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Acute Renal Artery Embolism: A Case Report and Literature Review

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Abstract

Renal artery embolism (RAE) is a rare disease, and its clinical features and diagnostic tools are mysterious to most physicians. Anticoagulants, surgery, and thrombolytic therapies have been used to treat patients with RAE. However, there is no universal protocol for the proper management of RAE and the timing of treatment. This variation in treatment management further impairs the comparison of different therapies, complications and prognoses.

We reported a RAE patient who underwent intra-arterial urokinase treatment. A detailed literature search found that the most common presentations of RAE are localized pain in the flank/abdomen, nausea and vomiting, and fever. A few laboratory abnormalities, including elevations of lactic dehydrogenase, C-reactive protein, and white cell count, as well as unexplained proteinuria and hematuria, are useful screening tools for RAE. A contrast-enhanced computed tomographic scan of the abdomen is currently the best diagnostic tool. Anticoagulants are an effective and safe treatment, resulting in a fair prognosis for RAE cases. The rates of mortality and long-term hemodialysis are low. Surgery and intra-arterial thrombolytic therapy should be reserved in cases where the aggressive preservation of residual renal function is necessary in patients with deteriorated renal function or only one functional kidney. In addition, concurrent and subsequent thrombolytic events in other organs are common in patients with RAE.

Keywords: Renal infarction; Renal embolism; Anticoagulant; Prognosis; Diagnosis

Background

Renal artery embolism (RAE) is rarely detected in clinical practice. The clinical features, diagnostic tools, management, and outcome of this disorder remain mysterious to most physicians [1,2]. The rarity of this disease hampers the conduction of prospective randomized studies, and only a few retrospective case series could be found. These studies are scattered across a wide time span, and the diagnostic tools and treatments have differed over time [3-20]. In addition, the management of RAE depends greatly on the capability of a given hospital. Few centers are capable of performing emergent intravascular interventions [21,22]; other hospitals are capable of only surgical or pharmacologic therapies. Different methods of RAE management further impair the comparison of the benefits of different therapies.

Here we report our experience with a RAE patient and review the relevant previous literature. We hope to gain diagnostic insight into RAE and to provide a practical therapeutic guide for physicians.

Case Presentation

A 58-year-old male patient presented to the emergency department with abrupt onset left abdominal pain. The pain radiated to his back and was not accompanied with other symptoms such as vomiting, diarrhea, dysuria, or fever. The patient denied any systemic disease and had undergone one prior abdominal surgery for traumatic hemoperitoneum approximately 30 years ago. His vital signs upon arrival were: a temperature of 37°C, a pulse rate of 84/min, a respiratory rate of 17/min, and an arterial pressure of 122/88 mmHg. Physical examination revealed irregular heartbeats and a longitudinal surgical scar in the middle of the abdomen. Neither abdominal tenderness nor flank knocking pain was discovered.

Blood tests demonstrated leukocytosis (white cell count 18400/μL; normal range: 3200-9200/μL) and a mild elevation of serum creatinine (1.64 g/L; normal range: 0.72-1.2 g/L). Urine analysis showed moderate proteinuria (dipstick 2+) and microscopic hematuria (10-19 cell/high power field). Electrocardiography revealed atrial fibrillation. Roentgenograms of the chest and abdomen were unremarkable. Because of the unexplained abdominal pain and leukocytosis, the patient underwent a contrast-enhanced computed tomographic scan (CT) of the abdomen. These images demonstrated an unenhanced left kidney with a filling defect in the left renal artery, indicating left RAE (Figure 1).

Approximately 24 hours after the onset of the patient's abdominal pain, he underwent a renal arteriography and a single intra-arterial injection of urokinase (50000 units). Fourteen hours later, he underwent another diagnostic renal arteriography, which revealed the recanalization of the left renal artery. However, the renal parenchyma remained poorly enhanced (Figure 2).

The pain resided gradually, and the level of serum creatinine returned to a normal range 2 days later. Rivaroxaban (20 mg daily) was administered to prevent further thromboembolic events, and the patient was discharged 6 days after admission.

