RESEARCH ARTICLE

Role of renal artery embolization in treatment of iatrogenic renal bleeding

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Abstract

Objective: To review institutional experience about the effectiveness and safety of percutaneous trans-arterial renal artery embolization in the treatment of iatrogenic renal bleeding.

Methods: The prospective study was conducted from December 2019 to December 2021 at Ain Shams University Hospital and Kafrelsheikh University Hospital, Egypt, and comprised patients of either gender who underwent renal artery embolization for iatrogenic arterial renal bleeding caused by percutaneous nephrolithotomy, renal biopsy and percutaneous nephrostomy. Diagnostic renal angiography was done to detect pseudoaneurysm and arteriovenous fistula. Embolization was done with either micro-coils or glue. Success of the procedure was defined as total occlusion of the bleeding artery proved by post-embolization angiogram.

Results: Of the 15 patients, 9(60%) were males and 6(40%) were females. The overall mean age was 35+/-14 years. Percutaneous nephrolithotomy was the main cause 8(53.3%), followed by renal biopsy 5(33.3%) and percutaneous nephrostomy 2(13.2%). There were 9(50%) cases of pseudoaneurysm and 6(40%) of arteriovenous fistula. Embolization was done with micro-coils in 5(33.3%) cases and with glue in 10(66.6%). The technical success rate was 15(100%). No major complications requiring intensive care or surgical intervention were encountered, and there was no significant differences in estimated glomerular infiltration rate or renal function after renal artery embolization ($p>0.05$).

Conclusions: Percutaneous endovascular renal artery embolization was found to be a safe and effective technique in the management of iatrogenic renal arterial injury.

Keywords: Renal artery, Aneurysm, Nephrostomy, Percutaneous, Arteriovenous, Angiography.

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Introduction

Traumatic renal haemorrhage with arterial injury, like pseudoaneurysm (PA) and arteriovenous fistula (AVF) are rare, but are life-threatening complications requiring immediate diagnosis and management.[1,2] Conservative treatment is ineffective in most cases of acute renal arterial bleeding (ARB), and is associated with a high recurrence rate.[3,4] With the development of percutaneous endovascular techniques in recent decades, selective angiography and embolization have been widely used to treat ARB with many advantages, as the whole procedure is done under local anaesthesia that means rapid recovery, short hospital stay and early resumption of physical activities.[5,6]

In iatrogenic renal bleeding after percutaneous nephrolithotomy (PCNL), renal biopsy and percutaneous nephrostomy (PCN), haemorrhage is the most serious and urgent complication, although it is usually self-limited and can be controlled conservatively.[7,8] In such patients, surgical intervention has a high risk of nephrectomy.[9] As a minimally invasive interventional therapy, renal artery embolization (RAE) is a mature method for the treatment of massive renal haemorrhage.[10,11]

Embolization means obliteration of a vessel by introducing an occlusive agent into the bloodstream, as, for example, a foreign body or sclerosing fluid, which then creates an interruption of the blood flow.[12]

Choice of material depends on the aim and the vessel to be embolized. In iatrogenic haemorrhage, the aim is not tissue necrosis, but to decrease the blood flow enough to allow natural haemostatic mechanisms to take effect.[13]

The current study was planned to assess institutional experience about the effectiveness and safety of percutaneous trans-arterial RAE in the treatment of iatrogenic renal bleeding.

Patients and Methods

The prospective study was conducted from December 2019 to December 2021 at Ain Shams University Hospital and Kafrelsheikh University Hospital, Egypt. After institutional medical ethical committee approval, the sample size was calculated based on literature[14] and using G Power software version 3.1.9.2[15] to assess the success of renal artery embolization for treating iatrogenic renal bleeding. A sample size of 15 patients was arrived at, to detect success of renal artery

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embolization. This was statistically significant with 80% power and at a significance level of 95% (alpha error probability=0.05). Informed consent has was taken after explaining the procedure and the possible complications. The sample was raised from among patients of either gender with iatrogenic ARB with coagulation profile of average normal values. Patients with non-correctable coagulopathy were excluded. The main iatrogenic trauma were caused by PCNL, renal biopsy and PCN, and presented with severe renal bleeding in the form of either haematuria or retroperitoneal haemorrhage with radiological evidence of a bleeding source from the kidney (Fig 1b Fig 3a). Imaging with either ultrasound (US) Doppler (Fig 2a), computed tomography (CT) angiography or diagnostic renal artery angiogram was done to confirm the bleeding source. Laboratory investigations, including renal functions, clotting profile and complete blood count (CBC) were reviewed to detect PA and AVF and to plan the procedure if there was any anatomical arterial variant, like accessory renal artery (Figure 1A, C), early renal bifurcation, and the targeted artery for occlusion.

