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Nonvariceal Upper Gastrointestinal Bleeding: the Usefulness of Rotational Angiography after Endoscopic Marking with a Metallic Clip

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Objective: We wanted to assess the usefulness of rotational angiography after endoscopic marking with a metallic clip in upper gastrointestinal bleeding patients with no extravasation of contrast medium on conventional angiography.

Materials and Methods: In 16 patients (mean age, 59.4 years) with acute bleeding ulcers (13 gastric ulcers, 2 duodenal ulcers, 1 malignant ulcer), a metallic clip was placed via gastroscopy and this had been preceded by routine endoscopic treatment. The metallic clip was placed in the fibrous edge of the ulcer adjacent to the bleeding point. All patients had negative results from their angiographic studies. To localize the bleeding focus, rotational angiography and high pressure angiography as close as possible to the clip were used.

Results: Of the 16 patients, seven (44%) had positive results after high pressure angiography as close as possible to the clip and they underwent transcatheter arterial embolization (TAE) with microcoils. Nine patients without extravasation of contrast medium underwent TAE with microcoils as close as possible to the clip. The bleeding was stopped initially in all patients after treatment of the feeding artery. Two patients experienced a repeat episode of bleeding two days later. Of the two patients, one had subtle oozing from the ulcer margin and that patient underwent endoscopic treatment. One patient with malignant ulcer died due to disseminated intravascular coagulation one month after embolization. Complete clinical success was achieved in 14 of 16 (88%) patients. Delayed bleeding or major/minor complications were not noted.

Conclusion: Rotational angiography after marking with a metallic clip helps to localize accurately the bleeding focus and thus to embolize the vessel correctly.

Index terms: *Gastrointestinal bleeding; Embolization; Angiography*

INTRODUCTION

In patients with acute upper gastrointestinal (UGI) bleeding, the bleeding site is by definition proximal

to the ligament of Treitz and the patient presents with hematemesis or melena (1). The incidence of acute UGI bleeding is 50 to 150 per 100,000 of the population each year (2). UGI bleeding occurs in subjects of all ages, though this bleeding most often occurs in subjects 60 years and older and it has a male predominance (1). The overall mortality rate of UGI bleeding is approximately 14% (1).

The numerous advances in the medical management of UGI bleeding, including endoscopy, have significantly reduced the number of patients who require emergency surgical intervention for catastrophic bleeding (3, 4). Recently, endoscopy is often the first method used to investigate and treat UGI bleeding in patients with a visible vessel or active bleeding from peptic ulcers (5). However, the rate of re-bleeding or continued bleeding

after endoscopic treatment is approximately 15-20% (6, 7), mainly because of the technical difficulties or a case-based problem due to the presence of exposed arterial vessels, an ulcer with adherent clots, massive bleeding and a large ulcer with active bleeding.

The patients with UGI bleeding who continue to bleed after aggressive endoscopic treatment require invasive angiographic intervention. Transcatheter arterial embolization (TAE) has recently been successfully used for controlling bleeding that is detected by angiography in 95-100% of cases, with an overall clinical success rate of 76-91% (8-11). However, during angiography, it is relatively common (22-76%) that there is no detectable contrast medium extravasation (10-13), and this leads to difficulties in locating the exact site for embolization. This study evaluated the usefulness of rotational angiography after marking a bleeding site with a metallic clip during endoscopy in patients with no detectable extravasation of contrast medium seen on angiography.

MATERIALS AND METHODS

We obtained Institutional Review Board approval for the study and informed consent was waived. We retrospectively evaluated the clinical records of all consecutive patients who had confirmed acute UGI bleeding and who received angiography from January 2006 to September 2007. During this period, TAE for acute UGI bleeding was performed in 54 patients at our institution. Of these patients, 16 patients who failed to have their bleeding controlled via the endoscopic approach because a large amount of bleeding in the stomach underwent TAE without a metallic clip, and 11 patients of the 54 patients underwent TAE without the endoscopic approach. Twenty seven patients underwent primary endoscopic treatment that included injection therapy, coagulation and/or the use of a metallic clip. The bleeding site was identified and endoscopic treatment was performed to stop the ongoing hemorrhage. However, none of the patients had undergone endoscopic treatment due to massive bleeding with large clots, large exposed vessels or large ulcerative lesions. Therefore, a metallic clip was placed in the fibrous edge of the ulcer adjacent to the bleeding point. All patients were immediately referred to the angiography suite for TAE. Of these patients, four patients did not undergo rotational angiography due to patients' lack of cooperation and seven patients did not undergo rotational angiography due to visualization of the bleeding focus during the initial selective angiography. Therefore, 16 patients (M:F = 11:5; mean age, 59.4 years; age range, 34-82 years) with bleeding ulcers underwent marking with a metallic clip during endoscopy and rotational angiography. The cause of bleeding was a gastric ulcer in 13 patients, a duodenal ulcer in two patients and a malignant gastric ulcer in one patient.

