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Quality Improvement Guidelines for Transcatheter Embolization for Acute Gastrointestinal Nonvariceal Hemorrhage

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Introduction

Acute gastrointestinal (GI) bleeding is associated with significant morbidity and mortality [1]. Most cases are treated medically by correction of coagulation or endoscopically. Nonetheless, there remains a group of patients with significant bleeding for which these methods fail and endovascular treatment is indicated. Endovascular treatment is now the preferred option compared with open surgery due to the advantages of reduced morbidity and mortality.

Acute gastrointestinal bleeding is classically divided into two groups according to its relationship to the ligament of Treitz: upper and lower GI bleeding. Differentiating upper and lower GI bleeding based on the clinical presentation of enterorrhagia, melana, and hematemesis may be difficult and unreliable. Bleeding from the upper gastrointestinal tract is more frequent with incidence 1 per 1,000 persons [2], causing up to 70 % of all gastrointestinal bleeding [1]. The most frequent etiology is bleeding from peptic ulcer disease and gastritis [3]. Less frequent causes are variceal bleeding in portal hypertension, Mallory-Weiss syndrome, and tumors [4]. Lower gastrointestinal bleeding causes approximately 30 % of all gastrointestinal bleeding. The most frequent etiology is diverticulosis and less frequent is bleeding in angiodysplasia, tumors, inflammatory disease, and bleeding from Meckel's diverticulum [4, 5]. A separate group comprises hemorrhage from sources outside the digestive tract, such as the biliary tract, the pancreatic duct, and arterioenteric fistula, or visceral arteries aneurysms or pseudoaneurysms [6, 7].

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Definitions

Transcatheter embolization is defined as the intravascular deposition of particles, liquid, or mechanical agents to produce vessel occlusion. Technical success is typically defined as a cessation of active contrast media extravasation (if present before embolization) from the bleeding site at the end of the procedure. In presence of only indirect signs, it is considered as complete occlusion of pathologically changed arteries or pseudoaneurysms.

Clinical success definition varies greatly between the various reports in the literature. It is usually associated with the resolution of signs and symptoms of bleeding in a defined time period (mostly 30 days). Some studies also include secondary clinical success after repeated embolization in case of recurrent bleeding. Persistence of melena or hematemesis within 12–24 h after the procedure should not be considered a clinical failure if not associated with clear laboratory or clinical signs of blood loss and should not indicate the need for a reintervention.

Acute significant bleeding is generally considered as bleeding requiring transfusion of at least 4 units of blood within 24 h or causing signs of hemodynamic instability and shock (hypotension systolic BP of <100, tachycardia >100) [8–10].

Pretreatment Imaging

Radionuclide Tc99 red cell labeling is the most sensitive imaging method, with the ability to detect bleeding from

0.1 ml/min [11]. However, this technique is not able to define precisely the anatomic source of the bleeding. In addition, it can be too time-consuming to use in emergencies. Nowadays, it is mainly used for intermittent bleeding [1].

Conventional digital subtraction angiography (DSA) is able to detect bleeding from amounts of approximately 0.5 ml/min [12, 13]. Its sensitivity ranges from 63 to 90 % for upper and 40 to 86 % for lower GI tract [1]. Its sensitivity can be further increased by using provocative angiography with vasodilators (usually Tolazoline 15–30 mg) [14] or by using carbon dioxide. The classic direct angiographic sign of active GI bleeding is extravasation of contrast material. The indirect signs include mainly presence of pseudoaneurysms, arterial wall irregularities, or vascular tangle with early vein drainage (AVM, angiodysplasia) [6]. The localization of bleeding can be improved by previous placement of metal clips at the source of bleeding during endoscopic examination [15].

MDCT angiography, using the correct protocol, is similarly able to detect bleeding from the amounts of approximately 0.3 ml/min, comparable to conventional angiography [11, 16]. In addition, compared to conventional angiography, it is able to depict surrounding anatomical structures and to determine not only the place, but also a possible cause of bleeding. MDCT angiography also displays the complete vascular anatomy and may allow better planning of subsequent endovascular intervention [17]. It is generally recommended to include precontrast scans before IV contrast injection to differentiate blood from other high-density material in the bowel. High-speed IV contrast injection is important to opacify adequately the arterial tree and it is generally recommended at 4 ml/s [18]. Most of the studies also suggest acquisition of delayed (venous) postcontrast scans [1, 18]. Oral contrast should not be administered, because it makes the correct diagnosis difficult. The localization of the bleeding site is usually based on the presence of extravasated IV contrast material within the bowel lumen (Table 1).