Under local anaesthesia, right femoral artery axis was done using 6 French (Fr) femoral sheath. Using 5Fr catheter to reach the main renal artery and doing diagnostic angiogram was done to identify the injured artery and the type of injury. The pooling of contrast in a saccular shape meant it was a PA (Figures 1d) (fig 3 b, c, d), while AVF was diagnosed when the saccular pool of contrast drained early into a renal vein with early appearance of the inferior vena cava (IVC) (Figures 2 b, c).

Using 2.7Fr microcatheter to reach the bleeding artery, embolization was done using the suitable available embolizing material. Using a microcatheter with a coaxial technique (2.7Fr micro-catheter within the 5Fr mother catheter) made the super-selection of the bleeding artery easier and decreased the incidence of non-target embolization of normal arteries and normal parenchyma.

Post-embolization renal angiogram was done to assess the success of embolization and the renal parenchyma Fig 1 f fig 2 d fig 3 e.

Embolization was done with either micro-coils (Fig 3f) or glue (acrylate mixed with lipidol) (Fig 1 e). The size of the coils was determined by the renal angiogram and the size of the injured artery. The acrylate was mixed with lipidol in different concentrations, according to the flow velocity in angiogram. In AVF cases with rapid flow, the acrylate concentration was 50% to keep it sticky just after it got out from the catheter so that it could not pass to venous side to the lungs. In PA cases and those with small artery with stagnant flow, the acrylate concentration was 20-25% to avoid rapid reflux and non-target embolization.

Assessment of the effectiveness of bleeding control was done clinically by cessation of haematuria, and improvement in vital signs, like blood pressure (BP) and heart rate (HR). Technical success of the procedure was defined as total occlusion of the bleeding artery proved by post-embolization angiogram. Follow-up haemoglobin (Hb) level was checked one week after embolization to confirm the cessation of bleeding.

Complications, such as non-target vessel embolization seen in post-embolization angiogram, persistence of gross haematuria, decreased haematocrit level, infection or abscess formation, were also evaluated. The collected data was analysed using Statistical package of social service (SPSS) version 19.

Results

Of the 15 patients, 9(60%) were males and 6(40%) were females. The overall mean age was 35±14 Years (range: 20-63 years). There were 8(53.3%) patients with frank haematuria, 5(33.3%) had haematuria with flank pain due to perinephric haematoma and 2(13.3%) presented with flank pain only. PCNL was the main case 8(53.3%), followed by renal biopsy 5(33.3%) and PCN 2(13.3%). There were 9(50%) cases of PA and 6(40%) of AVF. All 15(100%) cases were in native kidney; 10(66.6%) in the left side and 5(33.3%) in the right. In 11(73.3%) cases, the lesion was in the lower pole, 3(20%) in the middle segment and 2(13.3%) in the upper pole. Microcatheter with coaxial technique was used in all 15(100%) cases. Embolization was done with micro-coils in 5(33.3%) cases and with glue in 10(66.6%). In the post-embolization angiogram, the size of parenchymal loss did not exceeded 10% in all 15(100%) cases. Median volume of used contrast media was 55mL (range: 40-80mL).

The Hb level showed significant stability with good response to the blood transfusion ($p<0.05$). There were no significant differences in estimated glomerular infiltration rate (eGFR) or renal function after RAE ($p>0.05$). In 3(20%) cases, mild fever and moderate flank pain was encountered and adequately managed by analgesic and antipyretic. There was 1(6.6%) case that presented with high fever and severe flank pain in whom perinephric abscess was diagnosed due to secondary infection of the pre-existing haematoma, and was adequately managed by US-guided pig-tail drainage and antibiotics in the light of culture and sensitivity testing. No major complications requiring intensive care unit (ICU) admission or surgical intervention were encountered.

