Embolization for Upper GI Bleeding

Optimal techniques and how to avoid pitfalls when faced with this challenging presentation.

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Acute nonvariceal upper gastrointestinal (GI) bleeding remains a challenging presentation due to significant morbidity and mortality rates, and about half of all cases of upper GI bleeding are caused by gastric and duodenal ulcers.[1,2] Although first-line endoscopy achieves bleeding control in most patients, if this does not work, the mortality rate can be 5% to 10% because of multiple comorbidities, advanced age, and high transfusion requirements.[1] Surgery is also associated with high mortality, and therefore, selective transcatheter arterial embolization (TAE) is considered a safer alternative due to the avoidance of laparotomy, particularly in high-risk patients. In fact, in many institutions, TAE is now the first-line intervention for massive arterial bleeding from the upper GI tract that is resistant to endoscopic therapy.[1-7] Arterial embolization in the upper GI tract above the ligament of Treitz is generally considered to be very safe because of the rich collateral supply to the stomach and duodenum. However, interventional radiologists must be aware of technical and clinical factors that may influence the outcome of patients who undergo embolization procedures for acute gastrointestinal hemorrhage, as this can help one avoid pitfalls and complications.

EARLY INTERVENTION IMPROVES OUTCOMES

Many clinical variables have been identified as predictors of early rebleeding after embolization, such as clinical signs of shock and active bleeding at admission. Among the variables that were studied in our largest series, a longer time from shock onset to angiography was found to be associated with early rebleeding.[2,5,8] Thus, the ability to achieve bleeding control in critically ill patients seems to chiefly depend on early intervention.

BE SURE TO CORRECT COAGULATION DISORDERS

Among clinical predictors of rebleeding, coagulopathy has been shown to adversely affect the success rate for embolotherapy, with an increase in the odds ratio for clinical failure that ranges from 2.9 to 19.6.[2,5,6,9] In the same way, a number of factors have been identified as influencing mortality after embolization. One of the most important and frequently encountered factors is the absence of early recurrent bleeding.[2,8] In other words, a strong correlation has been found between coagulopathy, clinical failure, and mortality after embolization. By the time a patient with upper GI bleeding reaches the interventional suite, he/she should be fluid resuscitated, hemodynamically stable, and have all coagulopathy corrected. Blood products, such as fresh frozen plasma, platelets, or packed red blood cells, may also be given intraprocedurally. It is highly desirable to correct any coagulation disorder before embolization, because achieving hemostasis depends on technically successful embolization as well as the patient's ability to clot properly. Consequently, every effort should be made to correct coagulopathy not only before the procedure but also during and after the intervention.

USE OF ENDOSCOPIC MARKING

Marking with a metallic clip can assist with localizing the vessel feeding the bleeding ulcer, even if there is no contrast medium extravasation after injection with the catheter in the common hepatic artery or the main trunk of the gastroduodenal artery (GDA).[2,10] This is also important when the bleeding artery arises separately from the proper hepatic artery or the GDA. The clips remain in position for several hours and allow for efficient localization of the culprit vascular branch. Superselective angiography guided by clip position has a higher chance of demonstrating the extrava-

Figure 1. Arteriographic images showing bleeding from a bulbar duodenal ulcer in a 76-year-old man. Arteriogram showing contrast medium extravasated from a slender branch of the GDA into the duodenum (arrows) (A, B). After microcatheterization, selective glue embolization (radiopaque because of associated lipiodol) (arrows) preserving the GDA ensured bleeding control, with no early or late recurrences (C, D).

sation, making blind coil placement unnecessary, and thus increasing the efficacy of the procedure and decreasing the risk of coil misplacement and inadvertent hepatic embolization. The only limitation of this technique is the need for around-the-clock availability of an experienced gastroenterologist, which is usually only available in high-volume medical centers.

