

## RESEARCH COMMUNICATION

# Interventional Therapy for Renal Artery Pseudoaneurysms

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### Abstract

The aim of this study was to explore the angiographic diagnosis and embolization therapy for renal artery pseudoaneurysms due to acute urinary tract hemorrhage after conservative medical management failed. Seven out of ten cases had fever symptoms after the kidney surgery. The pseudoaneurysms were treated with gelatin sponge and (or) spring coil and the majority demonstrated rapid blockage of hemorrhage. Angiography diagnosis and trans catheter embolization are rapid, safe and effective methods for diagnosis and treatment of renal artery pseudoaneurysms.

**Keywords:** Interventional therapy - renal arteriography - pseudoaneurysm - kidney surgery

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### Introduction

Pseudoaneurysm are circumscribed aneurysmal dilatation that forms as the result of damage in artery wall. The vessel wall at the dilatation is thin and perforated that is prone to serious arterial damage and hemorrhage, making pseudoaneurysm a clinical emergency. Common causes of pseudoaneurysm are traumas (Farrell et al., 1996; Jebara et al., 1998; Weissbart et al., 2009), for example after surgery for cancer with fewer secondary renal artery pseudoaneurysms after kidney surgery (Albani and Novick, 2003; Treiber et al., 2003; Shapiro et al., 2009; Arroua et al., 2010; Netsch et al., 2010). Due to large blood flow in renal artery, once pseudoaneurysm is formed, it is prone to damages that can cause hemorrhage and endanger life. We have treated 10 cases of secondary pseudoaneurysm after kidney surgery with interventional radiology technology.

### Materials and Methods

#### Patients

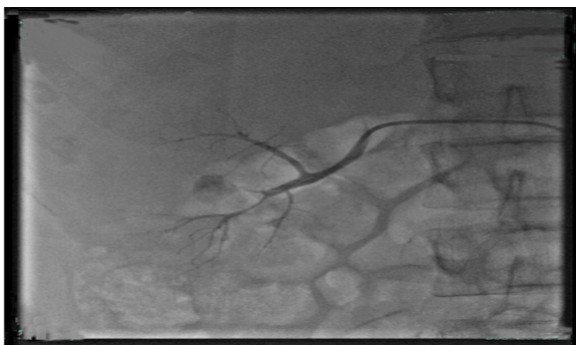
From July, 2008 to February, 2011, 10 cases of renal artery pseudoaneurysms were detected with radiography from patients coming to our department for urinary tract hemorrhage after kidney stone surgery. Among those 10 cases, 8 cases were men and 2 cases were women ranging from 28 to 79 years old with the average age of 50.7. All of them had medical histories of kidney surgery, with 7 cases having percutaneous nephrolithotomy and 3 cases having incision lithotomy. Quantity of hemorrhage ranged from 1200~2100 ml, with the average amount of 1600 ml. The patients' main clinical manifestations included large amount of hematuria, common occurrence of abdominal

pain caused by urethral obstruction due to blood clots, sudden irritability, decline in blood pressure, increased heart rate and other early symptoms of shock, which did not improve significantly after transfusion, expansion and anti-shock therapy, or recurred after patients' conditions were stable. Among them, 5 cases also had symptoms of hemorrhagic shock, such as decline in blood pressure. There were 4~11 days between kidney surgery and the occurrence of pseudoaneurysm symptoms. Seven cases of those 10 patients had fever after the kidney surgery, with the highest body temperature up to 40°C and the longest fever period up to 5 days. Patients with fever also had high white blood cell count and neutrophils. This study was conducted in accordance with the declaration of Helsinki. This study was conducted with approval from the Ethics Committee of Taizhou Hospital of Zhejiang Province, China (Permit Number: 20060828001). Written informed consent was obtained from all participants.

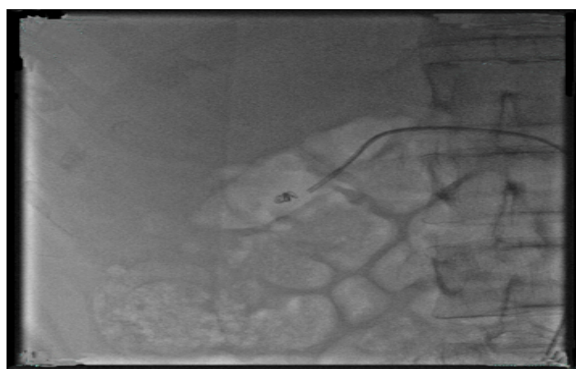
#### DSA Technique and Embolization

Using Seldinger technique for catheterization through femoral artery, regular abdominal aortography was performed to define quantity of renal arteries and each renal artery was evaluated respectively. A 10-mL dose of iopamidol (Iopamiro, Bracco SpA) 300 was injected at a rate of 3 mL/sec. If any suspected or abnormal signs of superselective angiography were found, the supplying blood vessel, form and quantity of renal artery pseudoaneurysm, the size of tumor cavity and the location of aneurysm neck were determined. Superselective aneurysm arterial embolization treatment was conducted basing on the selected method of interventional embolization and intervention instrument. Eleven pseudoaneurysms were found in those 10 patients,