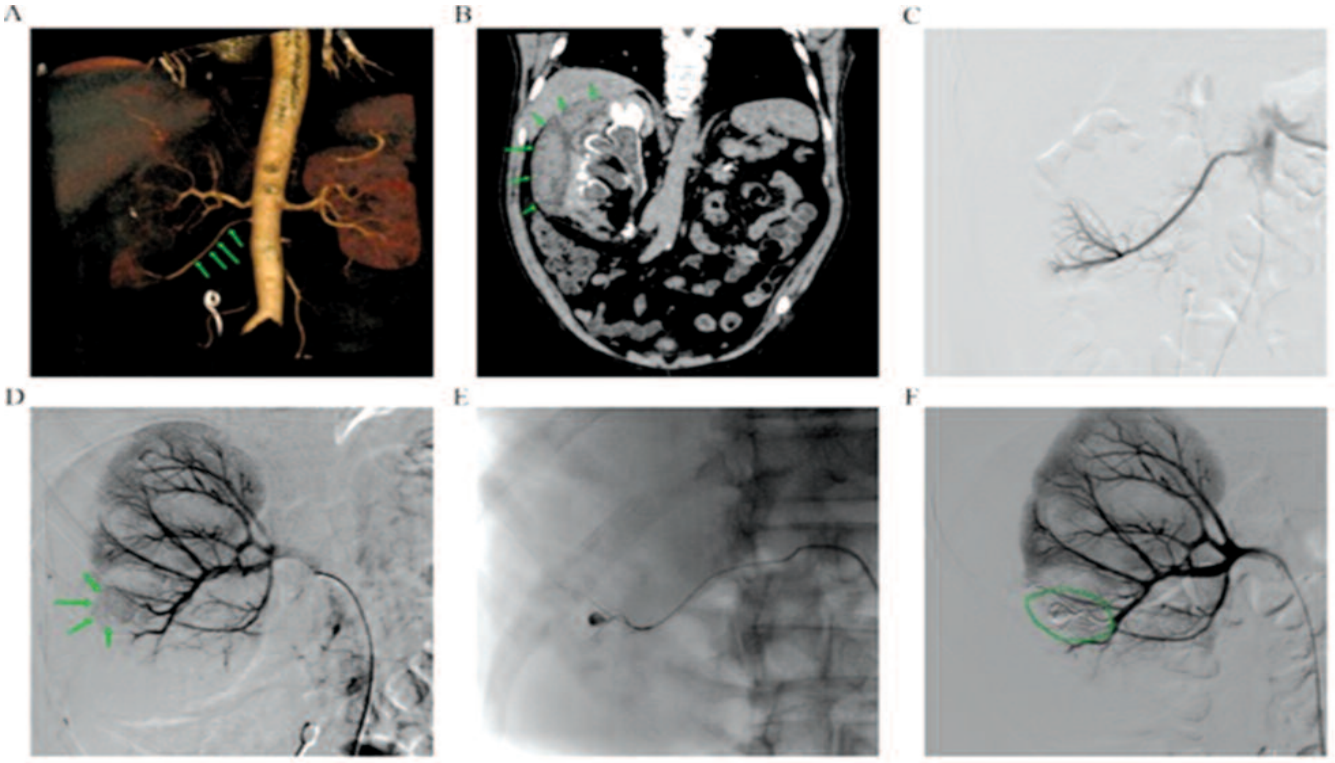

Figure 1: Male patient post-percutaneous nephrolithotomy (PCNL) for right renal stones presented with severe haematuria. (A) Computed tomography (CT) angiography revealed right lower pole accessory renal artery (arrows). (B) Delayed phase CT revealed large perinephric haematoma (arrows) and intra-clyceal haematoma. (C) catheterisation of the accessory renal artery revealed normal renal parenchymal blush. (D) Renal angiogram of the main renal artery revealed a pseudoaneurysm (PA) (arrows). (E) Super-selective catheterisation of the injured artery using microcatheter and embolization using glue. (F) Post-embolization control angiogram revealed total occlusion of the bleeding artery with small area of infarction that was supplied by only the occluded artery (green circle) and normal residual renal parenchyma.

