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Embolotherapy of Massive Duodenal Hemorrhage

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Abstract. Eleven patients with massive duodenal hemorrhage were treated by emergent embolization. Bleeding originated from duodenal ulcer in three patients, from duodenal tumor in one, from ruptured pancreaticoduodenal artery pseudoaneurysm in three, and from ruptured gastroduodenal artery pseudoaneurysm in four. Complete hemostasis was obtained immediately after embolotherapy in all cases. Three of these patients died during the hospitalization period, one of whom from duodenal infarction and pancreas necrosis induced by embolization. In three patients with duodenal ulcer, complete hemostasis was obtained only by the gastroduodenal artery embolization with Gelfoam particles. Seven patients with pseudoaneurysms of the gastroduodenal artery or its branches required not only blockage of blood flow from the celiac artery but also the superior mesenteric artery for complete hemostasis. Therefore, in patients presenting with duodenal hemorrhage, the possibility of dual blood supply to the duodenum should be considered. Emergent embolization represents a useful alternative to surgery for massive duodenal hemorrhage, but it carries a risk of complications in patients with previous gastroduodenal surgery or significant visceral atherosclerosis.

Key words: Gastroduodenal arteries, embolization—Duodenum, hemorrhage—Gastrointestinal bleeding, management.

Hemorrhage from the duodenum is most frequently due to peptic ulcer and rarely from the ruptured pseudoaneurysms of the gastroduodenal artery or its branches [1, 2].

In the past, the treatment of choice for massive duodenal bleeding had been surgery. However, in critically ill or postoperative patients, surgery carries a high risk of mortality [3, 4]. Recently, emergent embolization as a nonsurgical and less invasive procedure has been introduced for the control of arterial hemorrhage [5, 6]. Because of the dual blood supply and the large size of arteries that are frequently involved, embolotherapy for duodenal hemorrhage is usually considerably more challenging than that for gastric hemorrhage [7–9].

We report our experience with emergent embolization in 11 patients with massive duodenal hemorrhage who were not candidates for surgery.

Materials and Methods

From January 1984 through July 1990, emergent embolization was performed in 11 patients with massive duodenal bleeding. The pertinent clinical and angiographic information is summarized in Table 1. Our series consisted of eight men and three women, ranging in age from 10–81 years (mean 46.1 years). All of the patients were high-risk candidates for surgical control of bleeding because of shock condition and underlying severe disease. All patients required a blood transfusion ranging from 440–3500 ml before and/or during embolization. At first, emergent gastroduodenal endoscopy was performed and showed duodenal bleeding in all cases except one who had undergone subtotal gastrectomy and gastrojejunostomia for cancer and subsequent stomal ulcer (case 3). In all patients except this one, hemostasis was attempted by endoscopic coagulation therapy, but bleeding could not be controlled.

Diagnostic celiac and subsequent superior mesenteric arteriography were performed with a 5- or 6.5-French preshaped catheter (Cook, Inc., Bloomington, IN, USA) by the transfemoral route in all patients.

Celiac arteriogram revealed occlusion of the celiac artery in case 9, and occlusion of the gastroduodenal artery in one patient (case 5) who had undergone a ligation of the gastroduodenal ar-

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Table 1. Summary of 11 patients with duodenal hemorrhage treated by embolization

Case	Age (yrs)/sex	Underlying disease	Embolized artery and embolization method	Hemostasis and outcome
1	36/male	Duodenal ulcer Liver cirrhosis Under plasma pheresis for hepatic failure	GDA with GP	Successful and discharged
2	24/male	Duodenal ulcer Crush syndrome Under hemodialysis for renal failure Amputation of the leg	GDA with GP	Successful and discharged
3	51/male	Gastrectomy, stomal ulcer Under hemodialysis for renal failure Gastrectomy for gastric cancer	GDA with GP	Successful, but died of duodenal infarction and pancreas necrosis 5 days
4	63/female	Duodenal tumor Cholecystectomy for GB cancer	GDA with GP and SS coils	Successful and discharged later
5	65/male	GDA pseudoaneurysm Wedge resection of duodenum for cancer of papilla Vateri	IPDA with GP	Successful and discharged later
6	70/female	GDA pseudoaneurysm Cholecystectomy for GB cancer	GDA with GP initially CHA with SS coils additionally IPDA with GP	Unsuccessful Successful Successful and discharged later
7	24/male	GDA pseudoaneurysm Chronic myelogenic leukemia	GDA with HEMs IPDA with HEMs	Successful Successful and discharged later
8	37/male	GDA pseudoaneurysm Gastrectomy for gastric ulcer	GDA with HEMs SPPDA with HEMs	Successful Successful and discharged later
9	81/male	SPPDA pseudoaneurysm Left nephrectomy for renal cancer	SPPDA with HEMs	Successful and discharged later
10	10/female	APDA pseudoaneurysm Acute pancreatitis, DIC	SAPDA with HEMs IAPDA with HEMs	Successful, but died of DIC 2 weeks later
11	54/male	SPPDA pseudoaneurysm AMI	SPPDA with HEMs IPPDA with HEMs	Successful but died of AMI 7 days later