A transfemoral approach was used in all cases with placement of a 6-Fr introducer (Radifocus; Terumo, Tokyo, Japan) into the common femoral artery. Celiac angiography was performed in each patient with the use of distal subtraction imaging (Artis dBA; Siemens, Erlangen, Germany) and selective arterial contrast injections with standard 5-Fr catheters (Radifocus; Terumo, Tokyo, Japan). When the bleeding site was not identified, selective angiography was performed with the use of a 3-Fr coaxial microcatheter system (Microferret; Cook, Bjaeverskov, Denmark) with a 0.016-inch guide wire (GT; Terumo, Tokyo, Japan) in the gastric artery and/or gastroduodenal artery. If the selective angiogram did not show any bleeding focus, then rotational angiography was performed to determine the relationship between the metallic clip and the branch of the gastric artery or gastroduodenal artery. For rotational angiography, the catheter tip was positioned in the location that was anticipated to be the bleeding focus of the gastric artery or gastroduodenal artery. A single series of rotational angiographic images were then obtained during a breath-hold by using the DynaCT technique, with one continuous C-arm rotation that covered 200° of a circular trajectory for approximately 8 seconds. With the use of a power injector, iodinated contrast medium (Visipaque 320; GE Healthcare, Princeton, NJ) was injected at a flow rate of 0.5-1.0 mL/sec for 8 seconds at the initiation of acquiring the DynaCT images, concurrent with the breath hold. The contrast medium was injected intraarterially directly into the microcatheter. The acquired images (240 images, frame rate, 24.8/sec; 0.8° of increment for each frame; resolution, 1024 pixels) were then transferred to a workstation (Leonardo; Siemens Medical Solutions).

After rotational angiography, we selected the frame between the suspected vessels and the metallic clip, and we performed superselective angiography. If the bleeding site was identified on superselective angiography, then embolization was performed with the use of microcoils (Cook, Bloomington, IN) or N-butyl cyanoacrylate (NBCA; Histoacryl, Braun, Melsungen, Germany) according to the location of the microcatheter around the bleeding focus.

Patients without detectable extravasation of contrast medium on a superselective angiogram after rotational angiography then underwent TAE with microcoils as close as possible to the clip. A check angiogram was performed after completion of each embolization procedure. Total occlusion of the feeding vessel without evidence of extravasation beyond the microcoils of contrast material or the NBCA-mixture was considered as the endpoint.

The data was analyzed according to the definitions and guidelines for percutaneous transcatheter embolization as determined by the Society of Interventional Radiology (14). Technical success was defined as an immediate cessation of bleeding as evaluated by completion angiography. Clinical success was defined as clinical cessation of bleeding and stabilization of the hemoglobin level, with a requirement of no more than two units of packed red blood cells after the procedure. Re-bleeding was assessed by checking the clinical parameters (passage of blood per rectum) and by hematological evaluation (a requirement of more than 2 units of packed red blood cells).

RESULTS

Table 1 summarizes all of the clinical results. All of the

patients underwent rotational angiography during a single breath-hold by use of the DynaCT technique. A possible proximal branch, which was identified as close as possible to the metallic clip, arose from the left gastric artery (n = 11), right gastric artery (n = 2) and gastroduodenal artery (n = 3). Of the 16 patients, seven (44%) patients had active contrast medium extravasation detected on the superselective angiogram performed after rotational angiography in the stomach or duodenum and these seven patients underwent TAE with the use of microcoils (n = 5), NBCA (n = 1) or microcoils and NBCA (n = 1) (Fig. 1). Those patients who underwent TAE did not experience any re-bleeding.