CT ANGIOGRAPHY MAY BE USEFUL

CT angiography (CTA) has been accurately used (with a sensitivity up to 86%) in the diagnosis of acute GI bleeding and can show the precise location and etiology of bleeding, thereby directing further management (Figure 1).[11] However, the use of this technique necessitates hemodynamic stability. Furthermore, the use of CTA has the ability to change the management of patients with lower acute GI hemorrhage due to a greater likelihood of demonstrating the source of bleeding if performed as soon as a patient shows signs of active bleeding. Hence, there is much discussion about the need for diagnostic studies before angiography in the management of upper GI bleeding. Indeed, most cases allow accurate location of the bleeding source. Blind embolization can therefore be performed consequently based on endoscopic findings.[2] When CTA is performed, it must be done without delay, in the absence of hemodynamic instability, and particularly in specific situations (eg, the postoperative setting) in order to identify a false aneurysm-like lesion that endoscopy can miss.

IT IS CRITICAL TO KNOW THE ANATOMIC VARIANTS

Diagnostic angiography for upper GI bleeding is straightforward and is centered on the anatomy of the celiac artery. Specifically, the celiac artery gives rise to the left gastric artery, which provides branches to the distal esophagus and fundus of the stomach. These branches also communicate with distal branches of the small, short gastric arteries from the splenic artery and branches of the right gastric artery. The latter is usually a small artery that originates from the left or common hepatic artery, but it is not often visualized angiographically. The remainder of the stomach and duodenum are supplied by branches from the GDA. The superior mesenteric artery (SMA) may supply portions of the duodenum, mostly through pancreaticoduodenal anastomoses, which are important angiographically as a rich collateral supply keeping the stomach and duodenum viable after celiac branch embolization, but it may also be responsible for rebleeding after embolotherapy. Anatomic variations in the celiac anatomy (most notably in the origins of the hepatic arteries) occur in at least 50% of the population. Such variations must always be considered when evaluating a patient angiographically for upper GI bleeding.[12]

ANGIOGRAPHIC TECHNIQUE

The key to avoiding frustration and mistakes is to perform perfect angiography. A variety of introducers and selective catheters with a small caliber can be used to cannulate the celiac artery and achieve access to the common hepatic artery. For selective catheterization by femoral approach, the most widely used catheter configurations are the cobra, hook, and short- and long-curve sidewinder with a 4- or 5-F diameter. Once access is secured, arteriography is performed to delineate the anatomy and identify contrast extravasation. Selective catheterization for upper GI bleeding should always include the celiac artery and SMA. The first artery catheterized is the one most suspected of bleeding based on previous imaging or endoscopy, which is, of course, the celiac artery for upper GI bleeding. If no extravasation is seen, then superselective angiography is advised, depending on endoscopic findings that offer information on the most likely location of the bleeding source; superselective catheterization of the GDA, the left gastric artery, or the splenic artery may be performed.[2] Obtaining this quality of diagnostic arteriograms is only possible with totally cooperative patients, which is unlikely in patients who are actively bleeding. Angiography allows one to characterize the lesion, assess the presence of anatomic variations, and visualize the significance of the vessel network. It is best to use general

