Cardiovasc Intervent Radiol (1997) 20:174–179

CardioVascular
and Interventional
Radiology

Microcatheter Embolization of Hemorrhages

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Abstract
Purpose: To evaluate the efficacy of embolotherapy using microcatheters in patients with hemorrhage from various locations.
Methods: Among 29 patients there were 13 with severe epistaxis, 7 with gastrointestinal bleeding, 4 with hemorrhage in the kidney, 4 with bleeding in pelvic organs and 1 with bleeding in the shoulder region. In all cases, a Tracker-18 or Tracker-10 microcatheter was advanced coaxially through a 4.1 Fr guiding catheter in order to reach the bleeding site as distally as possible. Polyvinyl alcohol microparticles and/or platinum microcoils were used as embolic material.
Results: The bleeding was stopped in 90% (26 of 29) of cases. In 66% of cases the treatment was curative, in 7% preoperative, and in 17% palliative. There were 3 clinical failures.
Conclusion: Microcatheter embolization is an effective and safe means of managing different kinds of hemorrhage of various causes from a variety of sites.

Key words: Arteries, therapeutic blockade—Catheters and catheterization, technology—Hemorrhage

During the last two decades embolization has become recognized as a primary mode of therapy in the management of hemorrhage in a wide variety of conditions. The first report on selective arterial embolization to treat gastrointestinal bleeding was published in 1972 by Rösch et al. [1]. Since then both materials and techniques have undergone tremendous development and refinement [2–4]. New microcatheter techniques have made it possible to treat an even greater range of previously inaccessible conditions, including inoperable vascular malformations, aneurysms, and certain tumors in the head and neck region [5]. There is a wide selection of materials available for endovascular treatment including balloons, particles, coils, and liquids [6]. More recently, embolotherapy employing microcatheters has been advocated as the primary mode of therapy in hemorrhage from a variety of causes [7, 8]. The purpose of this study was to present our experience in the microcatheter embolization of various types of hemorrhage to determine whether accessibility, efficacy, and safety were improved using these techniques.

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Materials and Methods

Twenty-nine patients were treated at our institution for hemorrhage by embolization employing microcatheter techniques during a 47-month period between 1990 and 1993. The patients ranged in age from 15 to 81 years (mean 47.4 years); 20 were male and 9 were female. In all the patients conservative and/or surgical methods of stopping the bleeding had failed.

The bleeding sites were as follows: nasal cavity 13, gastrointestinal tract 7, kidney 4, pelvic organs 4, shoulder region 1. The cause of bleeding was idiopathic in 11, traumatic in 7, and neoplastic in 7 cases. Two patients had intestinal bleeding, 1 as a result of colonic diverticulosis and the other from a duodenal ulcer. One patient had profuse melena secondary to a severe coagulopathy, and 1 patient had necrotizing pancreatitis causing intraabdominal bleeding (Table 1).

To evaluate the severity of hemorrhage, retrospective data including hematocrit values (available for 27 patients) and the number of units of blood transfused were collected. Before treatment the mean hematocrit value was 0.25 (range 0.15–0.40) and on discharge from the hospital 0.34 (range 0.25–0.41). Eighteen patients needed blood transfusions before embolotherapy. The average transfusion required was 15.8 units per patient (range 2–73 units). The total amount transfused in all patients was 285 units.

Digital subtraction angiography (DSA; Siemens Neurostar, Siemens AG, Erlangen, Germany) with the roadmapping option was used in all cases. Tracker-18 or Tracker-10 microcatheters (Target Therapeutics, Fremont, CA, USA) were used coaxially through standard 4.1 Fr Torcon (Cordis, Miami, FL, USA) catheters; a 5 Fr introducer sheath was most commonly used. The primary goal of the procedure was to stop the bleeding and to avoid unnecessary extralesional tissue damage by embolizing the target as distally as possible. Embolic materials included PVA particles 250–500 μm in size (International Therapeutics Corp, South San Francisco, CA, USA) and Tracker platinum microcoils. The primary technical result was determined by immediate postembolization angiography. The clinical follow-up period was a mean of 121 days (range 1–1102 days).