Literature Review

We used "renal infarction", "renal embolism", and "renal thromboembolism" as the key words to search the PubMed and Google Scholar databases for related literature published between 1960 and 2014, with the results restricted to those written in English. The abstracts were read and full articles were retrieved if they were thought to contain relevant information. The obtained articles were further searched for referenced studies. We selected studies for inclusion if they contained more than 5 cases and they provided results

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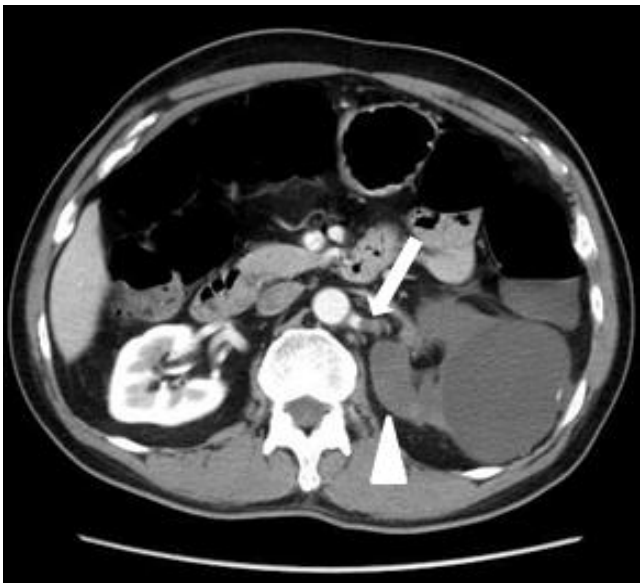


Figure 1: A contrast-enhanced computed tomographic scan of the abdomen. The arrow indicates a filling defect in the left renal artery, and the arrowhead shows the unenhanced left kidney.

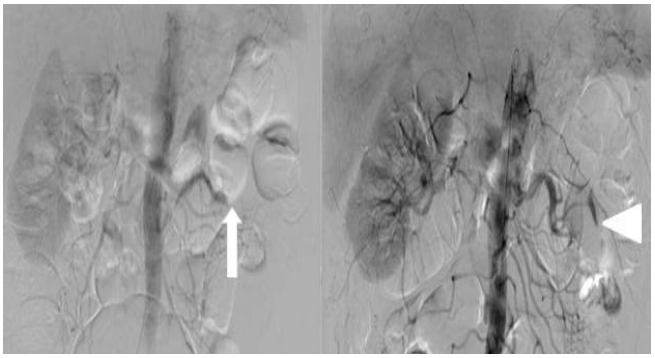


Figure 2: At left, renal angiography before urokinase treatment. The arrow indicates the filling defect in the left renal artery. At right, renal angiography after urolinase treatment. The arrow head shows the recanalization of the left renal artery; however, the left kidney remained unenhanced.

regarding symptoms, etiologies, risk factors, diagnosis, treatment, and the outcome of renal artery embolism. We collected data, including demographic characteristics (i.e., age, gender, and which side of the kidney was involved), presenting symptoms, concurrent diseases, a detailed history of risk factors for thromboembolism and previous thromboembolic events, laboratory tests, diagnostic tools, treatments, and outcomes. These were not recorded in every study, and the number of data points for each variable therefore differed. Two studies were designed for specific populations. Salam et al. [7] reported 10 cases of intra-arterial thrombolysis, and the study by Hazanov et al. [13] reported only patients with atrial fibrillation. Thus, the article by Hazanov et al. [13] was excluded from the analysis of risk factors for RAE. There were two studies from France and two studies from Taiwan [4,17,23,24]. The study cohorts were from the same hospitals, and part of the study periods overlapped. To avoid the overrepresentation of these patients, we chose the study that contained more cases [4,17].

Eighteen retrospective studies comprising data collected from 1963 to 2011 were reviewed in our analysis [3-20]. There were 277 male and 236 female patients who were an average age of 58.6 years old. The left side kidney was slightly more involved than the right side (left vs right: 169 vs 149), and bilateral renal involvement was discovered in 17.4% of all cases. Only 39.0% of the patients were diagnosed on the first day of admission (Table 1). The diagnostic tools employed for RAE varied in different studies. Contrast-enhanced CT of the abdomen was the most popular choice. In addition, histological examinations, isotope scan, angiography, and magnetic resonance imaging were reported in several papers. There were five studies that collected data after 1990 using contrast-enhanced CT of abdomen as the major diagnostic tool, which improved diagnostic accuracy. In four of the five studies, a diagnosis of RAE was established on the first day of admission in more than 50% of cases, and the overall rate of first day diagnosis in the five studies reached 56.7% [10,11,13,16,17].

The symptoms of renal artery embolism were usually non-specific, and the most common presentations were localized pain (89.4%), nausea/vomiting (43.8%), and fever (26.8%). A number of laboratory abnormalities were considered in relation to the occurrence of RAE, including elevations of serum lactated dehydrogenase (92.1%), C-reactive protein (75.4%), white cell count (72.3%), creatinine (42.7%), proteinuria (58.1%), and hematuria (53.2%) (Figure 3).