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**Figure 1. Selective Angiogram of the Right Renal, Clearly Shows the Pseudoaneurysm arising from below Segmental Artery of the Renal**

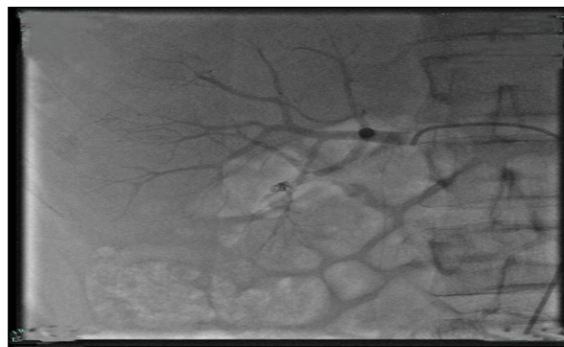


**Figure 2. Angiogram Showing the Segmental Artery was Thrombosis Using Microcoils**

with two pseudoaneurysms in one patient (Figure 1, 2 and 3). All pseudoaneurysms were occurred at segmental artery or below segmental artery. The first patient was treated with gelatin sponge strips for embolization after diagnosed with pseudoaneurysm; who had haematuria again 13 days after embolization and hemorrhage of original aneurysm after secondary radiography; treated with spring coils for aneurysm arterial embolism, the patient had no hemorrhage during follow-up visits. All other 9 patients were treated with one embolization therapy. Among them, 8 patients were treated with spring coils of various types for aneurysm arterial exclusion embolization from the proximal end to distal end; 1 patient with multiple pseudoaneurysms was treated with gelatin sponge grains for embolization at the distal end of vessel and then treated with spring coils for embolization in feeding artery. All 9 cases had no secondary hemorrhage after the surgery. Twenty three spring coils were used by 10 patients. After embolism, they all had re-examinations of aneurysm arterial radiography. The arterial radiography of those 10 patients after spring coil embolization did not show development of pseudoaneurysm.

#### *Treatment after Surgery and Follow-up Visit*

The catheter sheath was retained for 1~3 days after pseudoaneurysm embolization to observe whether hemorrhage would recur; if no further hemorrhage occurred, the catheter sheath was removed. Patients with infection symptoms were treated with anti-inflammatory treatment and those without such symptoms were treated with precautionary anti-inflammatory treatment for one



**Figure 3. Post-coiling Common Renal Angiogram Showing Successful Occlusion of the Pseudoaneurysm.**

day. In the mean time, treatment such as hemostasis and support was maintained and transfusion of blood was offered to patients with large amount of bleeding.

## **Results**

### *Radiography Manifestation*

Extravasations of contrast medium occurred in the early arterial phase, which formed into shadows of oval, pestle-head-like and irregular lobular external capsule of arterial cavity, and did not disappear until the venous phase. All DSA images of 11 cases clearly showed the location, size and shape of pseudoaneurysms. The pseudoaneurysms were located between segmental arteries, interlobar arteries, arcuate arteries and interlobular arteries respectively. Nine of 10 patients had single pseudoaneurysm and 1 had multiple ones (2 in total). The maximal diameters of aneurysm were 0.5~2.5 cm, with the average of 1.5 cm. The pseudoaneurysms of these 10 cases were all occurred at one side of the arteries. Although aneurysms sometimes overlapped with the arteries, they could be separated by turning the bulb tube. The size of aneurysm opening could be observed.

### *Embolization Treatment Result*

Nine patients were cured after one therapy. One patient had haematuria again 13 days after embolization with gelatin sponge grains and hemorrhage of original aneurysm after secondary radiography. After treating with spring coils for aneurysm arterial embolism, the patient had no further hemorrhage during follow-up visits.

### *Complication*

Due to acute ischemia after embolization surgery, 1 patient had transient pain in kidney areas which improved spontaneously. Five patients had fever after embolization with the highest temperature up to 39.3° C and the longest time up to 8 days. Among of them, 4 patients had fever before embolization. The fever disappeared after symptomatic treatment.

### *Follow-up Visits*

By the end of June of 2011, 10 patients were followed up from 4 to 35 months (the average time: 21 months). No damages and hemorrhage of pseudoaneurysm occurred during the follow-up visits.