Table 1. Distribution of hemorrhage by location and etiology

Site	Idiopathic	Traumatic	Neoplastic		Miscellaneous	Total
			B	M		
Epistaxis	11	1	1			13
GI tract		1	1	1	4	7
Kidney		3	1			4
Pelvic organs		1		3		4
Shoulder		1				1
Total	11	7	3	4	4	29

B = benign; M = malignant; GI = gastrointestinal

Table 2. Results of embolotherapy in different etiological groups

Result	Idiopathic	Neoplastic	Traumatic	Miscellaneous	Total	%
Curative	9		7	3	19	66
Preoperative		2			2	7
Palliative		5			5	17
Failure	2			1	3	10
Total	11	7	7	4	29	100

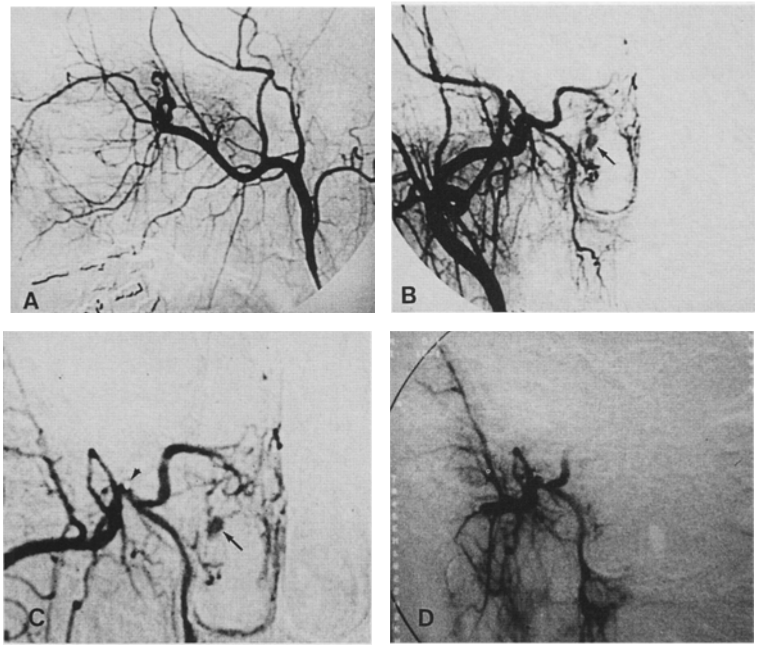

Fig. 1. An intractable postoperative epistaxis in a young woman. **A** The lateral projection of the external carotid angiogram shows no abnormality. **B** The antero-posterior projection reveals a small pseudoaneurysm in the postero-lateral territory of the sphenopalatine artery (arrow). **C** The approach to the lesion (arrow) with a Tracker-18 microcatheter (arrowhead, catheter tip). **D** The primary angiographic result after embolization with PVA particles and one microcoil; the sphenopalatine artery is totally occluded. There was no further bleeding during clinical follow-up.

Results

In 27 of 29 (93%) patients primary technical success was achieved. The bleeding was stopped in 26 of 29 (90%) patients. There were 3 failures: 1 technical and 2 clinical. The technical failure was due to an arterial route that was too tortuous and prevented the target from being reached. The clinical failures occurred as a result of a severe systemic coagulopathy in 1 patient, and an unknown reason in another patient with epistaxis. In 19 patients the treatment was regarded as curative, in 2 patients as preoperative, and in 5 palliative (Table 2).

Epistaxis Group

In the epistaxis group hemorrhage was idiopathic in 11, iatrogenic, i.e., postoperative bleeding (Fig. 1) in 1, and