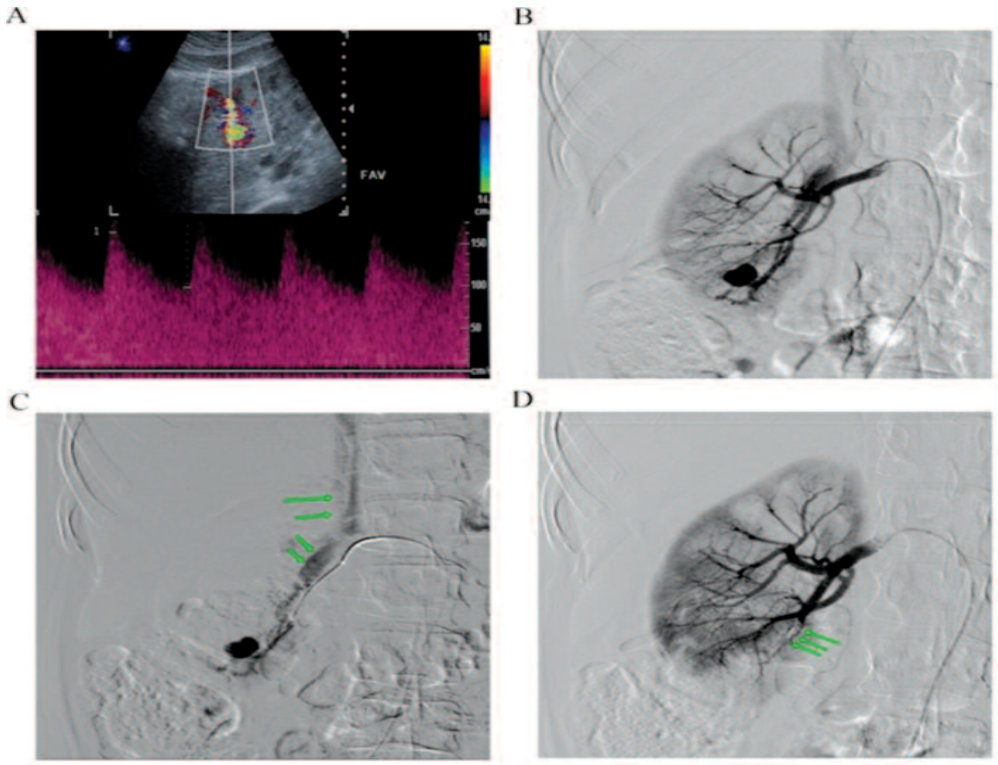

Figure 1: Female patient presenting with severe haematuria post-renal biopsy. (A) Doppler ultrasound (US) revealed a pseudoaneurysm (PA) with monophasic high flow arterial wave raising the possibility of arteriovenous fistula (AVF) (red arrows). (B) Renal artery angiogram revealed lower pole PA with early filling of the renal vein and the inferior vena cava (IVC). (C) Super-selective catheterisation of the bleeding artery using microcatheter showing the early filling of the renal vein and the IVC (arrows). (D) Post-embolization control angiogram showing complete occlusion of the injured artery with glue (arrows).

