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Case Report

Pseudoaneurysm of the lower pole segmental artery of the kidney following open nephrolithotomy using an avascular approach: a case report

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Abstract: Aneurysms are abnormalities in blood vessels that can be categorized as true aneurysms or pseudoaneurysms. Pseudoaneurysms occur when one or more layers of the blood vessel wall rupture, often as a result of trauma or medical procedures, such as nephrolithotomy. This case study discusses a pseudoaneurysm of the lower pole segmental artery of the kidney that developed after an open nephrolithotomy despite an avascular surgical plan. The patient experienced intermittent gross hematuria, highlighting the potential complications associated with renal surgeries. The diagnosis was challenging, necessitating a high suspicion index and imaging modalities such as ultrasound, CT scans, and angiography. Treatment options varied from conservative management to angioembolization, which is preferred for its minimally invasive nature and ability to preserve renal parenchyma. This study aims to demonstrate that the risk of pseudoaneurysm should be considered even in an atrophic nephrolithotomy performed without vascular invasion.

Keywords: Pseudoaneurysm, segmental artery, renal artery, kidney, open nephrolithotomy, angioembolization

Introduction

An aneurysm is a condition that often occurs due to diseases or trauma to the vessel wall. It can be categorized into two types: true aneurysms and pseudoaneurysms [1]. A pseudoaneurysm results from the rupture of one or more layers of the vascular wall, while an abnormal dilation of the lumen of blood vessels characterizes a true aneurysm. The critical difference between a pseudoaneurysm and a true aneurysm is that a true aneurysm involves all three layers of the vessel wall. In contrast, a pseudoaneurysm encompasses fewer than three layers and often does not involve any vascular layers, surrounded by the surrounding fascia [2].

Pseudoaneurysm is a rare complication that may occur following penetrating trauma, kidney biopsy, percutaneous procedures, partial nephrectomy, and, less commonly, blunt trauma [1, 3]. Trauma or iatrogenic injuries are the most common cause of pseudoaneurysms [1]. The incidence of pseudoaneurysms after minimally invasive and percutaneous surgeries is higher than after open surgeries [3]. In the avascular technique, also known as anatrophic nephrolithotomy, the renal artery and vein are identified, and the boundary of the segmental artery is delineated by occluding the posterior arterial branches and injecting methylene blue. Subsequently, the kidney is incised along the avascular plane that has been outlined. The stone is then removed, and the collecting system is closed afterward. Thus, this technique significantly reduces the likelihood of vascular injury and the formation of pseudoaneurysms [4, 5]. Clinical manifestations can range widely from asymptomatic cases to hemorrhagic shock [6], typically presenting within two weeks post-procedure, with hematuria being the most common symptom [7, 8].

Diagnosing pseudoaneurysms can be challenging and often requires strong clinical suspicion [1]. Diagnostic methods include noninvasive

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Figure 1. Abdominopelvic CT scan without contrast demonstrating renal staghorn calculus in left kidney.

techniques such as ultrasound, CT scans, and MRI, and invasive methods like angiography. Treatment options for pseudoaneurysms include conservative management, observation, noninvasive interventions, and surgical approaches such as nephrectomy. Angioembolization, a minimally invasive procedure, is the preferred treatment for pseudoaneurysms as it preserves renal parenchyma [1, 6].

In this particular case study, a pseudoaneurysm of the lower pole segmental artery of the kidney developed following an open nephrolithotomy despite the surgery being performed with an avascular approach. This resulted in intermittent gross hematuria in the patient. In a particular case study, a segmental renal artery pseudoaneurysm developed following an open nephrolithotomy despite the surgery being performed with an avascular plan. This resulted in intermittent gross hematuria in the patient.

Case presentation

A 49-year-old male patient with a history of hypertension presented with vague left flank pain. He underwent a non-contrast CT scan of the abdomen and pelvis, which revealed left renal staghorn calculus (**Figure 1**). The patient subsequently underwent open nephrolithotomy, and a double-J stent was placed. The following day, the patient experienced severe oxygen desaturation, with saturation dropping to 80%. Given the strong clinical suspicion of pulmonary thromboembolism (PTE) and the inability to transport the patient for imaging, high-dose therapeutic heparin was administered. Seventy-two hours later, the patient's condition improved significantly, with stable vital signs and oxygen saturation of 98%, allowing for discharge on apixaban.