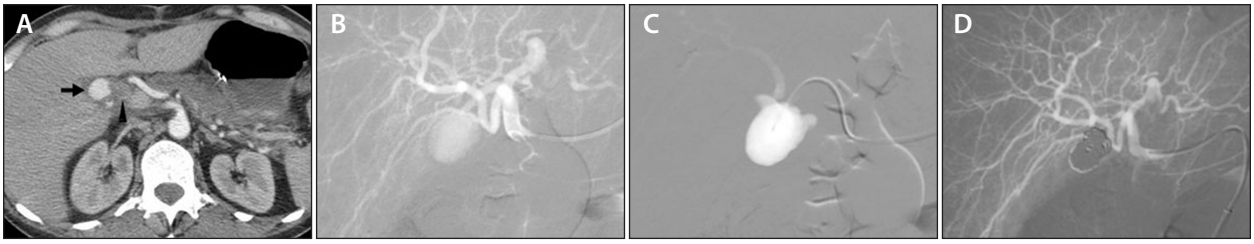

Figure 2. A 41-year-old woman presented 3 weeks after a laparoscopic cholecystectomy with right upper abdominal pain and hemobilia. A computed axial tomographic scan showing a round mass within the gallbladder fossa with contrast filling at the arterial phase (arrow) and dilatation of the bile duct (arrowhead) (A). A selective hepatic arteriogram showing a pseudoaneurysm of the cystic artery stump (B). Coil embolization of the aneurysmal sac across the neck using the packing technique through a microcatheter (C). Control angiography showing complete occlusion of the false aneurysm and preservation of the main and distal hepatic artery (D).

anesthesia with apnea during runs. An alternative is to use "cine" mode. In all cases, bowel paralysis with an intravenous injection of glucagon may be useful.

It is also very important to use enough contrast with a high rate of injection (30 mL at a rate of 7 mL/sec in the celiac trunk and SMA) whenever possible.[2,3] Longer injection durations or use of carbon dioxide angiography can also improve sensitivity for small bleeds. The use of nitroglycerin and other vasodilators is variably effective and, in our experience, not recommended in bleeding patients.[13] If by any chance an extravasation is observed on the celiac angiogram but not on the superselective angiogram, this is most likely due to the catheter ending up in the wrong artery rather than to interruption of the bleeding.

ALWAYS USE A STABLE DIAGNOSTIC CATHETER AND COAXIAL MICROCATHETER

It is mandatory to use a stable guiding catheter, as previously mentioned, and to position it appropriately. The sidewinder configuration is most useful. A microcatheter inserted coaxially is always necessary for a distal and superselective approach to the bleeding site, as well as to avoid the spasm caused by catheters with a 4- or 5-F caliber (Figure 2). Neurovascular microcatheters and wires may be very useful and more likely to achieve a satisfactory distal position for embolization. In cases of active hemorrhage with extravasation of contrast, the bleeding vessel is identified by superselective catheterization and embolized with microcoils or glue if arterial flow is not blocked by the microcatheter. If no evidence of bleeding is found on pre-embolization arteriography, then blind embolization (defined as embolization without angiographic proof of extravasation) is advised and is typically guided by endoscopic information regarding the location of the bleeding vessel.[2,3] Coils and gelatin sponges are then used in such a situation.

Finally, sandwich occlusion can be used at the level of the GDA: the catheter is pushed to the origin of the right gastroepiploic artery, and coils are introduced as the catheter is withdrawn to the proximal GDA. Complete embolization of the GDA, which includes proximal and distal embolization and exclusion of its two side branches, is the end point in this case. A selective SMA arteriogram is obtained after embolization to ensure that no collateral supply to the bleeding site is present. If extravasation is identified, superselective catheterization of the inferior pancreaticoduodenal artery and the side branch responsible for the collateral circulation is performed with the microcatheter. Embolization with microcoils of the bleeding site is completed as distally as possible.

However, it is mandatory to use extreme caution when embolizing near pancreatic circulation because of the high risk for pancreatitis, necrosis, or pseudocyst; in such a setting, it is probably preferable to use only microcoils rather than particulate or liquid agents as glue.

CONSIDER EMPIRIC EMBOLIZATION

Empiric or blind embolization is controversial. Because massive bleeding is often intermittent, most groups have adopted a policy to embolize on the basis of endoscopic findings, even in situations where no angiographic extravasation is seen.[2,3,8,10] Based on the findings from the literature and our own experience, we believe that blind embolization is appropriate (Figure 3). This approach is systematically used in our institution to maximize the results of TAE and minimize recurrent bleeding, even if some patients may experience spontaneous resolution of bleeding. Several previous studies found that empiric embolization based on endoscopic findings, in the absence of contrast extravasation, was helpful to achieve bleeding control, with no difference according to whether angiography identified the bleeding site. Although this technique remains controversial, there is now enough evidence from the literature to advocate the practice of endoscopy-directed empiric

