Imaging in Endourology

Direct Percutaneous Embolization of Renal Pseudoaneurysm

Mostafa A. Sakr, M.D., Salah Eldin Desouki, M.D., and Sherif E. Hegab, M.D.

Abstract

Purpose: To describe and evaluate a novel method of direct ultrasonography (US)-guided percutaneous embolization of renal pseudoaneurysm.

Patients and Methods: Fourteen patients with severe hematuria were included in this study from February 2005 to February 2006. They included five patients with penetrating renal trauma, two patients after renal biopsy, and seven patients after percutaneous nephrolithotripsy. Diagnostic duplex US of the pseudoaneurysm was performed. The size of the pseudoaneurysm and its neck were determined. A solution of Gelfoam particles was prepared in sterile saline and under US guidance, the tip of the needle was inserted into the aneurysm, and the solution with Gelfoam particles was injected slowly. During injection of Gelfoam, the pseudoaneurysm initially filled with an echogenic thrombus, thereby decreasing the color flow detected by US. The needle was removed when no flow in the pseudoaneurysm was detectable. The patient was kept for 30 minutes in the department and then discharged home. Follow-up by color Doppler US was performed every 2 weeks for 3 months and then every 3 months for 1 year.

Results: In 13 patients, bleeding was effectively controlled with direct embolization in a single session and did not need any further intervention, while one patient needed endovascular embolization because of recurrent severe hematuria after 24 hours. The amount of the injected Gelfoam particles (1-2 mm diameter) was 1 to 3 mL, according to the size of the pseudoaneurysm. No complication was observed secondary to the embolization procedure. Rebleeding did not occur in any patient during the follow-up period that ranged from 3 to 12 months.

Conclusion: Direct US-guided percutaneous embolization is a new method for managing renal pseudoaneurysm. It avoids the side effects of contrast media, hazards of irradiation, and complications of angiographic catheterization. Moreover, it saves the risk of surgical interference to control bleeding either by partial or total nephrectomy, especially in patients with a solitary kidney. It is rapid, effective, feasible, and tissue preserving, and likely to reduce morbidity and mortality. Therefore, it is recommended as a first-line treatment of actively bleeding renal pseudoaneurysms.

Introduction

Pseudoaneurysms develop as a result of inflammation, trauma, neoplasm, or surgical procedures and originate from disruption of arterial continuity with extravasation of blood into the surrounding tissue, where a fibrous tissue is formed. The natural history of pseudoaneurysms shows a high rate of early occlusion, usually with spontaneous regression.

Life-threatening hematuria from renal pseudoaneurysm has been reported, however, after penetrating renal trauma, renal biopsy, and percutaneous nephrolithotripsy (PCNL). PCNL is the management modality of choice for large renal calculous disease. Bleeding is a significant morbidity reported with PCNL. While most bleeding associated with PCNL can be managed conservatively, approximately 0.8% of patients need angioembolization to control intractable bleeding. Bleeding during PCNL results from injury to renal vessels. Excessive bleeding can occur during needle passage, tract dilatation, and nephroscopy or in the postoperative period. A high-flow arteriovenous network that constitutes 20% of the total cardiac output closely surrounds the collecting system. Significant among these are the segmental and the interlobar arteries. Access to the pelvicaliceal system and intra-renal manipulations may traumatize these vessels, resulting in significant bleeding.
The incidence of significant hemorrhage necessitating transfusion during percutaneous nephrolithotomy ranges from 10% to 25%. Acute bleeding associated with percutaneous renal surgery may be secondary to injury to the renal parenchymal vasculature or to branches of the renal vein or artery adjacent to the pelvicaliceal system. Renal venous lacerations are not uncommon and are usually managed conservatively.6 Management of these lesions has been limited to either partial or total nephrectomy or endovascular occlusion, resulting in gross renal parenchymal loss.6

There are different technical methods of embolization with the risk of varying degrees of parenchymal damage.7 Some instances of direct percutaneous and intraoperative puncture of the aneurysm with the introduction of embolic agents have been reported in hepatic pseudoaneurysm, superficial femoral artery, and superficial temporal artery.8 In this study, a new method of managing renal pseudoaneurysm with percutaneous injection of embolic material under ultrasonography (US) guidance is described.

