Original Article

Presentation and treatment of arteriovenous fistula, arteriovenous malformation, and pseudoaneurysm of the kidney in Ramathibodi Hospital

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Abstract

Objective: To review the presentation, predisposing factors, treatment and outcome of renal vascular malformation, including arteriovenous malformation (AVM), arteriovenous fistula (AVF) and pseudoaneurysm of the kidney in Ramathibodi Hospital.

Material and Method: In-patient medical records from January 2007 to January 2017 were retrospectively reviewed. Patients admitted and diagnosed with any type of vascular malformation of the kidney, comprising AVM, AVF and pseudoaneurysm in Ramathibodi Hospital were included in the study. Baseline characteristics of the patients, including gender, age at diagnosis, and underlying disease were recorded. Vascular malformation, clinical presentation, imaging data, predisposing factors of the disease, treatment and the outcome of patients were summarized and reported.

Results: Seventeen patients were diagnosed with vascular malformation; 9 patients were males and 8 females. The most common comorbidity was hypertension, followed by chronic kidney disease. Nine patients had AVF (52.94%), 3 had AVM (17.65%), 2 had pseudoaneurysm (11.76%), and 3 had AVF with pseudoaneurysm (17.65%). Common presentations were gross hematuria, flank pain, anemia, and hypovolemic shock. Previous surgery and history of renal biopsy were mutual predisposing factors. Embolization was the most common treatment option. All patients were asymptomatic on follow-up visit with a median follow-up of 90 days.

Conclusion: Vascular malformation of the kidney is not a common condition. The history of previous kidney surgery and renal biopsy may help for diagnostic suspicion. Renal embolization was the proper management with a high success rate.

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Introduction

Renal vascular malformation is a rare disease. AVFs are the most common type of renal vascular malformation, comprising 70-80% of renal arteriovenous abnormalities, which can be divided into acquired and congenital types. Congenital renal AVMs are uncommon, with a prevalence of less than 1% in the general population[1]. Of the acquired disease, 70-80% is caused by kidney injury due to accident, kidney biopsy, history of kidney surgery, cancer, and inflammation in the kidneys[2]. Most patients present with hematuria and flank pain. Physical examination demonstrates abnormal blood flow around the flanks. Furthermore, some patients present with disease consequences, such as high blood pressure, enlarged left ventricular or congestive heart failure[3].

The gold standard for diagnosis is renal angiography, which is a precise and effective method. However, it is the initial laboratory tests, such as urinalysis, kidney function test, Doppler ultrasonography, and computed tomography (CT) imaging[3], which guide diagnosis.

Compiling data from previous studies, renal vascular disease is not the priority for differential diagnosis in patients who presented with hematuria. On the other hand, these conditions tend to be considered last. Therefore, the diagnosis might be delayed until after serious complications, such as hypotensive anemia from blood loss or renal failure, have occurred[4-8], resulting in an increase in the duration of treatment, and thus a higher cost of treatment than necessary. As a result, patients will have higher morbidity, increased length of hospital stay, and higher costs for treatment. The aim of this study was to review the etiology, symptoms and signs, and treatment of renal AVF, AVM and pseudoaneurysm in Ramathibodi Hospital.

Material and Method

This study was approved by the Human Research Ethics Committee, Faculty of Medicine Ramathibodi Hospital, Mahidol University. In-patient medical records from January 2007 to January 2017 were retrospectively reviewed. Patients admitted and diagnosed with any type of vascular malformation of the kidney, comprising arteriovenous malformation (AVM), arteriovenous fistula (AVF), and pseudoaneurysm were included into the study. Computed tomography and renal angiogram were reviewed. Patients with incomplete medical records and radiography were excluded from the study. Baseline characteristics of the patients, including gender, age at diagnosis, and underlying disease were recorded. Vascular malformation, clinical presentation, imaging data, predisposing factors of the disease, the treatment and the outcome of patients were explored and reported. Statistical analysis: continuous data are presented as mean and SD. Categorical data are reported as frequency and percentage.

Results

We retrospectively reviewed medical records from January 2007 until January 2017. Seventeen patients were diagnosed with vascular malformation and admitted to the hospital; 9 patients were males (52.94%) and 8 females (47.06%). Mean ± SD age of the patients was 46.65 ± 19.70 years old; 41.22 ± 21.82 in males and 52.75 ± 16.12 in females. Of the 17 patients: hypertension was found in 11 (64.71%), diabetes mellitus was found in 5 (29.41%), chronic kidney disease was found in 6 (35.29%), and history of kidney transplantation in 4 (23.53%). Two patients (11.76%) had no underlying disease. The details of patient characteristics are shown in Table 1.

Table 1. Patient characteristics.