GB, gall bladder; GDA, gastroduodenal artery; CHA, common hepatic artery; SAPDA, superior anterior pancreaticoduodenal artery; SPPDA, superior posterior pancreaticoduodenal artery; APDA, anterior pancreaticoduodenal artery; IPDA, inferior pancreaticoduodenal artery; IPPDA, inferior posterior pancreaticoduodenal artery; IAPDA, inferior anterior pancreaticoduodenal artery; GP, Gelfoam particles; SS, stainless steel; HEMs, hilal embolization microcoils; DIC, disseminated intravascular coagulation; AMI, acute myocardial infarction.

tery by previous operation. Extravasation of contrast material from the gastroduodenal artery or its branches into the duodenum was demonstrated in the remaining nine patients. One had hemorrhage from duodenal tumor, three from duodenal ulcer, three from ruptured gastroduodenal artery pseudoaneurysm, and two from ruptured superior pancreaticoduodenal artery pseudoaneurysm. In two other patients, superior mesenteric arteriogram revealed extravasation of contrast material from the ruptured gastroduodenal artery and superior anterior pancreaticoduodenal artery pseudoaneurysms.

Immediately after diagnostic angiography, superselective embolization with the same catheter was performed on eight arteries in our early experience (cases 1–6), and with a 3-French Tracker coaxial catheter (Target Therapeutics, Inc., Mountain View, CA, USA) on nine arteries in later cases (cases 7–11).

Gelatin sponge particles (Gelfoam; Upjohn Co., Kalamazoo, MI, USA), 500 μ–1 mm in size, or Hilal embolization microcoils (Cook, Inc.) alone were used as embolic material in four arteries on four patients and in nine arteries on five patients, respectively. Gelfoam particles followed by a stainless steel coil (Cook, Inc.) were used in two arteries on two patients. Hemostasis was determined by the absence of clinical hemorrhage at the time of discharge or death, and/or a 1-month interval following embolotherapy.

Results

Complete and immediate hemostasis was obtained in all cases, but mortality during hospitalization was encountered in three patients (cases 3, 10, and 11). A postgastrectomy patient under hemodialysis for renal failure died of duodenal infarction and pancreatic head necrosis 5 days after embolization (case 3). The other two died of disseminated intravascular coagulation (case 10) or acute myocardial infarction (case 11). In the remaining eight cases, however, the emergent embolization was the definite therapy and obviated surgery.

In three cases with a bleeding duodenal ulcer, complete hemostasis was achieved rapidly by gas-

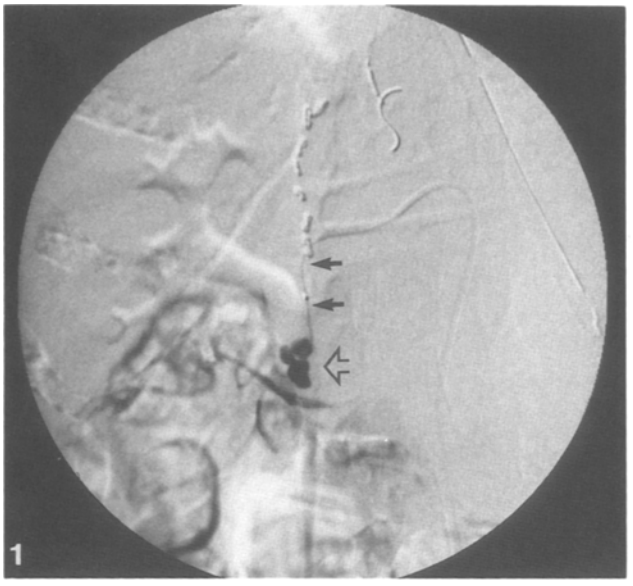

Fig. 1. Gastroduodenal artery pseudoaneurysms (case 8). Tracker coaxial catheter is introduced into the gastroduodenal artery with small caliber because of previous gastrectomy (*black arrows*). Arteriogram reveals a cluster of pseudoaneurysms (*open arrow*) as the source of massive duodenal hemorrhage.