**Patients and Methods**

Fourteen patients were referred to the radiodiagnosis department from the urology department of Alexandria University from February 2005 to February 2006 because of severe hematuria after direct traumatic renal injury. A thorough history was taken from all patients that stressed the history of the renal trauma. Clinical examination was performed by the urologist.

All patients underwent plain radiography and a US survey study of the abdomen, with emphasis on the kidneys. Duplex US of the pseudoaneurysm was performed using a 3.5 MHz convex transducer. The size of the pseudoaneurysm and its neck were determined. The range was 8 to 24 mm in diameter.

A solution of Gelfoam particles was prepared in sterile saline. The skin over the affected kidney was washed with antiseptic povidine solution. Then, the US transducer was sterilized using absolute alcohol and was placed directly over the pseudoaneurysm. With the aid of color imaging, the pseudoaneurysm was identified; the color was then turned off and, under US guidance, the tip of the needle (Abbocath needle 14–16 gauge ) was inserted into the aneurysm so that the tip was facing away from the neck. With the color turned back on, the trocar of the needle was removed and the Gelfoam particles solution was injected slowly. During injection of Gelfoam, the pseudoaneurysm initially filled with an echogenic thrombus, thereby decreasing the color flow detected by color Doppler US. The needle was removed when no flow in the pseudoaneurysm was detectable. The patient was kept for 30 minutes in the department and then discharged home.

Follow-up consisted of color Doppler US every 2 weeks in the first 3 months and then every 3 months for 1 year; renal function tests (blood urea, serum creatinine) every 3 months; and a radioisotope renal scan after 6 months.

**Results**

The study included 14 patients whose ages ranged from 26 to 54 years (mean 42 ± 16 yr). The study group included five patients with penetrating renal trauma, two after renal biopsy, and seven after PCNL. Intrarenal bleeding and hematuria occurred directly after the renal trauma and after 6 to 12 hours for renal biopsy and PCNL. Duplex US demonstrated that the injured vessels were the segmental intraparenchymal vessels.

In 13 patients, bleeding was effectively controlled with direct embolization in a single session; there was no need for further intervention. One patient needed endovascular embolization because of recurrent severe hematuria after 24 hours. The amount of the injected Gelfoam particles (1–2 mm diameter) was from 1 to 3 mL, according to the size of the pseudoaneurysm. Thirteen patients were referred to the US unit for diagnosis and intervention (Figs. 1, 2), while the last patient was referred to the angiographic unit for en-
vascular embolization; the feeding artery of the pseudoaneurysm could not be identified, so direct embolization was performed and confirmed by complete obliteration of the aneurysm by postembolization angiography.

No complications were observed secondary to the embolization procedure. During the follow-up period, which ranged from 3 to 12 months, duplex US was performed every 2 weeks to follow the fate of the direct embolization. Rebleeding did not occur in any patient during the follow-up period of 3 to 12 months. The median follow-up was 7.6 ± 3.2 months.

A radioisotope renal scan was performed on 11 (78.5%) patients who completed the follow-up after 6 months. The renal scan showed that the overall kidney function was good and the injected area of the parenchyma was not totally infarcted.

Discussion

Currently, renal pseudoaneurysm occurs most commonly post-PCNL. PCNL is a safe and reliable technique for management of renal stones. One of the most serious complications of PCNL is renal hemorrhage. Blood loss is a normal feature of PCNL, because some bleeding can occur during renal puncture, tract dilatation, nephroscopy, and stone disintegration. A transfusion rate of 3% to 23% has been reported.9

Fortunately, in most cases bleeding can be controlled with conservative measures, such as clamping the nephrostomy, hydration and diuretics, hemostatic medications, and Kaye balloon tamponade.10,11 Therefore, the necessity of renal embolization to control severe bleeding is low (range 0.3%–1.4%).6,9,12 The transfusion and embolization rates are 5.5% and 1%, respectively.