Contrast extravasation was not detected on a superselective angiogram performed after rotational angiography in nine patients. Of these patients, two patients had a psudoaneurysm at the site of the metallic clip and these two patients underwent TAE with the use of microcoils (n = 2) (Fig. 2). One patient had an abrupt obstruction of a branch of the left gastric artery and the patient underwent TAE with the use of microcoils. Six patients without detectable contrast extravasation or indirect findings such as a vascular spot or vessel anomaly underwent TAE with the use of microcoils (n = 4) or gelfoam

Table 1. Clinical Data of 16 Patients Who Underwent Rotational Angiography for Localization of Bleeding Focus

No.	Gender	Age	Underlying Disease	Angiographic Findings	Feeding Artery	Embolic Material	Re-Bleeding	Follow-Up
1	M	82	Malignant GU	Extravasation	LGA	NBCA	-	4 weeks: cancer surgery
2	F	64	GU	Extravasation	LGA	Microcoil	-	Discharged
3	M	49	GU, DM	NS	LGA	Gelfoam	+*	Discharged
4	M	34	GU	Extravasation	RGA	Microcoil	-	Discharged
5	F	57	DU, LC	NS	LGA	Microcoil	+	Died: DIC
6	M	72	GU	Pseudoaneurysm	LGA	Microcoil	-	Discharged
7	F	68	DU	Extravasation	RGA	Microcoil	-	Discharged
8	F	59	GU	Extravasation	GDA	Microcoil	-	Discharged
9	M	70	GU, DM	Abrupt obstruction	LGA	Microcoil	-	Discharged
10	M	44	GU	NS	LGA	Microcoil	-	Discharged
11	M	57	GU, lung cancer	NS	LGA	Gelfoam	-	Discharged
12	M	51	GU	Pseudoaneurysm	LGA	Microcoil	-	Discharged
13	F	81	GU, LC	NS	LGA	Microcoil	-	Discharged
14	M	42	GU	NS	GAD	Microcoil	-	Discharged
15	M	55	GU	Extravasation	GAD	Microcoil	-	Discharged
16	M	69	GU	Extravasation	LGA	NBCA, microcoil	-	Discharged

Note. — *Repeated endoscopy and hemoclip. DIC = disseminated intravascular coagulation, DM = diabetes mellitus, DU = duodenal ulcer, F = female, GDA = gastric duodenal artery, GU = gastric ulcer, LC = liver cirrhosis, LGA = left gastric artery, M = male, NBCA = N-nbutyl cyanoacrylate, No. = number, NS = nonspecific findings, RGA = right gastric artery
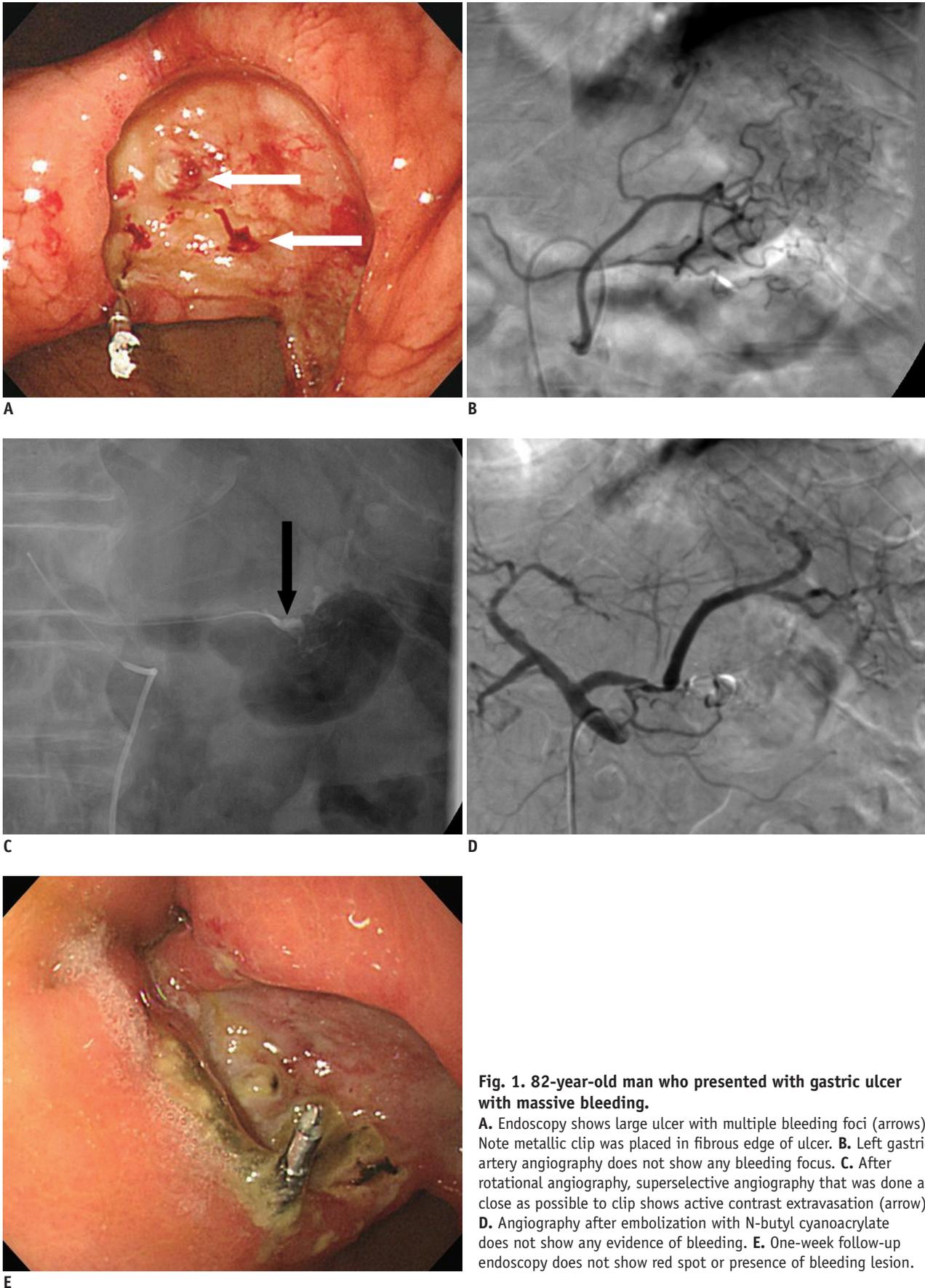
A