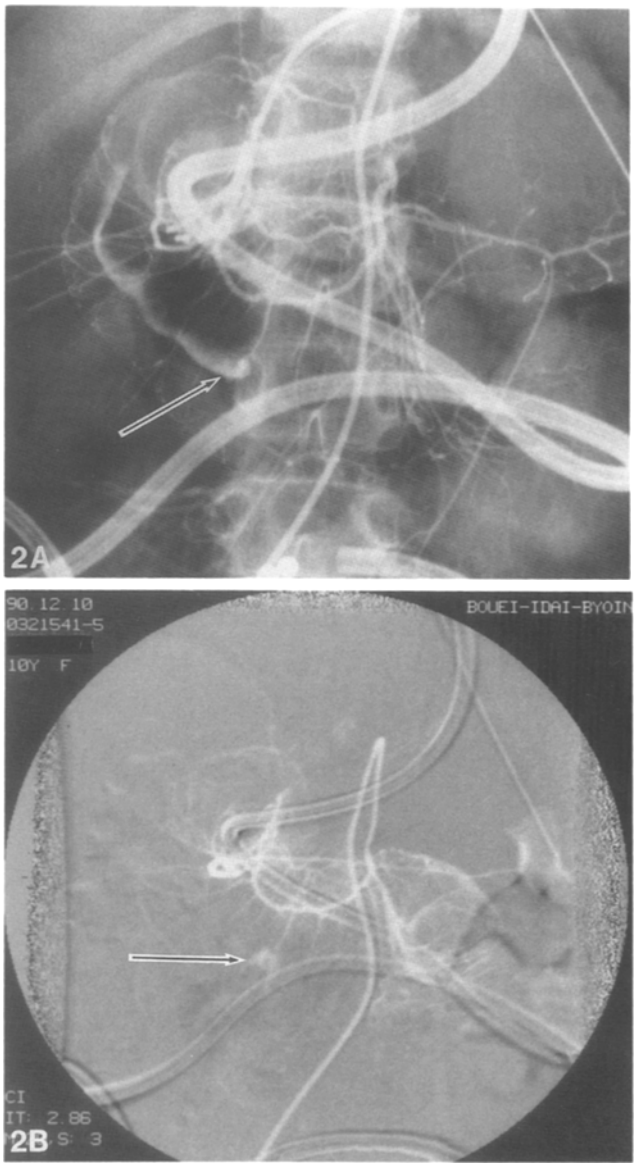

Fig. 2. Duodenal hemorrhage with dual source of blood supply (case 10). **A** Gastroduodenal arteriogram through the celiac artery reveals anterior pancreaticoduodenal artery pseudoaneurysm (*arrow*) and extravasation of contrast material into the duodenum. **B** Inferior anterior pancreaticoduodenal arteriogram through superior mesenteric artery also reveals extravasation into the duodenum (*arrow*). Both the superior and inferior branches of the anterior pancreaticoduodenal artery were embolized with microcoils.

troduodenal artery embolization with Gelfoam particles. In one case with bleeding duodenal tumor, complete hemostasis was obtained by gastroduodenal artery embolization with Gelfoam particles followed by stainless steel coils.

In seven cases with pseudoaneurysm of the gastroduodenal artery (cases 5–11, Fig. 1), it was necessary to obliterate not only the gastroduodenal artery or its branches but also the inferior or superior pancreaticoduodenal arteries through the superior mesenteric artery for complete hemostasis (Fig. 2). Neither rebleeding nor complications, such as infarction of tissue or misplacement of embolic materials, occurred in any patient except one (case 3).

Discussion

Hemorrhage from the duodenum is almost always due to peptic ulcer. Although angiographic management is frequently successful in controlling acute duodenal hemorrhage, it does not change the underlying pathophysiology of duodenal ulcer disease [7]. Therefore, in patients who are acceptable operative candidates, surgery is usually preferred for managing both the hemorrhage and the duodenal ulcer. When surgery poses excessive risk, however, angiographic management of duodenal hemorrhage can be achieved successfully [7, 9, 10].

