Renal Artery Embolization in Post Traumatic Vascular Lesions

IHAB I. ALI, M.D.*; HESHAM BADAWY, M.D.**; AMR A. NASSEF, M.D.* and AHMED S. AWAD, M.D.*
The Departments of Radiology* and Urology**, Faculty of Medicine, Cairo University

Abstract

Background: Renal vascular injuries mostly result from interventional urologic procedures such as percutaneous biopsy and nephrostomy. Serious hemorrhagic complications associated with percutaneous urologic procedures occur in 2.3-15% of the patients endangering patients’ life. Conventional surgical treatment including partial and total nephrectomy carries great morbidity and results in remarkable renal parenchymal loss.

With the development of transcatheter endovascular interventional procedures, microcatheters and embolizing materials precise localization and superselective catheterization of the arterial bleeder followed by embolization gives a minimally invasive treatment option which is able to control bleeding with minimal parenchymal loss and complication compared to surgery.

Purpose: To evaluate the effectiveness of endovascular embolization as a therapeutic technique in post traumatic (iatrogenic and non iatrogenic) renal vascular injuries.

Patients and Methods: This is a single center prospective study from July 2004 to November 2009. Thirty two patients (25 males and 7 females) between the ages of 3 and 60 years (mean age 37 years) with suspected renal vascular injury after percutaneous renal intervention or stab injury underwent angiography and percutaneous transcatheter arterial embolization using coils, glue, poly vinyl alcohol (PVA) particles and absolute alcohol.

Results: The source of bleeding was identified and embolized in 87.5% of patients (pseudoaneurysm=17, pseudoaneurysm with arteriovenous fistula=7, arteriovenous fistula (AVF) alone=2 and extravasation=2).

Bleeding stopped in 26 of the 28 patients (92.8 %). In two patients (7%), recurrent bleeding occurred. Re-angiography and assessment was done and insertion of another coil was needed in one patient, while in the second one, glue was administrated.

None of the patients underwent embolization required further surgical intervention. No significant immediate or delayed complications related to angiography or embolization was recorded.

Conclusion: Transcatherter endovascular renal embolization is effective minimally invasive treatment option in iatrogenic and penetrating vascular renal injuries that allow control of bleeding with minimal renal parenchymal tissue loss and rapid recovery.

Key Words: Renal trauma — Iatrogenic injury — Haematuria — Transcatheter endovascular embolization — Radiological interventional procedures — particles — Coils.

Introduction

RENAL vascular lesions mostly result from interventional urologic procedures such as percutaneous biopsy and nephrostomy. Non iatrogenic renal injury may result from blunt trauma, stab wounds and gunshots [ii.

Serious hemorrhagic complications associated with percutaneous urologic procedures occur in 2.3-15% of the patients. Injuries include lacerations, false aneurysm formation, or arteriovenous fistula. Approximately 70% of the arteriovenous fistulas close spontaneously. Therefore in the absence of life-threatening symptoms a conservative attitude is adopted [2]. However, in many occasions bleeding may continues, becomes life threatening and needs emergent management [3,4]. Surgical treatment including partial and total nephrectomy results in renal parenchymal tissue loss and carries great morbidity [5].

With the advent of endovascular coaxial techniques, microcatheters and microcoils, precise localization, catheterization and embolization of the bleeding arterial branches is more feasible [6]. So, compared with partial or total nephrectomy, embolization reduces tissue loss because the embolization material can be deployed immediately proximal to the bleeding site; therefore, most of the tissue loss is limited to that caused by the original trauma itself [ii.
The aim of our work is to evaluate the effectiveness of endovascular embolization as a therapeutic technique in various post traumatic (iatrogenic and non iatrogenic) renal vascular injuries.

Patients and Methods

Between November 2004 to May 2009, 32 patients were referred from urology, nephrology and causality departments to our vascular and interventional unit, radiology department, Kasr El Ainy hospital, Cairo University for suspected renal vascular injury after trauma. Their ages ranged from 3 to 60 years (median age 37 years). They included (25) males and (7) females.

The clinical conditions of the patients were internal bleeding (without haematuria) causing unstable haemodynamic status in 5 patients and persistent gross haematuria in 27 patients. Twenty two patients required blood transfusions.