## Discussion

The main causes of pseudoaneurysm are trauma and iatrogenic, and the increase in surgery operations especially contribute to the increase in the incidence rate (Farrell et al., 1996; Jebara et al., 1998; Albani and Novick, 2003; Treiber et al., 2003; Shapiro et al., 2009; Weissbart et al., 2009; Arroua et al., 2010; Netsch et al., 2010). Up to now, the pathogenesis of pseudoaneurysm is considered to be as follows: the artery damages and bleeding caused by factors, such as injury and infection lead to local hematoma, which is surrounded by soft tissues around it and then gradually develops into cavity with blood inside and capsule wall of fibrous connective tissue. The 10 cases we presented is mainly caused by iatrogenic renal artery injury, which often occurs after various surgical operations on the kidney, such as percutaneous nephrolithotomy lithotomy, renal biopsy and open surgery for kidney. Five out of 10 cases occurred after renal parenchyma lithotomy and 5 cases occurred after nephrolithotomy lithotomy. These 10 cases were all manifested as intermittent or persistent gross (macroscopic) hematuria after the kidney surgery. The hematuria lasted for 4~14 days and the median of days of hematuria was 7, among which 5 cases were with larger amount of bleeding and blood pressure decline. The 10 cases were all proved with radiography to be pseudoaneurysm rupture that led to blood flowing into the renal pelvis and large amount of hematuria were present.

Renal artery pseudoaneurysm rupture and bleeding have no specific symptoms and signs. The most common symptoms are abdominal pain and acute urinary tract bleeding (Steinway et al., 2009; Arroua et al., 2010; Inci et al., 2010). All the 10 cases we reported were detected in emergency treatment of angiography for acute urinary tract hemorrhage. Through angiography, we can determine the location, size, and form of the pseudoaneurysm, vessel wall conditions, whether branches of artery are involved, whether there is collateral circulation and the relationship between the pseudoaneurysm and adjacent tissues and organs. Arteriography is manifested as extravasations of contrast medium, direct entry of contrast medium into the renal pelvis and the cyst formed outside the lumen, the shadow of which will last to late venous phase. The pseudoaneurysms with small diameters are round, oval and lobulate cavities, with smooth edges and uniform density. Adjacent arteries might be compressed or pushed away. The treatment of renal artery pseudoaneurysm through surgery often cannot determine the location of hemorrhage and the only method is to conduct complete nephrectomy; besides, for patients with serious conditions, second-look laparotomy is very dangerous. Aneurysm arterial embolization through main renal artery can avoid nephrectomy and preserve most renal functions with little injuries. Preferred clinical choices are often emergency treatment of angiography and interventional therapy (Hidas et al., 2005; Cohenpou et al., 2007; Shakhssalim et al., 2010; Stout and Glickman, 2010).

According to literature reports, the embolism of viscera aneurysm should completely block both the

proximal artery and distal artery of the aneurysm as well as stuff the aneurysm cavity (Hall et al., 1987; Hidas et al., 2005; Cohenpour et al., 2007; Shakhssalim et al., 2010). The materials of embolism are mainly various metallic rims with small amount of gelatin sponge. There are also reports of application of  $\alpha 2$  n-butyl cyanoacrylate glue (NB2CA). Generally, renal artery often has 3~4 branches. Renal artery has abundant blood flow. Renal artery pseudoaneurysm often occurs below the artery, and the pseudoaneurysms in those 10 cases are all occurred at segmental arteries or below segmental arteries. Therefore, even one branch of segmental artery is embolized, most renal functions are still preserved. As to renal artery pseudoaneurysm, the author's experience is to use spring coils of various types with small quantity of gelatin sponge grains according to its location for embolization. Embolization with only gelatin sponge is not preferred. One case we reported had hemorrhage again after embolization with only gelatin sponge grains, and it was considered that when gelatin sponge grains absorbed blood, the pseudoaneurysm had blood supply again to the extent of its damages and hemorrhage. As the neck of pseudoaneurysm is distant from the starting part of interlobar artery, extend the superselective catheter to the proximal end of the pseudoaneurysm, and then embolize with gelatin sponge grains at the distal end, with spring coils at the proximal end at the same time, and exclude the pseudoaneurysm with dual aneurysm arterial embolization at both the proximal end and the distal end. In case the neck of pseudoaneurysm is near to or at the starting part of the interlobar artery, we can directly use spring coils for aneurysm arterial embolization at the proximal end. Radiography re-examination with hand bolus injection is the preferred recommendation. If the embolization effect is not satisfactory, strengthen the spring coils until satisfactory embolization effect is achieved to achieve complete hemostasia.

The incidence rate of the complications of interventional therapy for abdominal viscera aneurysm is about 0.5-5.0% (Albani and Novick, 2003; Zorn et al., 2007; Povo-Martín et al., 2010). The complications include aneurysm rupture during surgery, ectopic embolization, internal infection of aneurysm and hematoma at site of puncture, et. Most complications are of no serious consequences and only few complications call for surgical intervention.

In conclusion, according to the author, when patients of renal artery pseudoaneurysm after kidney surgery are positively going through treatment of hypovolumic shock and infection, emergency treatment of angiography should be the first choice to determine the location and type of hemorrhage and corresponding TAE hemostasis therapy should be performed.

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