Characteristic	No. (%) or mean±SD
Age (years)	46.65±19.70
• Male	41.22±21.82
• Female	52.75±16.12
Gender	
• Male	9 (52.94)
• Female	8 (47.06)
Comorbidities	
• Hypertension	11 (64.71)
• Diabetic mellitus	5 (29.41)
• Chronic kidney disease	6 (35.29)
• History of kidney transplantation	4 (23.53)
• No underlying disease	2 (11.76)

Regarding the type of vascular malformation, 9 had AVF (52.94%), 3 had AVM (17.65%), 2 had pseudoaneurysm (11.76%), and 3 had AVF with pseudoaneurysm (17.65%). For the patients with a transplanted kidney, 3 patients had AVF and another patient had AVF with pseudoaneurysm. Eleven patients presented to the hospital in the emergency department with the presentation of gross hematuria (8 patients, 47.06%), flank (1 patient, 5.88%), and anemia (2 patients, 11.76%). Hypovolemic shock was found in 1 patient (5.88%). Among the asymptomatic patients, 5 underwent ultrasound for renal disease surveillance. Predisposing factors: previous surgery was found in 4 patients (23.53%), comprising 2 percutaneous nephrolithotomy (PCNL) and partial nephrectomy for renal cell carcinoma. Six patients (35.29%) had a history of renal biopsy. On the other hand, the rest of the patients had no history of prior procedure (Table 2). Embolization was the most common treatment for vascular malformation (12 patients, 70.59%). However, unsuccessful embolization was found in 2 patients because of the vasospasm and dissection of the segmental branch. Two patients had persistent hematuria and underwent a second embolization during the same admission. Median follow-up was 90 days (range: 9-3,285). All patients were asymptomatic on their last visit.

Discussion

Renal vascular malformations are abnormal communications between the arteries and veins in the kidneys. Generally, 2 types are described. Renal AVMs are congenital and represent a developmental abnormality wherein the artery and the vein communicate through a network of abnormal vessels. AVF is defined as a single direct communication between a renal artery and an adjacent vein. Acquired AVFs are more common than congenital AVFs and usually result from a penetrating trauma, percutaneous biopsy, surgery, malignancy, or inflammation. About 39% of AVFs are symptomatic, and the majority resolve spontaneously (87%). Only 13% require treatment[9]. Cho et al. studied a series of 9,500 angiograms of the renal artery and found only 4 cases of congenital origin. Acquired renal AVF is more common and occurs secondary to trauma, inflammation, renal surgery, renal angioplasty, or percutaneous biopsy[10].

Table 2. Disease characteristics and treatments.

	No. (%)
Type of vascular malformation	
• Arteriovenous fistula (AVF)	9 (52.94)
• Arteriovenous malformation (AVM)	3 (17.65)
• Pseudoaneurysm	2 (11.76)
• AVF with pseudoaneurysm	3 (17.65)
Clinical presentation	
• Gross hematuria	8 (47.06)
• Flank pain	1 (5.88)
• Anemia	2 (11.76)
• Hypovolemic shock	1 (5.88)
• Asymptomatic	5 (29.4)
Predisposing factor	
• Previous surgery	4 (23.53)
• Renal biopsy	6 (35.29)
• No history of prior procedure	7 (41.18)
Treatment	
• Embolization	12 (70.59)
• Partial nephrectomy	1 (5.88)
• Nephrectomy	1 (5.88)
• Conservative	3 (17.65)

The clinical manifestations of vascular lesions of the kidney vary widely, from asymptomatic presentation, flank pain, hematuria, perinephric hematoma, abdominal mass, flank bruit, and high output heart failure to hypertension. An AVM is usually symptomatic with gross hematuria due to a rupture of the small venules into the calyces from abnormally increased intravascular pressure. Patients may present with flank pain from an obstruction of the renal collecting system by blood clots or with hypertension due to the stimulation of the renin-angiotensin pathway, or with cardiac failure due to a high-output state[9].

The diagnosis of congenital renal AVM relies on clinical manifestation, ultrasonography, CT, magnetic resonance imaging, and angiography. Small AVM may escape recognition on ultrasonography and CT scans[8]. Sonography is the preferred initial diagnostic method for evaluation of the kidneys, and color doppler ultrasound is low cost and widely available. CT imaging of renal vascular malformations are characterized by masses of vascular density with dilated draining renal veins. Contrast-enhanced CT angiography can depict the presence of numerous feeding vessels and abnormal tortuous vessels in a vascular tangle with early opacification of the draining veins. Magnetic resonance imaging (MRI) demonstrates flow-related signal voids within the lesion, and prominent draining veins. Catheter angiography remains the gold standard in demonstrating detailed vascular anatomy of renal vascular malformation.

As a minimally invasive nonsurgical treatment, transarterial embolization (TAE) is a treatment for hematuria that was first reported in 1973, and it has been used widely to control hematuria and preserve the kidney since[11]. Zhang et al. performed a brief review of TAE in the treatment of hematuria secondary to congenital renal AVM from 1973 to 2012, and demonstrated that the primary and secondary success rates of TAE were 73.7 and 94.7%, respectively[8]. Eom et al. reported on TAE of renal AVM safety and efficacy in 24 patients with follow-up to evaluate the efficacy and safety of renal artery embolization (RAE) for renal AVM. They found that the clinical success rate after the initial RAE was 67%. The overall clinical success rate, including multi-session RAE, was 88%. However, 3 underwent a second session of RAE to achieve clinical success, and 3 patients underwent nephrectomy due to recurrence[12]. Traditional treatment options for renal AVF are open partial or total nephrectomy. This treatment is less popular compared with embolization because of its higher morbidity[7,8,13].