Even in hemodynamically unstable patients with acute significant bleeding of obscure localization, MDCT angiography should be considered the imaging method of choice due to its noninvasiveness, speed, and sensitivity. Angiography and embolization generally should be considered in those cases when bleeding is identified on MDCT [1, 11, 20, 21].

Table 1 Usefulness of CT angiography to locate GI bleeding site [19]

Sensitivity	89 %
Specificity	85 %

Indications for Treatment and Contraindications

The indication for the procedure is usually based on a multidisciplinary consensus between the gastroenterologist, radiologist, and surgeon. In the event of acute significant gastrointestinal bleeding and after failure of conservative treatment, endoscopy is the method of choice. Endovascular procedures are indicated generally for patients with significant acute gastrointestinal bleeding with endoscopically untreatable or unrevealed source of bleeding or with excessive bleeding that obscures the endoscopic view [6], even in patients with signs of hemodynamic instability.

As indicated above, it is recommended to perform MDCT angiography before the intervention in the case of an unclear source of bleeding and if it is immediately available, it should be considered for hemodynamically unstable patients. In the case of a negative finding on MDCT angiography, the probability of detection of bleeding site in DSA is low [1, 11, 20, 21]. Surgical treatment is generally considered in operable patients especially those with a bleeding gastroduodenal peptic ulcer [22] or recurrent bleeding from colonic diverticula [23] and after endoscopy and embolization therapy failure.

Contraindications of embolization in significant GI bleeding are only relative. In addition to general contraindications for iodine-contrast examinations (allergy and renal insufficiency), there are specifically those of coagulopathy and residues of barium sulphate contrast agent after the previous examination (Fig. 1).

Procedure

The patient preparation before procedure includes initiation of supportive therapy (volumotherapy, etc.) and correction of coagulopathy. Bladder catheter insertion is desirable. During the procedure, blood pressure, heart rate, saturation, and ECG are monitored. In patients with GI bleeding, it is always desirable to have anesthetic and intensive care physician support, particularly in unstable patients.

The most common access used for embolization is the common femoral artery. Use of spasmolytics (i.e., Buscopan) could be helpful to avoid image artefacts. Usually all three unpaired visceral branches of the abdominal aorta are selectively examined with 4–5-F catheter (i.e., Simmons, Cobra, SOS Omni, etc.) to increase diagnostic accuracy before embolization. After verifying the source of bleeding, microcatheters are usually introduced coaxially. The choice of embolic material is individual. The most commonly used embolic materials are 0.018-inch microcoils (also 0.035-, 0.01-inch, and detachable microcoils for precise positioning could be used), PVA microspheres (500–700 μm), and gelatin foam. In the case of massive bleeding, the use of

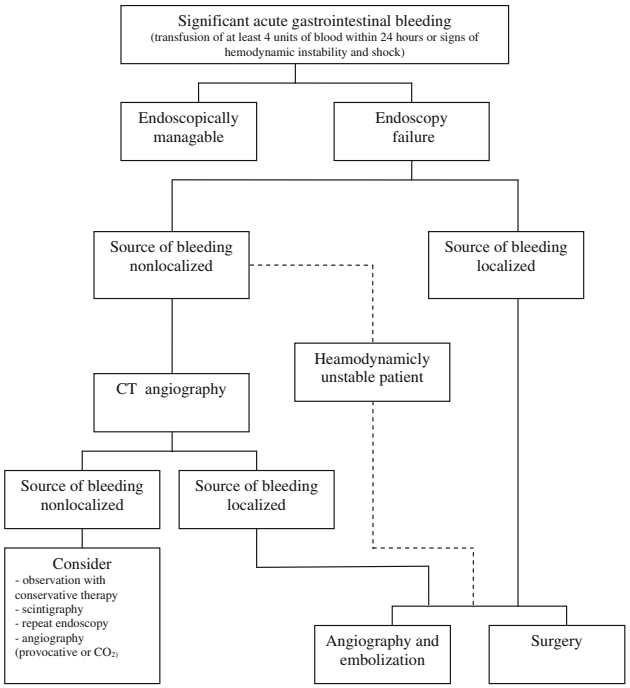

Fig. 1 Algorithm for management of significant acute nonvariceal gastrointestinal bleeding