Fifty-nine percent of all reviewed cases exhibited risk factors for thromboembolism (i.e., atrial fibrillation, rheumatic heart disease, hypercoagulation, dilated cardiomyopathy, and endocarditis). Approximately one-sixth of all cases (16.5%) experienced thromboembolic episodes, and 14.4% of patients experienced at least one concurrent thromboembolic event involving other organs at the presentation of renal artery embolism.

Anticoagulants, including heparin, low-molecular-weight heparin and warfarin, constituted the majority of treatments for RAE (82.2%). Intra-arterial thrombolytic therapy, systemic thrombolytic therapy, and surgery were also treatment options. Nevertheless, the time interval from symptom onset to the initiation of therapy varied among studies. The evaluation of the recovery of renal function was also different between studies. It is difficult to compare the therapeutic effects of various treatment modalities (Figure 4).

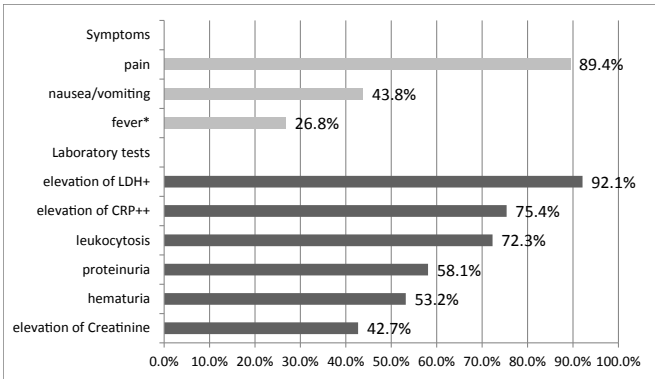
We discovered complications during the hospital stay in 12.0% of patients, including thromboembolic events in other organs, sepsis, gastrointestinal bleeding, and hepatitis. Long-term hemodialysis was indicated in 5.9% of all cases. The mortality rate of RAE was 7.6%, and most deaths were caused by subsequent thromboembolic events in other organs, such as cerebral infarction, myocardial infarction, pulmonary embolism, and infarctions to intra-abdominal organs. Other rarer causes of death were sepsis, malignancy, aortic dissection, and post-operative complications.

Discussion

The incidence of RAE is low, and the presenting symptoms are non-specific. A study conducted in Israel estimated that the incidence of RAE was 0.007% among hospitalized patients and that all cases were missed initially [11]. A number of diseases, including renal colic, pyelonephritis, renal carcinoma, acute abdomen, endocarditis, and digitalis intoxication, had been misdiagnosed in the first presentation of RAE [6,11,13]. We found that more than 60% of patients were misdiagnosed upon first presentation, indicating that the emergency physicians need better criteria for differentiating this rare disease from numerous more common diseases.

Female/Male	236/277
Age	58.6 years old
Left/Right	169/149
Bilateral renal involvement	17.4%
Concurrent thromboembolic events	14.4%
Diagnosis in the first day of admission	39.0%
Complication rate	12.0%
Mortality rate	7.6%
Rate of long-term hemodialysis	5.9%

Table 1: Characteristics and outcome of the study population.



*Temperature > 37.5°C
+Lactated dehydrogenase ++C-reactive protein

Figure 3: Common symptoms and laboratory abnormalities of renal artery embolism.

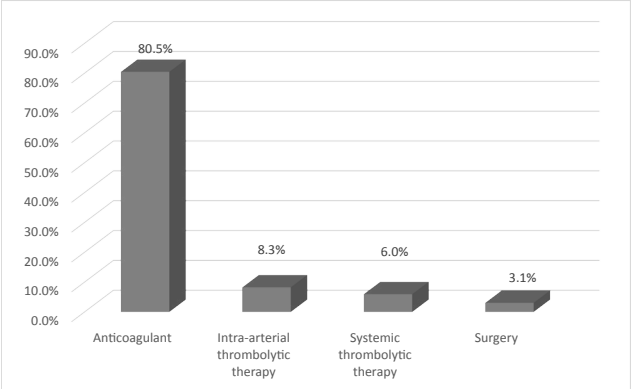


Figure 4: Treatment for renal artery embolism.