The patients had a history of percutaneous, open surgical renal intervention or stab trauma. The iatrogenic cases were 29 patients (percutaneous nephrolithotomy in 17 patients, renal biopsy in 7 patients and open surgery in 5 patients). The non iatrogenic cases include 3 patients following stab injury.

The following was done for the cases:

- Full history taking.
- Laboratory investigations include complete blood picture, hemoglobin, and coagulation profile and kidney function tests.
- Pre intervention CT was done in 17 patients.
- Diagnostic angiography and interventional procedure.
- Follow-up.

The Angiographic machines used were Philips, Diagnost 94 (USA) (13 patients) and Siemens AXIOM Artis (Siemens, Germany) (19 patients).

Technique:

After standard sterilization steps in the angiography suite local anaesthesia (5 cc Xylocaine 2% solution) was infiltrated under the skin around the puncture site. General anesthesia was needed in 3 children.

Vascular access was obtained via the femoral artery in all patients. A vascular sheath was used as an introducer (6-F in 15 cases, 5-F in 14 cases and 4-F in 3 cases). Abdominal aortography was first performed by pigtail catheter (Fig. 1-a). In all patients, the renal artery on the side of the intervention was selectively catheterized via cobra catheter (Figs. 1b, 2a,b) (4 F in 3 patients and 5 F in 29 patients).

In two patients, the source of bleeding was from accessory renal artery (Fig. 1a) arising from lower aorta and supplying lower renal pole.

In 28 patients, arterial injury was demonstrated. The catheter was advanced superselectively into the branch of the renal artery feeding the lesion (Fig. 2b). Additional oblique and magnification views were used in all cases to help in delineation of the exact location of the arterial injury. In 10 patients, the lesion was accessed by Cobra catheter and embolization was performed. In 18 patients, coaxial micro catheter system was used to reach the lesion (Fig. 1c, 2c). In 10 patients, we used Renegade microcatheter (Boston Scientific) while in 8 patients; SP microcenter (Terumo) was used.

Various embolic materials were used depending on the location, size, accessibility of the feeding artery and blood flow at the level of the lesion. We used coils in 13 patients, glue (histoacryl) in 13 patients, combined coil and glue in one patient and combined PVA particles (Boston Scientific), (150 to 250 μm) and absolute alcohol in one case. The total number of the used coils was 28 including 18 steel coils (cook) (range in size from 3 to 5 mm in diameter) and 12 platinum micro coils (target therapeutics). The micro coils included 10 straight 0.018 (7 mm in length) and 2 coiled 0.018 (4 mm X 40 mm in diameters and length respectively). In the cases treated with glue, the glue concentration was prepared by diluting with lipiodol. The concentration of the glue was 50% (1:1) in 4 cases, 30% (1:2) in 8 cases and 25% (1:3) in 2 cases.

Control angiograms were done after each embolization with the catheter tip placed at proximal position to the bleeder and in the renal artery; the lesions were checked for any vascular filling (Fig. 1d, 2d).

Results

The source of bleeding was identified and embolized in 28 patients (87.5%) of our patients in the same session (pseudoaneurysm=17, pseudoaneurysm with arteriovenous fistula=7, arteriovenous fistula (AVF) alone=2 and extravasation=2).

In the patients treated with coils, control angiograms made after insertion of the coils showed residual vascular filling in 6 patients. So, more than one coil was inserted (two coils in three patients, 3 coils in one patient, four coils in one
patient and five coils in one patient). No proximal migration of the coils had occurred in any patient.

In patients treated with glue, single injection was done for each case. Control angiograms showed complete embolization with no need for further embolization. No reflux or spill over had been observed to the main or any other large branches of the renal artery. Also no reflux through the fistula into the venous system occurred.

In one patient with double lesions (pseudoaneurysm and arteriovenous fistula), we used two coils for the fistula and three micro coils for the pseudoaneurysm till complete occlusion occurred.

After the end of the procedures, post embolization angiogram showed occlusion of the feeding vessel with non-visualization of lesion and a small avascular segment distal to the occluded branch.

Bleeding stopped and clinical stabilization occurred in 26 out of the 28 patients (92.8%) within 48 hours. In one patient haemodynamic instability continued and deteriorated within the next 24 hours despite good occlusion in the control angiograms.