Figure 3. Typical sandwich embolization in a 73-year-old woman with bleeding from a postbulbar duodenal ulcer at endoscopy. Global and selective angiography before embolization with no evidence of active bleeding (A, B). Coil embolization of the distal and proximal GDA (with gelatin sponge in the arterial trunk), including the anterior and posterior superior pancreaticoduodenal arteries and the right gastroepiploic artery, to prevent retrograde flow (arrows) (C). The bleeding stopped, and no ischemic complications were reported.

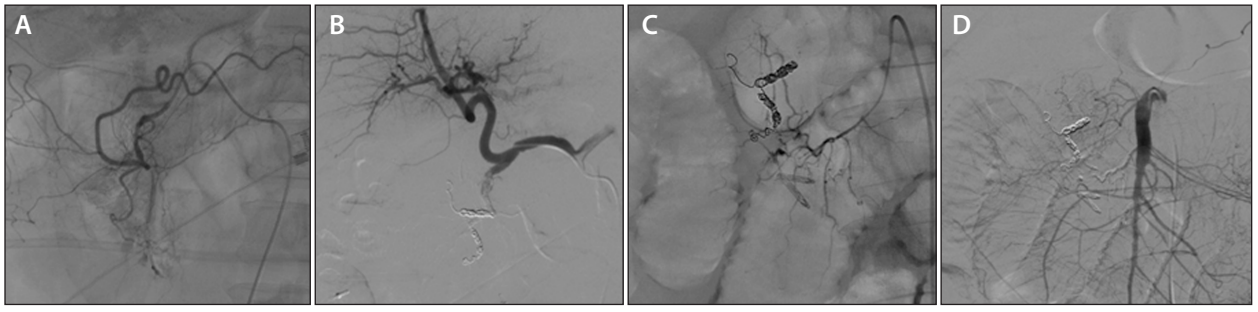

Figure 4. Images of a duodenal ulcer bleed in a 68-year-old man. Angiography before embolization, guided by metallic clips, showing bowel hyperemia (A). Glue embolization of the GDA after protection of the right gastroepiploic artery with coils to avoid distal embolization of the gastroepiploic artery (B). Check control of the SMA showing "back door" bleeding from a proximal jejunal branch with extravasation at the initial bleeding site (C). Results after superselective embolization with Glubran 2 cyanoacrylate glue, without rebleeding (D).

embolization for angiographically negative upper GI bleeding. In addition, this technique can be used not only in the GDA area but in the left gastric artery territory as well, because the left gastric artery and GDA supply 80% to 90% of upper GI hemorrhages.[2,3]

REMEMBER "BACK DOOR" BLEEDING

Arteriography after superselective cannulation may show extravasation that could have been missed during contrast injection in the main hepatic artery. When a dual supply of the bleeding area is suspected, both arterial sources must be embolized to ensure that all of the inflow ceases. This is the typical case of bleeding secondary to an ulcer that erodes into the GDA. Embolization in this case must start distally to prevent persistent "back door" hemorrhaging from the right gastroepiploic and superior pancreaticoduodenal arteries and then proceed to the proximal side of the erosion. Furthermore, it is mandatory to angiographically check the collateral pathways from the SMA after embolization of the GDA via the celiac trunk to ensure that no revascularization of the embolized bleeding site exists (Figure 4).[2,5,6]

DO NOT HESITATE TO USE CYANOACRYLATE GLUE

The influence of the type of embolic agent on the clinical outcome is still controversial. Encarnacion et al achieved only a low success rate in their series, which included mostly patients embolized with Gelfoam (Pfizer, Inc.) alone.[14] These data confirm that the use of gelatin sponge alone as the embolic agent guarantees only short-term results and should probably be avoided. The literature supports the use of Gelfoam in association with coils when choosing a strategy for the subgroup of patients with bleeding from the GDA.[2] We demonstrated that the use of coils as the only embolic agent was significantly associated with early rebleeding in the upper GI tract.[5] Coils should probably not be used as the only embolic agent, but rather in association with Gelfoam for the treatment of gastroduodenal hemorrhage, especially when using the sandwich technique.