In PCNL, venous bleeding can be controlled with conservative measures in most cases, because the intrarenal venous system is quite resilient. On the other hand, arterial injuries result in severe bleeding that necessitates embolization. Therefore, the most commonly detected vascular lesions in this and other studies were arteriovenous fistula (AVF) or arterial pseudoaneurysm. Blood passage from the high pressure of the injured artery to the injured adjacent vein results in AVF, and blood passage to the parenchyma leads to pseudoaneurysm.13 Delayed bleeding may result from pseudoaneurysm rupture.14 Arterial laceration is rare, but it can lead to severe intraoperative bleeding. The success rate of superselective embolization for controlling post-PCNL severe bleeding was 92.3%,6,13,15

The method of embolization used in this study was adopted from our previous success with direct embolization of traumatic hepatobiliary aneurysm and other reported successful management of the pseudoaneurysm of the superficial temporal artery by Partap and coworkers.9 These investigators reported that as long as the pseudoaneurysm measures less than 4 cm in diameter and has a narrow neck, successful thrombosis is possible. Therefore, pseudoaneurysm in other locations, such as the brachial or popliteal artery, may be candidates for repair by direct thrombin injection.

Gelfoam injection is simple and easy to perform. This procedure can be accomplished with or without local anesthesia and on an outpatient basis, with excellent immediate results.

A direct percutaneous puncture and embolization of the aneurysm allow complete exclusion of the lesion. Eventually, recovery was complete. Only one (7%) patient had recurrent severe hematuria after 24 hours. This patient was referred to the angiographic unit for endovascular embolization; the feeding artery of the pseudoaneurysm could not be identified, so direct embolization was performed and confirmed by complete obliteration of the aneurysm by postembolization angiography. Perhaps this was related to the increased size of the aneurysm or the decreased amount of Gelfoam used in the first trial.

This percutaneous technique could be a valuable alternative to classical superselective endovascular embolization without the risk of varying degrees of parenchymal damage. The postembolization parenchymal ischemic area ranges from 0% to 30%. In addition, it could avoid surgical treatment that still carries a high morbidity compred with therapeutic embolization.16–18

No postembolization syndrome was encountered, while postembolization syndrome was reported to occur in 10% to 18% after endovascular embolization.19 A long-term follow-up study should be conducted to detect any long-term consequences, such as AVF, hypertension, and high-output cardiac failure, and confirm the long-term cure.

FIG. 2. (A) Color Doppler image of the kidney after percutaneous nephrolithotomy showing a small pseudoaneurysm; (B) postembolization—the pseudoaneurysm is nonvisualized (completely occluded).
Conclusion

A new method for managing renal pseudoaneurysm has been developed and presented. Direct percutaneous embolization directed by US guidance should be increasingly used in actively bleeding renal pseudoaneurysms, because it is rapid, effective, tissue preserving, and likely to reduce morbidity and mortality. This new percutaneous management modality obviates the need for surgical resection and general anesthesia and avoids the side effects of contrast media, hazards of irradiation, and complications of angiographic catheterization. Therefore, this technique is recommended to be included among the therapeutic options available for the management of renal pseudoaneurysm. The importance of this technique is preserving renal tissue, especially in cases of renal insufficiency and in patients with a solitary kidney.

Disclosure Statement

No competing financial interests exist.

References


Address reprint requests to:
Mostafa A. Sakr, M.D.
Department of Urology
Faculty of Medicine
Alexandria University
Sultan Hussein Street
Azarita 21131, Alexandria
Egypt
E-mail: msakr3000@yahoo.com

Abbreviations Used

AVF = arteriovenous fistula
PCNL = percutaneous nephrolithotripsy
US = ultrasonography