tissue glue (Histoacryl, etc.) or Onyx may be considered [15] but with increased risk of ischemia and need for further surgical intervention. A combination of embolic materials can be beneficial (microcoils with gelatin foam or microparticles) to reduce the risk of rebleeding [24]. Selective intra-arterial infusion of vasoconstrictor agents is rarely used due to the high frequency of rebleeding (>50 %) [8, 25, 26] and occurrence of systemic side effects [6]. It could be considered for diffuse mucosal hemorrhage, diverticular bleeding, postpolypectomy, or lesions inaccessible to a microcatheter. Typically 100 units of vasopressin are mixed in 500 ml of saline and infusion speed is set to between 0.1 and 0.4 U/min and lasts up to 16 h.

Due to differences in blood supply of the upper and lower GI tract, the technique of embolization also differs. The upper gastrointestinal tract is characterized by a rich network of collateral supply with a lower risk of ischemia. Before the embolization itself, it is necessary to map all the possible sources of collateral supply, especially in the region of gastroduodenal artery and pancreaticoduodenal arcades. Because of the risk of rebleeding via collaterals, it is necessary to perform embolization proximally and distally from the site of bleeding (so-called sandwich method) [8].

In the lower gastrointestinal tract, in particular in the colon, there is a higher portion of terminal branches. Therefore, the ischemia risk is higher and embolization should be as selective as possible [27]. Due to the poor submucosal collateral circulation, extensive embolization from the periphery to proximal vessels may interrupt the blood supply for a longer part of the intestine and therefore could cause bowel ischemia [6]. Use of particles of 700 μm or larger is advisable in order not to compromise the submucosal circulation and lower the risk of ischemia.

Outcome

The presence of uncorrectable coagulopathy is the most significant negative predictive factor for recurrent bleeding and mortality [9, 15]. Other negative predictive factors include older age, cirrhosis, oncologic diseases, multiple organ failure, and current corticosteroid treatment [7, 56]. Generally, the morbidity and mortality associated with endovascular intervention is lower or comparable than for surgical procedure [28, 42, 57–59].

In view of the lower morbidity and mortality compared with open surgery is endovascular therapy, which is now considered the treatment of choice for GI bleeding following failed medical and endoscopic therapy (Table 2).

Complications

In addition to the standard rate of nonspecific complications associated with other angiographic procedures (such as reactions to the contrast agent, renal failure, local complications in the groin, dissection, vasospasm), the most common and specific complication of GI embolization is ischemia. In the upper GI tract, the risk of ischemia is low due to the rich collateral supply. Duodenal stenosis as a result of duodenal ischemia following embolization is low and reported to be less than 7 % [60]. Patients are at increased risk of ischemia if they have a previous history of surgery or radiotherapy [9] and after embolization with glue or microparticles [6, 60].

Other rare, specific complications include unintentional main hepatic artery embolization with the risk of liver failure [15]. Overall average complication rate is approximately 9 % [28].

Similarly, in the lower GI tract, the most common specific complication is intestinal ischemia. The mild form

Table 2 Outcome

Upper GI bleeding [15, 28–41]	
Technical success	93 %
Clinical success	67 %
Rebleeding rate	33 %
Lower GI bleeding [5, 42–55]	
Technical success	95 %
Clinical success	76 %
Rebleeding rate	24 %

(transient abdominal pain and asymptomatic stenosis) occurs in 10 %. Severe ischemic complications requiring surgical treatment (symptomatic ischemic stenosis, intestinal infarction) occur in 2 % [5].

Conflict of interest The authors, Jakub Husty and Vlastimil Valek, declare that they have no conflict of interest.

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