely without the use of particles. In the so-called "sandwich" technique (figure 4) the bleeding vessel is occluded by two coils from different directions surrounding the bleeding site, through the superselective catheterization of the two different vascular supplies.

Trans-catheter embolization procedure was considered technically successful if there was no contrast material extravasation at the bleeding site on a repeated superselective DSA (figure 2b, 4d).

After embolization all patients were transferred to their departments for clinical monitoring.

Improvements in hemodynamic parameters and in blood hemoglobin concentration were considered as evidence of clinical success of the trans-catheter arterial embolization.
Fig. 1: Case A: 87-year-old patient with massive upper gastrointestinal hemorrhage. (a) Digital Subtraction Angiography after placement of the catheter in the celiac artery showing contrast extravasation from the gastroduodenal artery (arrow head). (b) The selective angiogram of the gastroduodenal artery confirms the gastrointestinal hemorrhage even after positioning the catheter beyond the bleeding site.

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**Fig. 2:** Case A: (a) Retrograde coiling of the bleeding vessel, distally and proximally to the injury site with the "back-door-front-door" technique. (b) Digital Subtraction Angiography demonstrating the embolization of the gastroduodenal artery with platinum coils. No bleedings detected

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**Fig. 3:** Case B: 68-year-old patient with upper gastrointestinal hemorrhage. (a) DSA of the celiac artery demonstrating a psuedoaneurism of the gastroduodenal artery (arrow head) and the presence (b) of intraluminal contrast pooling. (c) The superselective angiography of the gastroduodenal artery, through a co-axial microcatheter, shows endoluminal massive contrast extravasation from the broken vessel

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**Fig. 4:** Case B: (a) Angiography after embolization of the bleeding gastroduodenal artery with release of platinum coils. In order to complete the "sandwich" embolization the study proceeded with the catheterization of the superior mesenteric artery (b) and superselective angiography of the inferior pancreaticoduodenal artery (c) for coiling the hemorrhage collateral blood supply. (d) Multiple platinum coils released on both sides of the pancreaticoduodenal arcade
Results

EGDS was firstly performed on patients who presented clinical signs of gastrointestinal hemorrhage (26 patients). In 5 patients EGDS was not possible because of severe hemodynamic instability or because there was not suspicion for gastrointestinal bleeding: these patients underwent CT examination that pointed out all bleeding sites (due to gastric and duodenal ulcer disease, duodenal and pancreatic malignancies).

In 22 patients EGDS was able to show active bleeding site and 15 of them were treated endoscopically with epinephrine injection or with argon plasma coagulation: hemorrhage control was reached in 4 patients. 11 patients did not benefit from endoscopic treatment and presented persistent bleeding.

All patients underwent diagnostic DSA examination. Selective catheterization of bleeding arteries was effective in all patients and embolization was feasible in all cases. Details on bleeding arteries are summarized in table 1.

DSA showed active gastrointestinal bleeding in 12 patients (figure 1; 3c) and 10 patients presented indirect signs of hemorrhages (figure 3a; 3b). In 9 patients there was no evidence of bleeding (either direct or indirect), but the interventional radiologist proceeded with a blind embolization on the basis of endoscopic and CT scan findings.

Details of causes of gastrointestinal bleedings are summarized in table 2.

4 of the treated patients needed additional embolization after the first procedure because of clinical evidence of continuous or recurrent bleeding, but in 2 of them hemostasis was not achieved so they required surgical intervention.

Trans-catheter arterial embolization was effective in the treatment of upper gastrointestinal hemorrhages in 93.5% of cases (29 on 31 patients), as confirmed by post-embolization DSA (figure 2b; 4d) and clinical and instrumental follow-up. No complications related to the embolization were observed during or after the procedure.

During follow-up (18±15 days), a considerable overall clinical improvement was observed, with an increase in mean haemoglobin level from 8.4 mg/dL before the embolization to a mean value of 9.2 mg/dL (range 5.9-11.7) two day after arterial embolization and 9.8 mg/dL (range 6.9-12.7) at the time of hospital discharge.

During the hospital stay (from 3 to 33 days after the embolization) six patients died because of multi-organ failure due to hemodynamic complications related to the hemorrhage and hemodynamic shock. Other causes of death were severe sepsis in patient with chronic renal failure (1 patient) and complication of pancreas malignancy (1 patient). The remaining 23 patients were discharged from hospital in good clinical conditions.
Images for this section:

Table 1

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<table>
<thead>
<tr>
<th>Causes of Gastrointestinal bleedings</th>
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<tbody>
<tr>
<td>Duodenal ulcer disease</td>
<td>15</td>
</tr>
<tr>
<td>Duodenal and gastric ulcer disease</td>
<td>3</td>
</tr>
<tr>
<td>Gastric ulcer disease</td>
<td>1</td>
</tr>
<tr>
<td>Gastritis</td>
<td>2</td>
</tr>
<tr>
<td>Esophagitis</td>
<td>1</td>
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<tr>
<td>Erosive Gastritis</td>
<td>1</td>
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<tr>
<td>Duodenal involvement from pancreas malignancy</td>
<td>2</td>
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<tr>
<td>Complication after surgery</td>
<td>2</td>
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<tr>
<td>Gastric malignancy</td>
<td>1</td>
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<tr>
<td>Duodenal GIST</td>
<td>1</td>
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<tr>
<td>Angiodisplasia</td>
<td>1</td>
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<tr>
<td>Complication after ERCP</td>
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<td>Dieulafoy's lesion</td>
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**Table 2**

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Conclusion

The presence of upper gastrointestinal bleeding can be well recognized from clinical presentation, which may include hematemesis, hematochezia, melena, anemia or hemodynamic instability. The nasogastric lavage can detect the presence of red blood suggestive for a proximal source of bleeding. Sudden onset of bleeding leads to early intervention [9-11] and the amount of blood lost can affect the treatment strategy: an active and continuous bleeding may require emergency angiography in the first instance without passing through other diagnostic tests. The amount of blood to define a bleeding as massive is normally related to the need to transfuse the patient with four or more units of red blood cells in 24 hours.

In this study, in agreement with literature, a decrease in blood hemoglobin concentration, presence of tachycardia, hypotension and transfusion requirements were defined as signals of blood loss in progress. These factors are also important predictors of an effective resuscitation of the patient [12].

The identification of the site of gastrointestinal bleeding often requires a multidisciplinary approach. 80% of cases of UGIB resolve spontaneously, but an endoscopy is usually performed within 24 hours to identify the cause of the bleeding and begin a treatment to prevent recurrences [9-11].

DSA is often performed after endoscopy to identify and treat causes of gastrointestinal bleedings, but percutaneous embolization is particularly useful when used early in the course of the UGIB [13].

Endoscopy treatment and percutaneous arterial embolization have different rebleeding rate, respectively 15-20% and less than 10% [8].

Our series demonstrate that percutaneous arterial embolization of upper gastrointestinal hemorrhages is a safe technique (no patient died because of this procedure) with high effectiveness if performed by experienced physicians. It also leads to a bleeding control in most of cases (93.5%), especially when endoscopic diagnosis and treatment are not suitable or conclusive. Furthermore trans-catheter embolization presents a low procedural complications rate: no complication has been observed in our patients. Main complications include bowel or hepatic ischemia, coil migration, arterial dissection or bleeding, renal impairment secondary to contrast nephrotoxicity, and contrast reactions.

Thus, in patients with upper gastrointestinal bleedings not successfully managed by a conservative (endoscopic) approach, an early DSA with the intention to percutaneous arterial embolization is recommended.
References