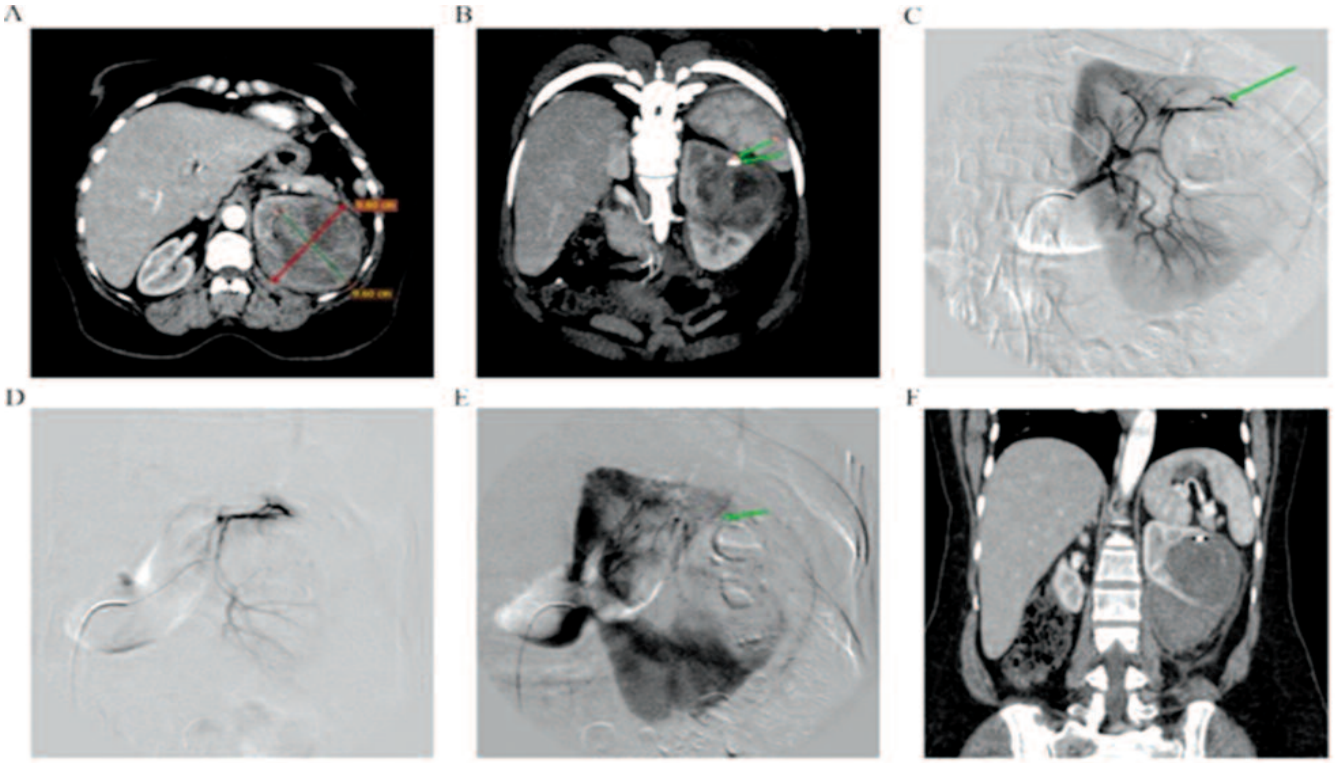

Figure 3: Male patient with post-percutaneous nephrolithotomy (PCNL) bleeding. (A) Computed tomography (CT) revealed large intraparenchymal and perinephric haematoma. (B) Multiplanar reconstructive CT image showed upper zonal small pseudoaneurysm (PA) (arrows). (C) Renal artery angiogram revealed upper renal pole small PA (arrow). (D) super-selective catheterisation of the injured artery using a microcatheter. (E) Post-embolization angiogram revealed total occlusion of the bleeding artery with micro-coil (arrow). (F) Follow-up CT 1 week after embolization revealed the coil in place with no PA and liquefaction of the haematoma.

Discussion

With rise in the number of interventional procedures in recent years, the number of iatrogenic renal injuries have become the most common (>50%) cause of renal bleeding needing intervention.[16,17] In the current study, iatrogenic renal injury were caused by different renal intervention procedures, like PCNL, renal biopsy and PCN, which is in line with literature.[2]

The study was also in agreement with the findings of Cimsit et al.[3] Phadke et al.[18] performed renal angiography in 29 patients who sustained significant haematuria after iatrogenic renal trauma; 14(48%) had PCNL, 8(28%) renal biopsy, 5(17%) PCN and 2(7%) patients had had open pyelolithotomy. The differences were mostly due to different sample sizes in the two studies.

In our study, PA was the predominant vascular abnormality, followed by AVF. The pattern was similar to Hongjie Guo et al.[1] In contrast, to Wang, et al.[19] showed AVF more than PA.

The current study mostly used glue, while Breyer et al. used coils in 90% cases.[12] The choice of the embolizing material is determined by the experience and availability at a centre.

In terms of clinical success, mean haematocrit level showed significant stability after embolization in all cases, and the same was the case with BP and HR. Similar results were reported earlier.[12] However, a study reported that mean haematocrit and Hb levels before and after embolization were significantly different ($p< 0.001$).[20]

There were no serious complications post-embolization in the current study, which is in line with Mohsen et al.[21]

The current findings indicated that minimal renal parenchymal loss can be obtained if an extremely super-selective technique is used. This agrees with Venkateswarlu et al.[1]

Conclusion

Percutaneous trans-arterial RAE in cases of urinary tract bleeding secondary to iatrogenic renal arterial injury was found to be a safe and effective procedure to control the bleeding and save the residual renal tissue. The technique had the advantages of being under local anaesthesia, short hospital stays and rapid recovery.

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Conflict of Interest: None.

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