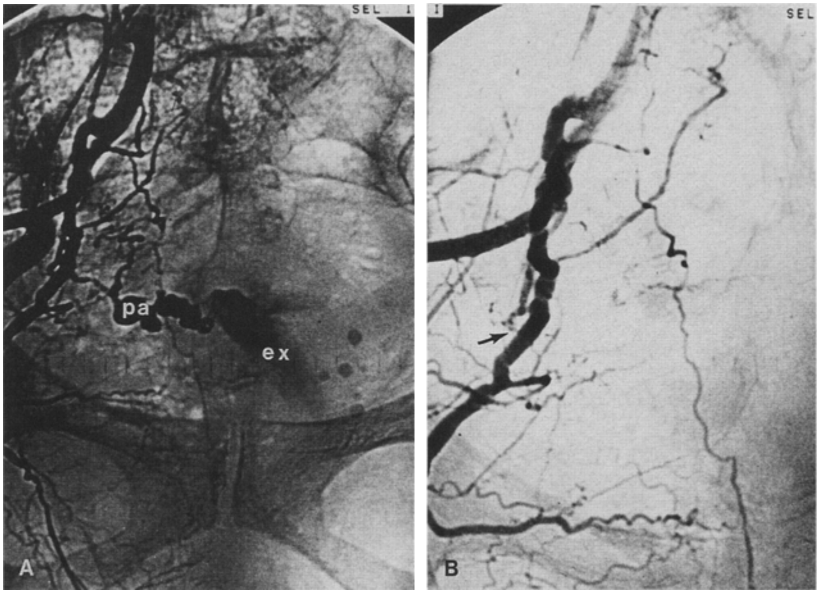

Fig. 2. Serious transvaginal bleeding in an older woman with widespread cervical carcinoma. After several trials to stop the bleeding with vaginal tamponade, the patient was referred for embolization. The total number of blood units used before embolization was 27. **A** The right internal iliac angiogram shows the pseudoaneurysm (pa) and contrast extravasation to the vagina (ex). **B** The uterine artery was closed selectively with platinum microcoils (arrow), which stopped the bleeding immediately.

neoplastic due to juvenile angiofibroma (JAF) in 1. The embolization procedure was regarded as curative in 10 patients. In the patient with JAF the bleeding was stopped by embolization prior to surgery, and the preoperative blood loss was only 170 ml. One patient was reembolized 2 days after the first procedure; however, he required surgery 4 days after the second embolization because of recurrent bleeding. One procedure was a technical failure because of the tortuosity of the proximal arterial tree.

Neoplasm Group

Within the neoplasm group one patient had hematuria and severe back pain secondary to bleeding from a large renal angiomyolipoma. The tumor was embolized selectively, preserving most of the normal renal parenchyma. One week later the tumor was electively resected, saving the part of the kidney that was functioning normally. The patient with JAF is described above. Three patients had malignant neoplasms within the pelvic organs and one in the gastrointestinal tract. One patient had melena, two hematuria, and one had profuse hemorrhage from the vagina (Fig. 2). Three patients needed several (three or four) separate embolizations before the bleeding ceased, but in every patient at least temporary relief was achieved.

Trauma Group

Trauma was the cause of the hemorrhage in seven of our patients: five iatrogenic and two following blunt trauma (Figs. 3–6). The iatrogenic group consisted of two postoperative hemorrhages, two cases of hematuria following renal biopsy, and one pelvic hemorrhage after coronary angioplasty performed by a cardiologist. One of the two patients with blunt trauma had a renal contusion with hematuria, and the other had a fracture of the scapulae with a huge regional hematoma. All the patients in this group were treated curatively. Two patients required two separate embolization procedures.

Miscellaneous

Four of our patients had intestinal bleeding of other etiology. One had necrotizing pancreatitis, one had a bleeding duodenal ulcer, one had diverticulitis, and one had a severe coagulopathy. This last patient died of fulminant and diffuse intestinal bleeding despite technically successful embolotherapy. The others were cured.

Complications

Four minor complications were encountered, including one puncture site hematoma and three postembolic syndromes. One major complication occurred in a patient with postoperative gastrointestinal bleeding: after embolization, hepatic artery thrombosis developed and was treated successfully by local thrombolysis. Thus, all the complications were transient. Two patients died during the 30 days following embolization. The causes of the deaths were severe coagulopathy and fecal peritonitis which were not related to the endovascular therapy in either case.

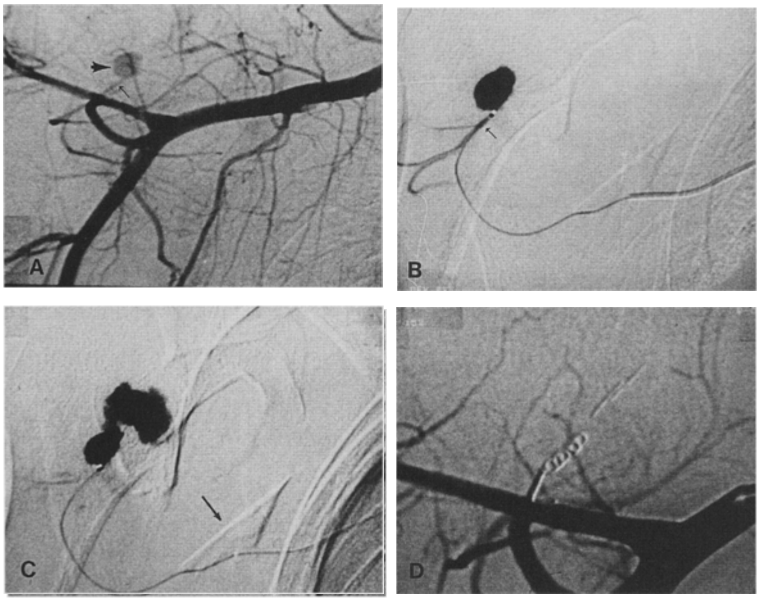

Fig. 3. A persistent hematoma of the scapular region in a young man after an automobile accident. **A** The axillary angiogram shows the bleeding site (arrowhead) in a tiny branch (small arrow) of the circumflex humeral artery. **B** The bleeding site has been approached with a Tracker-18 microcatheter (arrow). **C** Extravasation of contrast agent into the hematoma and a fractured scapular fragment (arrow) are shown. **D** After embolization, the arterial connection with the hematoma was completely closed, and the patient made an uneventful recovery.