Vasoconstrictor infusion therapy has been

widely used to control gastrointestinal bleeding [7, 11, 12]. However, this therapy is less effective in controlling hemorrhage from the duodenum than from the stomach [11, 12]. Several reasons have been offered to explain this difference. First, the duodenum has the dual blood supply from the celiac and superior mesenteric arteries. Second, infusion of vasoconstrictors has its most marked effect on small vessels. However, duodenal hemorrhage often originates from relatively large arteries which may not fully constrict when exposed to vasoconstrictors [11, 12].

Embolization of the gastroduodenal artery and its branches is an alternative approach for the control of duodenal hemorrhage under emergent condition [7, 9, 10]. Prior to embolization, it is necessary to identify the bleeding site and catheterize the artery responsible for the hemorrhage superselectively.

The blood supply to the duodenum is derived from gastroduodenal branch of the celiac artery, and from the inferior pancreaticoduodenal branch of the superior mesenteric artery.

In our series, all three patients with bleeding duodenal ulcer and one with duodenal tumor had a single blood supply from the gastroduodenal artery; these were controlled by embolization of the gastroduodenal artery with Gelfoam particles alone or followed by stainless steel coils.

Although gastroduodenal artery pseudoaneurysms are uncommon [4, 9, 10, 13], we have encountered seven patients with duodenal hemorrhage from rupture of these pseudoaneurysms. In two patients the blood flow from the celiac artery to the gastroduodenal artery was obliterated by previous intervention. Therefore, the ruptured pseudoaneurysms were supplied by the inferior pancreaticoduodenal artery through the superior mesenteric artery alone. In the other five patients, the gastroduodenal artery or its branches were occluded by initial embolization, but duodenal bleeding was not stopped and additional inferior or superior pancreaticoduodenal artery embolization via the superior mesenteric artery was necessary to halt bleeding.

Thus, our experience and previous reports [4, 10, 13] emphasize the diagnostic and therapeutic importance of selective arterial catheterization of branches of the celiac and superior mesenteric arteries in patients with duodenal hemorrhage, especially in those from ruptured pseudoaneurysms.

The smaller the vessel to be occluded, the greater the likelihood of success and the safety of the procedure. Therefore, the ideal technique for achieving hemostasis requires that the catheter is selectively advanced as close as possible to the bleeding artery to be occluded [14, 15]. Recently, a new commercially available 3.0-French coaxial catheter and a tapered 0.41-mm platinum-tipped steerable guidewire have been used to successfully catheterize and embolize a small artery [16, 17]. The flexible polyethylene tip and the semirigid proximal portion of the Tracker catheter allows some control of torque, so that it can be advanced past the tip of the introducing catheter without a guidewire and directly into a small branch without accompanying trauma. Alternatively, the catheter can be advanced over a 0.41-mm steerable guidewire into a superselective position.

In our recent series, we used this coaxial catheter system on seven arteries of five patients; we were able to introduce the catheter into all the aimed small branches superselectively without subintimal injury or spasm. Complete hemostasis was obtained by embolization with microcoils using this coaxial system in all cases without infarction of tissue or misplacement of embolic materials.

Because the duodenum has dual blood supply, its spontaneous infarction and full-thickness necrosis following embolization therapy was unexpected [7, 18]. However, there have been few reports of ischemic injury to the duodenum after embolization [5, 18]. Shapiro et al. warned that local circulation altered by surgery or arteriosclerosis might be further compromised by embolization [18]. We encountered one such fatal complication: massive duodenal infarction and pancreatic necrosis were induced by gastroduodenal artery embolization with Gelfoam particles in a patient who had undergone subtotal gastrectomy and gastrojejunostomia and had been treated by a hemodialysis for chronic renal failure. In this case, previous gastroduodenal surgery and visceral atherosclerosis induced by hemodialysis may have facilitated development of duodenal infarction and pancreas necrosis after embolotherapy.

Emergent embolization under superselective catheterization appears highly effective in controlling duodenal hemorrhage, but carries possible risk of bowel infarction. Therefore, during the embolization procedure, we must carefully monitor the blood flow of the gastroduodenal artery and its branches.

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