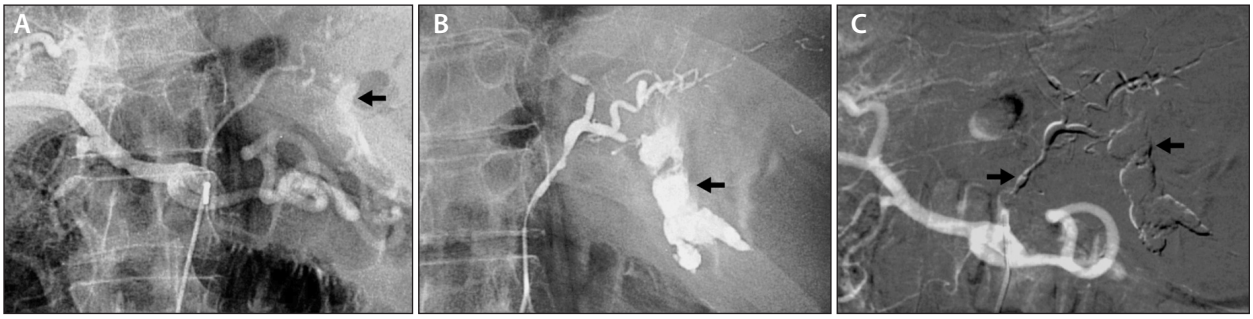

Figure 5. A bleeding Dieulafoy's lesion in an 87-year-old man. Extravasation of contrast medium from the left gastric artery (LGA) at the celiac trunk, and superselective angiography indicates continuing bleeding (arrows) (A, B). After arterial microcatheterization, bleeding was controlled after embolization of the LGA using a 1:3 Glubran 2/lipiodol mixture (arrows) (C).

More recently, the use of n-butyl cyanoacrylate glues, such as Glubran 2 (GEM Srl) or Trufill (Codman Neuro, Johnson & Johnson) has gained acceptance, with very good results in upper GI bleeding and lack of increased ischemic complications than with other embolic agents.[6,9,15] Furthermore, the time for embolization using glue is significantly quicker than for procedures that do not use glue. This is particularly important in cases of massive bleeding that require urgent hemostasis, especially in patients with coagulopathy (Figure 5). Furthermore, polymerization of glue does not depend on the coagulation parameters of the patient, leading to better efficacy in case of coagulation disorders. Glue should be used more often without fear, because it provides a better and faster hemostasis. However, the use of liquid embolic agents, such as glue, requires a steep learning curve.

CONCLUSION

Managing massive bleeding from the upper GI tract remains a challenge. A multidisciplinary team of skilled endoscopists, intensive care specialists, experienced upper GI surgeons, and interventional radiologists all have a role to play. The past 3 decades have seen enormous advances in endovascular device development and treatment of a wide variety of hemorrhagic conditions. The safety and efficacy of TAE for the treatment of life-threatening, acute, nonvariceal upper GI bleeding is now widely accepted and is considered the gold standard for endoscopy-refractory patients.[2,3] Embolization may be effective for even the most severely ill patients for whom surgery is not a viable option, even when extravasation is not visualized by angiography. As described in this article, several clinical and technical factors must be known by interventional radiologists, because they may influence the clinical outcome of embolotherapy in such settings. Specifically, every effort should be made to perform embolization soon after bleeding onset and to correct coagulation disorders. In addition, it seems that careful selection of the embolic agents, according to the bleeding vessel, may play a role in a successful outcome. ■

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