Re-angiography after 24 hours showed revascularization of the bleeding artery around the in place deployed coil, so occlusion by glue was done. The other patient developed recurrent bleeding after 4 days from embolization, re-angiography also showed revascularization of the bleeding artery around the in place coil with, insertion of another coil was done.

No recurrence of bleeding was observed in all patients available for long-term follow-up.

None of the patients underwent embolization required further surgical intervention. No immediate or delayed complications related to angiography or embolization was recorded.

In 4 out of the 32 patients, the source of bleeding could not be demonstrated by arteriography, in three of them, spontaneous improvement was achieved under conservative management, while one patient needed partial nephrectomy for persistent haematuria and dropping haemoglobin level with no identified bleeder by repeated angiography (three times).

Fig. (1): Male patient, 57 years old, had history of right PCNL followed by persistent haematuria and rapid decline of haemoglobin level reaching to 7g/dl over three days. (A). Flush aortogram showed faint right renal lower pole accessory artery (black arrow). (B and C) Selective right accessory artery angiography showed pseudoaneurysm (arrow). (D) Control angiography showed complete closure of PSA (filled with histoacryl ball) with patent adjacent arteries.
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Fig. (2): Male patient 45 years old, had history of right PCNL for left renal stone followed by haematuria and rapid decline of haemoglobin reaching to 8g/dl over three days. (A). Selective left renal and superselective segmental angiography showed large pseudoaneurysm of lower pole interlobar artery (white arrows) associated with high flow AVF, early venous filling (arrow heads) and pacification of the renal vein (RV). (C) More distal superselection with microcatheter (thin black arrows). (D) Angiography after embolization by histoacryl showed complete closure of PSA and AVF with minimal parenchymal loss.

Discussion

In the vast majority of renal trauma the injury is minor and self-limiting. Since these injuries usually heal spontaneously, conservative management has become the preferred approach to most renal injuries in the absence of life-threatening symptoms. Persistent or life-threatening bleeding is an indication for surgical or radiological intervention aiming at localization and treatment of the vascular lesion [1,3,7].

Different embolic materials have been reported to be used in renal artery embolization, namely polyvinyl alcohol particles (PVA), embosphere, gelfoam, coils, and glue as reported by Golzarian et al. [8]. In our study, we used coils in 14 patients, glue (histoacryl) in 14 patients and PVA particles and alcohol in one case. In 5 cases, we used more than one coil while in cases treated with glue; single injection was done for each case. In one patient we used glue and coil. Based on our data, we agree with Nuri et al., who stated that glue provided quick and stable occlusion and thrombosis; yet, its administration requires experienced operator.

In our study clinical success was achieved in (92.8%) which is near to those reported by Constantinou et al., [7] (91%) whom used different types of embolic materials as we used and less than (100%) reported by Cantasdemir et al. [3] and Nuri et al. [9] that were using glue as the initial embolizing material in their studies. In our study two cases (7.2%) required reembolization during the early 4 days follow-up period due to rebleeding; both were successfully controlled after the second session; those data are near to Constantinou et al., 2005 [7] who reported 2 out of 22 patient (9%) with failure of clinical success after the initial intervention.
We agree with Constantinos et al., [7] in that the use of coaxial microcatheters greatly facilitating the procedure whenever superselective embolization of an interlobar branch was attempted. This approach allowed superselective embolization of injured vessel while preserving normal parenchyma.

Using the superselective technique also significantly reduces the extent of a renal infarct resulting in excellent preservation of functioning renal tissue as mentioned by Dinkel et al., [ii] and was clearly confirmed in our study, where the gross estimate average parenchymal tissue loss after lobar and interlobar branch treatment was around 30% of the total renal parenchyma as documented by the nephrogram on the completion angiography.

This study confirmed conclusion of previous investigations that percutaneous embolization is effective and sufficient in the treatment of renal vascular trauma even in the acute setting, provided that the haemodynamic status of the patient can be controlled.

Conclusion:
Transcatheter endovascular renal embolization is effective minimally invasive treatment option in iatrogenic and penetrating vascular injuries that allow control of bleeding with minimal renal parenchymal tissue loss and rapid recovery. High success rate, low incidence of complications, and rapid recovery represent highly appealing reasons for making it the first-choice treatment option in cases of severe renal hemorrhage.

References