Two days later, the patient was readmitted due to gross hematuria accompanied by a hematoma. He had also experienced a drop in hemoglobin due to bleeding. A hematoma was drained via catheterization, and packed red blood cells were transfused due to acute anemia. Three days later, considering the improvement in the patient's hemoglobin levels, the resolution of hematuria, and the stability of the patient's vital signs, the patient was discharged. Given that the patient had received anticoagulant therapy and there was no bleeding during the surgery, which was performed using an anatrophic technique, these complications were believed to be related to anticoagulants. There was no suspicion of a pseudoaneurysm. Therefore, after addressing the issues above and ensuring no ongoing bleeding, the patient was discharged confidently.

Twenty-four hours later, the patient returned with tachycardia, fever, and gross hematuria, leading to readmission and conservative management. An abdominopelvic CT scan revealed a sizeable retroperitoneal hematoma extending to the pelvic region, as well as a dropped double-J stent (**Figure 2**). The patient underwent double-J stent revision and hematoma drainage before being transferred to the ICU. After stabilization, he was moved back to the ward. However, one day later, in the ICU, he developed clot retention; a CT scan showed significant clot accumulation in the bladder, which was subsequently drained - approximately two liters of clots were evacuated with open surgery - after which he was again transferred to the ICU.

The following day, the patient exhibited elevated creatinine levels and decreased urine output. A CT scan indicated bilateral hydroureteronephrosis (**Figure 3**). Cystoscopy and ureteros-

Figure 2. Abdominopelvic CT scan without contrast showing dropped DJ stent, and retroperitoneal hematoma extending to the pelvic region.

copy were performed, revealing clots that had refluxed from the bladder into the ureters. The clots were evacuated, and double-J stents were placed in the ureters. Twenty-four hours later, the patient's creatinine levels normalized (Cr = 0.8), allowing for transfer back to the ward.

Twenty-four hours later, the patient experienced hypovolemic shock and severe gross hematuria. Following resuscitation and stabilization, an urgent interventional radiology consultation was requested to evaluate for pseudoaneurysm, fistula, or bleeding vessels. The patient underwent angiography, which identified a pseudoaneurysm of the segmental artery of the lower pole of the left kidney (**Figure 4**); successful embolization was performed (**Figure 5**).

The next day, the patient developed a high-grade fever that did not respond to broad-spectrum intravenous antibiotics. Additionally, he presented with swelling, erythema, and warmth in the left flank area. An abdominopelvic CT scan without contrast revealed extensive retroperitoneal hematoma on the left side, extending into the anterior pararenal space and pelvic cavity. The patient underwent open surgery via flank approach, during which a significant amount of organized clot along with purulent discharge was evacuated. The area was thoroughly irrigated with saline and gentamicin. The patient received antibiotic treatment and was discharged after one week in good general condition, with resolution of fever and intermittent hematuria and stabilization of hemoglobin levels.

Four weeks later, a follow-up CT scan was performed (**Figure 6**), and the double-J stent was removed. No recurrence was observed, and the patient's condition was completely normal.

Discussion

Today, thanks to various endourologic techniques, open nephrolithotomy surgery is rarely the first choice for kidney stone removal. While ureteroscopy (URS) and laparoscopic surgery are considered present-day methods for removing staghorn stones, percutaneous nephrolithotomy (PCNL) is still preferred over these procedures [9]. However, in some instances, such as with our patient with morbid obesity and anatomical abnormalities, open nephrolithotomy was the preferred method to remove the stone [10].

Interventional treatments for kidney stones can lead to various complications, from kidney damage to extrarenal complications such as fever, infection, cardiovascular problems, bleeding, and renal artery pseudoaneurysm (RAP) [11-13]. To our knowledge, the only hitherto published case of RAP following surgical nephrolithotomy belongs to the Boutakioute et al. study [6]. Surprisingly, our case had an unusual occurrence of a pseudoaneurysm of the lower pole segmental artery of the kidney after open nephrolithotomy, even though we had planned for avascular surgery and encountered no vascular invasion or bleeding during the operation.