Discussion

In our series, patients with epistaxis were the largest group treated (45%). The etiology was variable, though most cases were idiopathic. There have been reported failure rates of 26%–52% [9] with conservative therapy of posterior and superior epistaxis. Ligation of the internal maxillary artery is the most common surgical procedure in the treatment of severe epistaxis; sometimes it has to be combined with ethmoidal artery ligation [10]. Since 1974, when Sokoloff et al. [11] reported their experiences on selective arterial embolization for managing intractable nasal hemorrhage, embolotherapy has become an increasingly popular alternative.

Embolotherapy is at least as successful as surgery and less invasive. The costs have been shown to be slightly less than for surgery and significantly less than for a trial of prolonged conservative therapy [9]. For these reasons some institutions employ embolization as the primary treatment method for severe and intractable epistaxis [7, 9, 10]. We had no patients in our series with Osler-Weber-Rendu disease (hereditary hemorrhagic telangiectasia), although embolization therapy has been used in these patients. The long-term results are poor because of the nature of the disease. Elden et al. [9] have recommended reserving this method because septodermoplasty and yttrium aluminum garnet (YAG) laser treatments may provide better long-term control in such patients.

Endovascular embolotherapy in the management of hemorrhage in cancer patients has been widely used and reported [4, 12–14]. Bleeding usually results from tumor extension into adjacent vessels or tumor regression in response to chemotherapy or radiation. Such patients have an increased risk of hemorrhage and infection and are poor surgical candidates. Thus, embolotherapy represents an ideal alternative treatment. Embolization has also been used successfully in children with a ruptured Wilms' tumor [12].

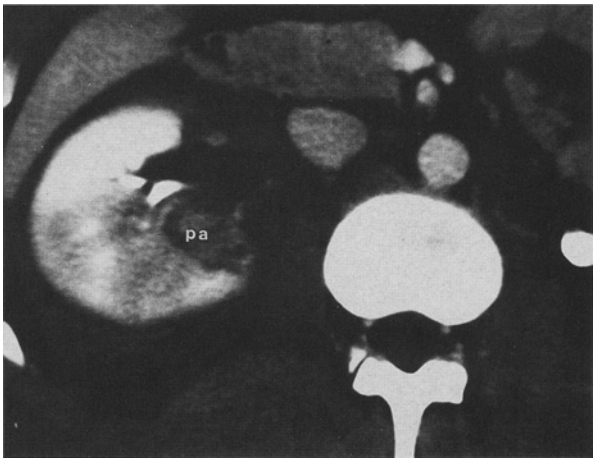

Fig. 4. Longstanding hematuria in a young man after a motorcycle accident, and blunt trauma of the right kidney. The CT scan shows a rounded, well-circumscribed hypodense lesion in the medial lower part of the kidney; a pseudoaneurysm (pa) is demonstrated.

Many authors have shown the usefulness of embolotherapy in the treatment of tumor hemorrhage, especially in the pelvis and renal area [4, 12–14]. Our experience was similar. In this group of patients other symptoms, i.e., pain, also were relieved by embolotherapy. This improved their quality of life and allowed them to return to their local hospital or home.