B

C

D

E

Fig. 1. 82-year-old man who presented with gastric ulcer with massive bleeding.
A. Endoscopy shows large ulcer with multiple bleeding foci (arrows). Note metallic clip was placed in fibrous edge of ulcer. **B.** Left gastric artery angiography does not show any bleeding focus. **C.** After rotational angiography, superselective angiography that was done as close as possible to clip shows active contrast extravasation (arrow). **D.** Angiography after embolization with N-butyl cyanoacrylate does not show any evidence of bleeding. **E.** One-week follow-up endoscopy does not show red spot or presence of bleeding lesion.
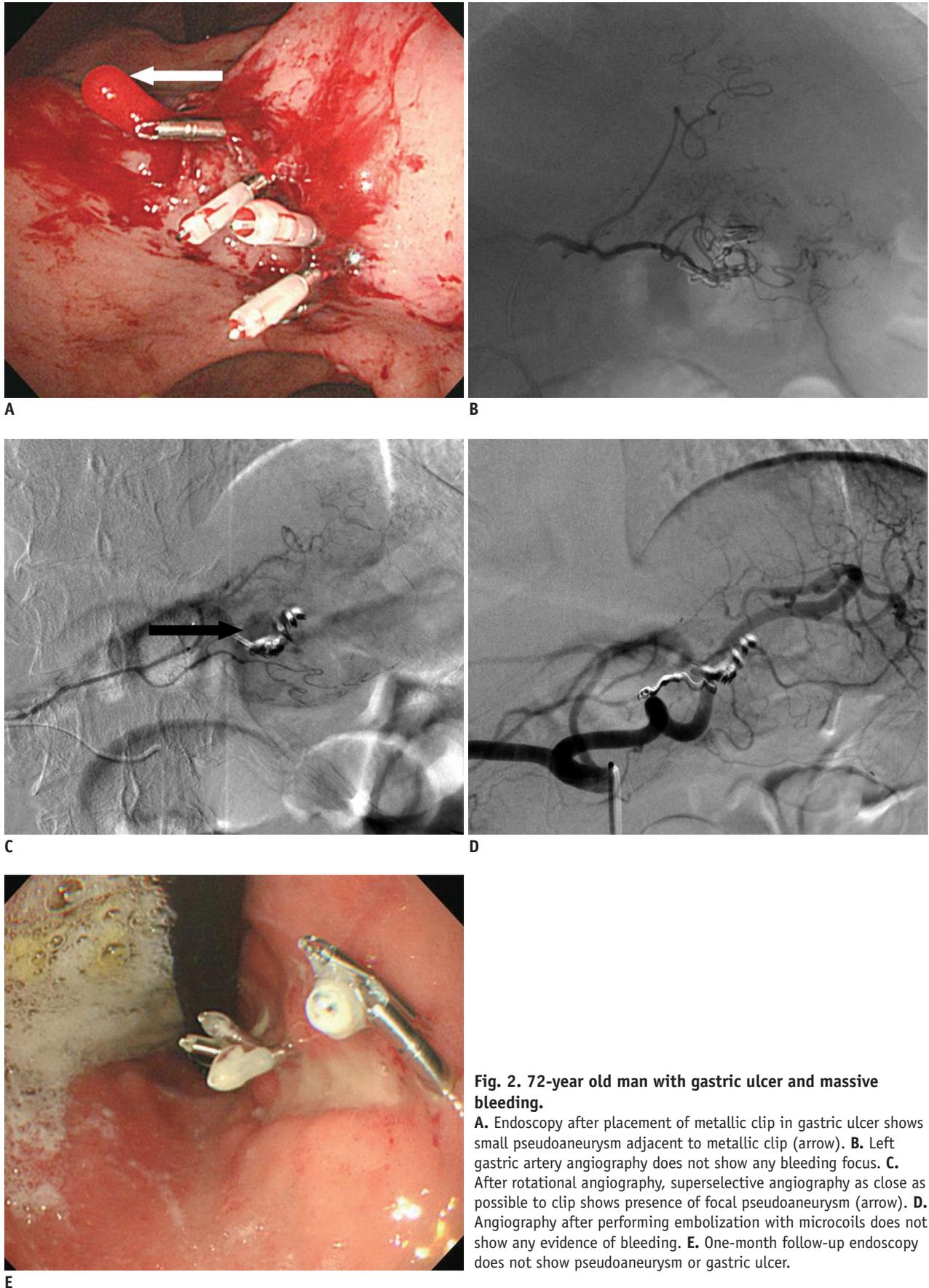
Fig. 2. 72-year old man with gastric ulcer and massive bleeding.
A. Endoscopy after placement of metallic clip in gastric ulcer shows small pseudoaneurysm adjacent to metallic clip (arrow). B. Left gastric artery angiography does not show any bleeding focus. C. After rotational angiography, superselective angiography as close as possible to clip shows presence of focal pseudoaneurysm (arrow). D. Angiography after performing embolization with microcoils does not show any evidence of bleeding. E. One-month follow-up endoscopy does not show pseudoaneurysm or gastric ulcer.

(n = 2) at a site as close as possible to the clip. Technical success, which was defined as target area devascularization, was achieved in 100% of the patients.

Of the six patients who received blind embolization without detectable contrast extravasation, two of these patients experienced a repeat episode of bleeding two days later, which required repeated endoscopic treatment. Of the two patients, one patient had subtle oozing at the ulcer margin and the patient underwent endoscopic treatment. One patient with a gastric ulcer continued to bleed with the hemoglobin level falling from 9 g/dL to 6 g/dL and the patient died due to disseminated intravascular coagulation one month after the embolization procedure. The remaining patients were clinically observed and they were discharged from the hospital after the return of stable vital signs and normal hematocrit levels. Therefore, complete clinical success was achieved in 14 of 16 (88%) patients.

There was no evidence of delayed bleeding or other major and minor complications related to embolization in all patients, excluding the one patient who died from the disseminated intravascular coagulation. Follow-up endoscopic evaluations were performed in ten patients one week later after embolization and postembolization complications such as ischemia or perforations were not observed in any of the patients.