Pseudoaneurysm of the renal arteries is a renovascular severe injury that can occur after trauma, renal biopsy, or urinary system interventions. It can vary from asymptomatic to rupture-related phenomena, with hematuria being the most associated symptom. Timely and accurate diagnosis is crucial for proper treatment and preserving renal function. Noninvasive and invasive imaging modalities can be used to

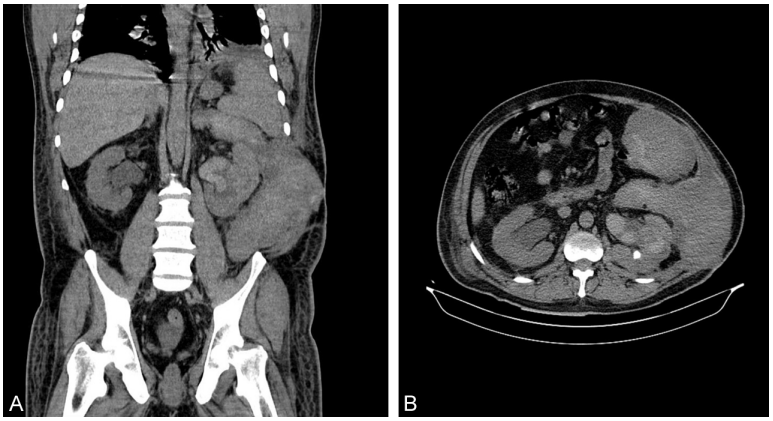

Figure 3. Abdominopelvic CT scan without contrast showing bilateral hydroureteronephrosis.

Figure 4. Angiography of the left renal artery, showing the pseudoaneurysm (Red arrow).

diagnose pseudourysms in the renal arteries. CT angiography is the preferred initial imaging modality for diagnosis and patient follow-up [14].

The management of pseudoaneurysm in the renal arteries depends on the patient's clinical profile. Observation and conservative management can be options for self-limited Pseudoaneurysms, while surgery or angioembolization are choices for symptomatic individuals. Angioembolization is preferred due to its significant success rates and less invasiveness. This technique is performed by using microcatheters inserted coaxially over a guide wire. According to the reports, the patient's vascular anatomy determines the embolization material; gel foam, resorbable particles, and liquids can be used [6, 8, 14, 15]. In our case study, Due to unavailable imaging services, a post-operative pulmonary consultation suggested a high suspicion of pulmonary thromboembolism (PTE) regarding the patient's clinical outline (dyspnea and depleted SpO2 to 80%, tachycardia (heart rate > 100/min), a history of recent surgery, etc.). Therefore, intravenous unfractionated heparin (UFH) was started on a therapeutic dose [16]. Thus, the diagnosis of RAP was postponed; she was reckoned as a PTE case and discharged on apixaban after the resolution of her symptoms. Subsequently, she was readmitted a couple of times, with several episodes of fever, tachycardia, gross hematuria, hypovolemic shock, urine reflux, and diminished urine output. On those occasions, the abdominal CT-scan images showed the development of retroperitoneal hematomas, and the lack of definite diagnosis led to symptomatic and conservative management administration; hematomas were drained via catheterization, urinary tract clots were removed by open surgery, and packed blood cells were transfused to resuscitate the patient. Afterward, an urgent CT angiography was requested to examine the blood vessels and their supplied organs, which confirmed the Left RAP. Following that, the segmental artery of the lower pole of the left kidney was embolized successfully. Considering that the incision was made along the Brodel line, where we have the least vascular supply to the kidney, and given that we did not experience any bleeding during the surgery, we did not anticipate the formation of a pseudoaneurysm. However, it is possible that, due to the macroscopic nature of the renal parenchyma repair, microvascular structures may have been damaged, subsequently leading to the development of a pseudoaneurysm in the patient. An underlying disease or inflammation (such as hypertension) could also be the primary etiology. Besides, the use of anticoagulant therapy may have been a trigger for pseudoaneurysm formation [17]. Further studies are needed to understand the association between

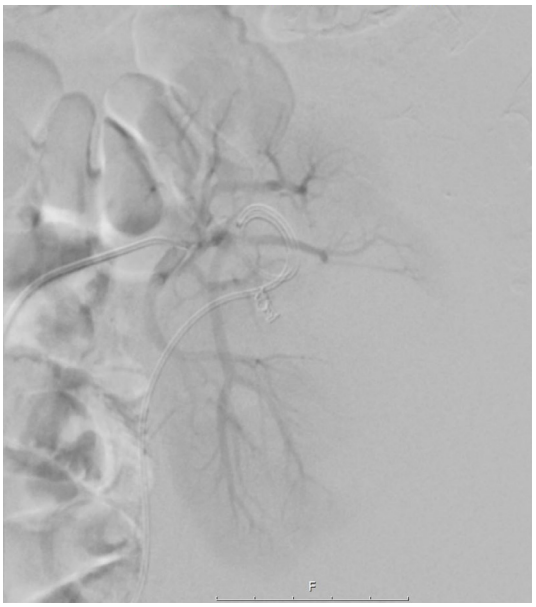

Figure 5. Angiography of the left renal artery after embolization, demonstrating complete exclusion of the pseudoaneurysm.

anticoagulant administration and pseudoaneurysm development.