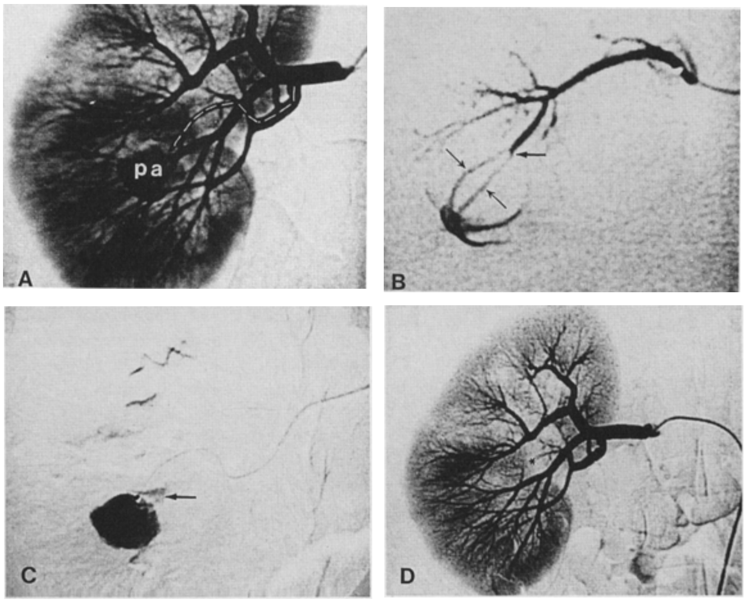

Fig. 5. Same patient as in Figure 4. **A** The renal angiogram reveals the pseudoaneurysm (pa) with a small arterial branch involved (dashed line). **B, C** The approach to the lesion with a microcatheter is clearly demonstrated. **B** The bleeding site (thick arrow) and the jet streams into the pseudoaneurysm (thin arrows) are seen. **C** The tip of the microcatheter is inside the pseudoaneurysm; contrast injection shows a tiny amount of extravasation into the lower pole calyx (arrow). **D** The final result after embolization. The distal arterial branch involved was occluded with a single straight platinum polyester embolus 10 mm in length (asterisk). The hematuria was stopped.

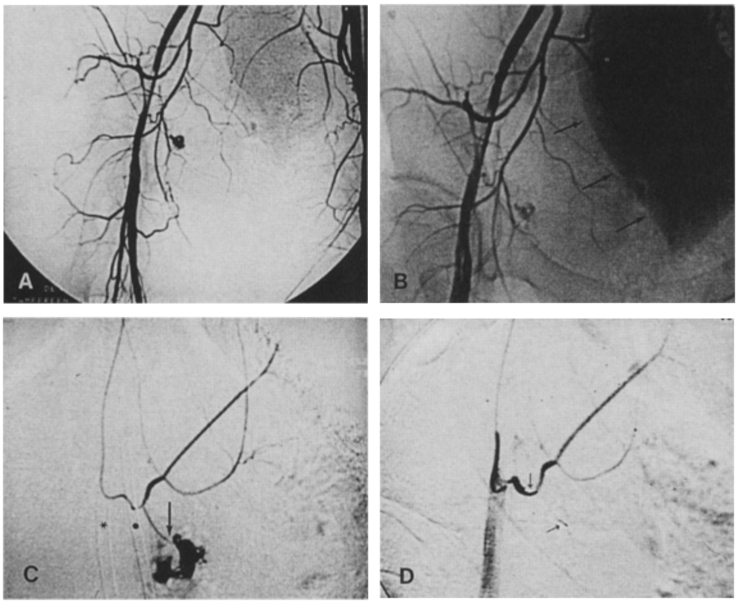

Fig. 6. A sudden intrapelvic hemorrhage after coronary angioplasty in a 43-year-old woman. The estimated blood loss was about 2 L. **A** The bleeding site was well visualized, but the bleeding vessel was not clearly demonstrable. **B** Dislocation of the urinary bladder due to hematoma (arrows). **C** A tiny branch of the common femoral artery was injured, as shown by the microcatheter technique (arrow); the arterial (asterisk) and venous (dot) sheets introduced by the cardiologist are well visualized. **D** After placement of two straight platinum polyester emboli 5 mm in length (small arrows) the bleeding stopped. The next day the patient was asymptomatic; at ultrasound examination there was no perceptible mass in the pelvic region.

Most internal bleeding is traumatic in origin. After severe blunt trauma, emergency angiography combined with embolotherapy can be a life-saving procedure [8, 15]. Vascular injuries caused by penetrating trauma are more often localized and are therefore ideally suited to superselective catheterization and occlusion. Iatrogenic trauma, including hemorrhage after biopsy, operation, or other interventions is readily treated by embolotherapy [4, 16]. In patients with persistent hematuria after renal biopsy, superselective endovascular treatment is the most effective method of control. This is especially true in renal allografts when minimal loss of renal parenchyma is desirable [17]. Hemobilia after blunt trauma, biopsy, or percutaneous transhepatic cholangiography has also been treated successfully with this method [12, 14, 16].

Major hemorrhage often presents difficult management problems: conventional therapy may not work, the patient may be a poor surgical candidate, and the bleeding site may be inaccessible with ordinary catheters. These patients are ideal candidates for embolotherapy with microcatheters because this method seems, both from our series and from a review of the literature, to be safe and effective, and furthermore the risks of multiple transfusions can be minimized.

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