DISCUSSION

Upper GI bleeding is typically intermittent and it ceases spontaneously. Localization of the bleeding site by angiographic evaluation requires that the patient is actively bleeding at the time of the study. Angiographically negative results are relatively common in patients with acute GI bleeding, and especially in patients with a stable hemodynamic status or lower GI bleeding. Most patients with a negative bleeding focus have experienced spontaneous resolution of their condition (15). But there remain some patients where an exhaustive investigational work-up fails to adequately identify a bleeding site, and these patients are subjected to repeat invasive investigations and blood transfusions. For localization of bleeding sites, performing provocative angiographic studies with the use of intraarterial tissue plasminogen activator (tPA), heparin, urokinase and tolazoline has been reported (16-19). Ryan et al. (19) reported that intraarterial provocative mesenteric angiography with the use of heparin, vasodilator and tPA identified the site of

bleeding in 38% of patients and it contributed to treatment in 50% of patients. Although it is reasonably successful and without any reported hemorrhagic complications, provocative mesenteric angiography is not a commonly used examination due to potential hemorrhagic complications, it is a complex procedure and poor condition of patient. All of these previous studies were performed in patients with lower gastrointestinal (LGI) bleeding and they reported the positive results at the LGI tract, but not much is known about the clinical results of provocative angiography in patients with nonvariceal UGI bleeding.

In our hospital, endoscopy is the first step for making the diagnosis and managing UGI bleeding and the use of a metallic clip has been popular among our physicians to achieve endoscopic hemostasis. The applicator is inserted through the biopsy channel of the endoscope and the metallic clips are applied directly to the visible bleeding vessel. Some studies have reported a metallic clip to be effective (20, 21). However, the rate of re-bleeding or continued bleeding after endoscopic treatment is approximately 15-20% (6, 7) and this is mainly because of technical difficulties or case-based problems due to the presence of exposed arterial vessels, an ulcer with adherent clots, massive bleeding and a large ulcer with active bleeding.

In our hospital, none of the patients received endoscopic treatment due to the presence of massive bleeding with large clots, large exposed vessels or large ulcerative lesions. Therefore, a metallic clip was placed in the fibrous edge of the ulcer adjacent to the bleeding point. Eriksson et al. (22) reported that the embolization procedure benefited from marking with a clip in 60% of cases. The use of a clip made it easier to identify the suspected bleeding vessel without signs of contrast medium extravasation. However, although superselective angiography was performed as close as possible to the clip, most patients did not have detectable contrast extravasation or indirect signs of bleeding vessels, and they underwent TAE with the use of microcoils adjacent to the clip. In our study, direct contrast extravasation on the superselective angiography that was done after rotational angiography and using a metallic clip was seen in 44% (7 of 16) of the cases and indirect signs such as pseudoaneurysms or abrupt obstruction of an artery were seen in 19% (3 of 16) of the cases.

Three-dimensional (3D) rotational angiography can be considered to be superior to conventional planar angiography because it can provide multiple projections

with the use of only one injection of contrast medium. Although 3D rotational angiography has been one of the most commonly used interventional neuroradiology procedures, its use has also been applied to renal (23), uterine (24) and liver procedures (25-27). In previous studies, the use of conventional 3D rotational angiography helped to delineate complex vascular anatomy and this facilitated the subsequent delivery of a microcatheter to the target vessels. In our study, rotational angiography was performed to determine the relationship between the metallic clip and a branch of the gastric artery or gastroduodenal artery. After rotational angiography, the microcatheter was positioned as close as possible to the proximal branch and the metallic clip. A superselective angiogram of the proximal branch adjacent to the metallic clip showed active contrast medium extravasation in the stomach or duodenum in six patients. Therefore, TAE was performed for completely obstructing the bleeding vessels at the correct site.

There are some limitations to this study. First, we did not determine the effect of rotational angiography on the radiation exposure, the procedural time and the reduced load of contrast medium to the patient. Second, the patients with massive UGI bleeding and the older patients who were unable to perform a single-breath hold during rotational angiography were excluded from the study. Therefore, additional C-arm cone-beam CT was not used because of the possibility of poor imaging quality and respiratory artifacts. However, we only required information on the vascular anatomy between the metallic clip and bleeding vessels. Finally, the study was performed on a small subject population at a single tertiary-care academic medical center. Studies with a larger number of subjects need to be performed to firmly establish the protocol.

In conclusion, our results demonstrated that rotational angiography after marking with a metallic clip enhances the possibility that a bleeding focus is accurately localized and that the correct vessel is embolized. This procedure will most likely minimize the risk of recurrent bleeding after embolization. Prospective and preferably multicenter studies are needed to further refine the technique and to clinically validate the usefulness of the procedure.

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