Conclusion

Pseudoaneurysms of the renal artery are a significant but often overlooked complication following renal surgeries, incredibly open nephrolithotomy. This case demonstrates that even with careful surgical techniques aimed at minimizing vascular injury, pseudoaneurysms can still develop, leading to severe clinical manifestations such as gross hematuria. The complexity of diagnosing pseudoaneurysms emphasizes the necessity for heightened clinical vigilance and the utilization of advanced imaging techniques.

Disclosure of conflict of interest

None.

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References

[1] Roman LI, Efel CF, França VT, Merten CM and Dummer CD. Renal artery pseudoaneurysm. J Bras Nefrol 2017; 39: 458-461.

Figure 6. Follow-up abdominopelvic CT scan without contrast.

[2] Yamaçake KG, Lucon M, Lucon AM, Mesquita JL and Srougi M. Renal artery pseudoaneurysm after blunt renal trauma: report on three cases and review of the literature. Sao Paulo Med J 2013; 131: 356-362.
[3] Jain S, Nyirenda T, Yates J and Munver R. Incidence of renal artery pseudoaneurysm following open and minimally invasive partial nephrectomy: a systematic review and comparative analysis. J Urol 2013; 189: 1643-1648.
[4] Assimos DG. Anatrophic nephrolithotomy. Urology 2001; 57: 161-165.
[5] Bove AM, Altobelli E and Buscarini M. Indication to open anatrophic nephrolithotomy in the twenty-first century: a case report. Case Rep Urol 2012; 2012: 851020.
[6] Boutakioute B, Chehboun A, Ouali M and Ganouni NCIE. Embolization for the treatment of renal artery pseudoaneurysm following surgical nephrolithotomy: a case report. Radiol Case Rep 2022; 17: 4021-4024.
[7] Mavuduru RM, Mohd Ziauddin SA, Bora GS and Gorsi U. Renal artery pseudoaneurysm following robot assisted nephron sparing surgery: two case reports. J Med Case Rep 2024; 18: 191.
[8] Rami A, Kassimi M, Habi J, Guerroum H, Sabah MSZ, Belhaj K and Mahi M. Renal artery pseudoaneurysms post percutaneous nephrolithotomy: a case report. Radiol Case Rep 2022; 17: 891-893.
[9] Schulz AE, Green BW, Gupta K, Patel RD, Loloi J, Raskolnikov D, Watts KL and Small AC. Management of large kidney stones in the geriatric population. World J Urol 2023; 41: 981-992.

[10] El-Husseiny T and Buchholz N. The role of open stone surgery. Arab J Urol 2012; 10: 284-288.
[11] De Coninck V, Keller EX, Somani B, Giusti G, Proietti S, Rodriguez-Socarras M, Rodríguez-Monsalve M, Doizi S, Ventimiglia E and Traxer O. Complications of ureteroscopy: a complete overview. World J Urol 2020; 38: 2147-2166.
[12] Kyriazis I, Panagopoulos V, Kallidonis P, Özsoy M, Vasilas M and Liatsikos E. Complications in percutaneous nephrolithotomy. World J Urol 2015; 33: 1069-1077.
[13] Wagenius M, Jakobsson J, Stranne J and Linder A. Complications in extracorporeal shockwave lithotripsy: a cohort study. Scand J Urol 2017; 51: 407-413.
[14] Inci K, Cil B, Yazici S, Peynircioglu B, Tan B, Şahin A and Bilen CY. Renal artery pseudoaneurysm: complication of minimally invasive kidney surgery. J Endourol 2010; 24: 149-154.
[15] Singh B, Sudan D, Singh P and Kaul U. Intraarterial ethanol for the management of iatrogenic renal artery pseudoaneurysm. Cathet Cardiovasc Diagn 1998; 45: 442-444.
[16] Kearon C, Akl EA, Comerota AJ, Prandoni P, Bounameaux H, Goldhaber SZ, Nelson ME, Wells PS, Gould MK, Dentali F, Crowther M and Kahn SR. Antithrombotic therapy for VTE disease: antithrombotic therapy and prevention of thrombosis, 9th ed: American College of Chest Physicians evidence-based clinical practice guidelines. Chest 2012; 141 Suppl: e419S-e496S.
[17] Rivera PA and Dattilo JB. Pseudoaneurysm. StatPearls. StatPearls Publishing; 2024.