First, emergency physicians should establish an index of suspicion for RAE in patients presenting with localized pain (flank/abdomen), nausea/vomiting, and fever. We suggest using laboratory tests such as elevations of lactic dehydrogenase, C-reactive protein, white cell count and unexplained proteinuria and hematuria to screen suspected patients, especially those at risk for thromboembolism (i.e., atrial fibrillation, rheumatoid heart disease, hypercoagulant state, dilated cardiomyopathy, and endocarditis) [2,3,8,13,17,18]. Imaging studies are imperative to diagnosis RAE. Ultrasound is known to be inaccurate for the diagnosis of RAE. However, it is non-invasive imaging can identify other diseases with similar clinical features of RAE [6,11]. Isotope scanning, magnetic resonance imaging, and angiography are all practical diagnostic tools. Nevertheless, these imaging studies are not available around the clock in most institutions, which limits the timely diagnosis of RAE in the emergency department. Contrast-enhanced CT of the abdomen is currently the most useful diagnostic imaging technique. Wong et al. [4] have proposed few CT criteria for diagnosing RAE. For example, a wedge-shaped or a global area of low attenuation, cortical rim signal, renal mass effect, subcapsular fluid collection, and perirenal facial thickening [12]. We recommended the liberal use of contrast-enhanced CT of the abdomen in patients with typical presentation, unexplained abnormalities on serum tests and urine analysis, and a history or risk of thromboembolic events. Early diagnosis of RAE with contrast-enhanced CT facilitates the initiation of adequate treatment and may improve the outcome of RAE. Additionally, some RAE patients present with concurrent thromboembolic events in other intra-abdominal organs. CT images provide valuable details for diagnosing other involved organs.

In humans, ischemia for 4 hours can cause irreversible renal damage [6]. However, in clinical practice, it is extremely difficult to diagnose and to begin treatment for RAE within such a short interval. Fortunately, human kidneys receive collateral circulation from the suprarenal, inferior phrenic, lumbar, genital and ureteric arteries and from the perirenal arterial circle [6,25]. The low collateral flow from these sources are inadequate to ensure normal renal function. However, the viability of the kidney can be maintained for a longer period. Furthermore, occlusions of renal arteries can be partial and progressive, and it is impossible to estimate the exact time of total renal infarction. Therefore, Lacombe proposed that neither the elapsed time since the onset of obstruction nor the arrest of renal function can predict the complete infarction of the kidneys [5].

Anticoagulants comprise the majority of treatments for RAE patients. This form of management is effective, safe, and accompanied by minimal side effects. In most reported cases, the renal outcomes associated with RAE remain favorable, and the serum creatinine level returned to a normal value within 2 days of anticoagulant treatment [2,8,17]. Moreover, it is common to discover concomitant and subsequent thromboembolic events during hospitalization for RAE. Anticoagulant treatment provides additional benefits when treating or avoiding these complications.

Intra-arterial thrombolytic therapy has been applied to treat RAE. Based on angiographic images, thrombolytic therapy demonstrated a better chance of patency in cases of RAE than anticoagulants [7,21,22]. However, when compared to anticoagulants, the overall improvement of renal function, morbidity and mortality of RAE patients is not prominent [6,14,17]. Moreover, patients who underwent intra-arterial thrombolytic therapy carry an additional risk of invasive arterial therapy and contrast medium related nephrotoxicity. We suggest that intra-arterial thrombolytic therapy should be reserved in cases where the aggressive preservation of residual renal function is necessary in patients with deteriorated renal function or only one functional kidney.

Surgical embolectomy or revascularization has been proposed as a renal salvage therapy [5,6,24,26,27]. Lacombe [26] and Nicholas [27] have reported a case series of RAE treated with surgical intervention. However, the mortality rate of surgery was approximately 11-25%, which is higher than anticoagulant or intra-arterial thrombolytic therapy [5,26,27]. The overall kidney salvage rates and improvements of renal function in surgically treated RAE patients were not better than those of RAE patients who underwent medical treatment only [5,27]. Accordingly, surgical treatment may be conducted in patients with deteriorated renal function or a solitary functional kidney, and

when the admitted hospital cannot perform intra-arterial thrombolytic therapy, or in patients who require simultaneous arterial surgery, such as for the repair of aortic dissection.

Emergency physicians should maintain a high index of suspicion for RAE, especially in patients with typical presentations, unexplained abnormalities in serum test results and urine analysis, and a history or risk of thromboembolic events. Contrast-enhanced CT is currently the best diagnostic tool for RAE. Treatment with an anticoagulant is suitable for most RAE patients and provides a favorable renal outcome. Revascularization with intra-arterial thrombolytic therapy or surgery should be reserved for patients with deteriorated renal function or a solitary functional kidney.

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