In this study, we found 11 patients (64.71%) had hypertension. Pathophysiology of hypertension followed renal vascular malformation due to the stimulation of the renin-angiotensin pathway[9]. In addition, we found 6 patients with a history of chronic kidney disease, 4 in 6 patients had kidney transplantation. Post kidney transplantation: the patients had rising serum creatinine and suspected graft rejected. After which, the patients underwent kidney biopsy and turned to transplant kidney vascular malformation afterwards. Although percutaneous renal biopsy is the gold standard for diagnosing renal disease, AVF formation is a potential complication which occurs in up to 15% of patients. Most fistulae resolve spontaneously, but some enlarge and become clinically apparent and symptomatic in the first weeks or months after biopsy[14,15].

In patients with previous renal surgery, 2 had partial nephrectomy due to RCC and turned to renal vascular malformation at the surgical site. Two other patients had a PCNL procedure and renal vascular injury then AVF and pseudoaneurysm was formed. Most of our patients had successful embolization. Only 2 patients were reported as having undergone an unsuccessful procedure due to vasospasm and dissection of the segmental branch. In the group of embolization, 2 patients had persistent hematuria and underwent a second embolization during the same admission and ended up with a favorable outcome. For the clinical outcome: all patients were asymptomatic on their last visit.

Conclusion

Vascular malformations of the kidney represent an important group of entities for diagnostic consideration, and understanding the natural history of the disease, vascular anatomy, and hemodynamics of these vascular lesions help in guiding proper treatment. Renal angiography and embolization should be recommended as the first choice to treat gross hematuria secondary to renal vascular malformation.

Conflict of interest

The authors declare no conflict of interest.

References

1. Cindolo L, Ingrosso M, De Francesco P, Castellan P, Berardinelli F, Fiore F, et al. Giant renal artery aneurysm: A case report. Arch Ital Urol Androl 2015;87:169-70.
2. Hwang JH, Do YS, Park KB, Chung HH, Park HS, Hyun D. Embolization of Congenital Renal Arteriovenous Malformations Using Ethanol and Coil Depending on Angiographic Types. J Vasc Interv Radiol 2017;28:64-70.
3. Thayaparan A, Amer T, Mahdi E, Aboumarzouk O, Hughes O. Complete renal artery embolization in a comorbid patient with an arteriovenous malformation. Case Rep Urol 2014;2014:856059.

4. Ali M, Aziz W, Abbas F. Renal arteriovenous malformation: an unusual cause of recurrent haematuria. BMJ Case Rep 2013;2013.
5. Dames EL, Ng LG, Tay KH. Congenital renal arteriovenous malformation presenting with gross hematuria after a routine jog: a case report. J Med Case Rep 2014;8:65.
6. Sountoulides P, Zachos I, Paschalidis K, Asouhidou I, Fotiadou A, Bantis A, et al. Massivehematuria due to a congenital renal arteriovenous malformation mimicking a renal pelvis tumor: a case report. J Med Case Rep 2008;2:144.
7. Nassiri N, Dudiy Y, Carroccio A, Rosen RJ. Transarterial treatment of congenital renal arteriovenous fistulas. J Vasc Surg 2013;58: 1310-15.
8. Zhang B, Jiang ZB, Huang MS, Zhu KS, Guan SH, Shan H. The role of transarterial embolization in the management of hematuria secondary to congenital renal arteriovenous malformations. Urol Int 2013;91:285-90.
9. Chimpiri AR, Natarajan B. Renal vascular lesions: diagnosis and endovascular management. Seminars in interventional radiology 2009;26: 253-61.
10. Cho KJ, Stanley JC. Non-neoplastic congenital and acquired renal arteriovenous malformations and fistulas. Radiology 1978;129:333-43.
11. Rizk GK, Atallah NK, Bridi GI. Renal arteriovenous fistula treated by catheter embolization. Br J Radiol 1973;46:222-4.
12. Eom HJ, Shin JH, Cho YJ, Nam DH, Ko GY, Yoon HK. Transarterial embolisation of renal arteriovenous malformation: safety and efficacy in 24 patients with follow-up. Clin Radiol 2015; 70:1177-84.
13. Sasaki N, Joashi UC, Vergara M, Saland JM, Love BA. Postrenal biopsy AVM leading to severe hypertension and dilated cardiomyopathy. Pediatr Nephrol 2009;24:2459-62.
14. Ozdemir S, Cekirge S, Kara A, Bakkaloglu A. A rare complication of renal biopsy in a child with membranoproliferative glomerulonephritis. Int Urol Nephrol 1998;30:689-92.
15. McDonald P. Arterio-venous fistulae following percutaneous renal biopsy. Australas Radiol 1966;10:124-6.