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Evaluation of Clinical and Radiological Findings in Patients Diagnosed with Acute Renal Infarction, Descriptive Research, Case Series

Akut Böbrek Enfarktüsü: Etiyoloji, Risk Faktörleri, Tedavi ve Uzun Dönem Takip Sonuçları ,Tanımlayıcı Araştırma, Olgu Serisi

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ABSTRACT Objective: Renal infarction is a rare and significant clinical condition caused by renal artery occlusion, which can lead to permanent renal parenchymal damage. This study aimed to present the demographic data, etiologies, and early and long-term treatment outcomes of patients diagnosed with renal infarction. **Material and Methods:** The medical records of patients who presented to our clinic with acute renal infarction between January 2021-2024 were retrospectively reviewed. In this study, the patients' demographic information, laboratory results, tests conducted for etiological evaluation, treatments administered, and clinical status during follow-up were obtained from hospital databases and analyzed statistically. Approval was obtained from the Van Yüzüncü Yıl Ethics Committee University Non-Interventional Clinical Research Ethics Committee (date: February 4, 2025; no: 2025/01-13). Our study was conducted in accordance with the principles of the Declaration of Helsinki. Obedient. **Results:** Total of 20 patients were included in the study. The mean age was 64.3±11.3 years. Two patients (10%) had diabetes mellitus, 12 patients (60%) had hypertension, and 4 patients (20%) had atrial fibrillation. Right renal infarction was observed in 10 patients (50%), left renal infarction in 8 patients (40%), and bilateral renal infarction in 2 patients (10%). Etiological investigations revealed the following: a genetic anomaly causing thrombosis in 1 patient (10%), trauma was identified in 1 patient (10%), a hematological disease in 1 patient (10%), and no identifiable etiology in 1 patient (10%). The mean follow-up period was 10 months. The mean creatinine and glomerular filtration rate (GFR) values at 3 months were 1.33 mg/dL and 65 mL/min, respectively. The final mean creatinine and GFR values were 1.1 mg/dL and 68 mL/min, respectively. The mean serum lactate dehydrogenase level at admission was 1,049 U/L. All patients received anticoagulant therapy in the early period. Renal angiography and percutaneous transluminal angioplasty (PTA) were performed at admission in 8 patients (40%) with total renal infarction. After discharge, all patients continued anticoagulant therapy for at least 6 months. During the 10-month follow-up, chronic kidney disease developed in 2 patients (10%). Among the 8 patients (40%) who were diagnosed early and underwent PTA and thrombectomy by interventional radiology, renal function improved in 6 patients (75%), while atrophy of the kidney was observed in 2 patients (25%) whose renal arteries could not be reopened. Among the 12 patients who were treated only with long-term anticoagulant therapy, renal function was preserved in half of them. **Conclusion:** Early diagnosis, early interventional intervention, and anticoagulant therapy significantly reduce kidney function loss.

Keywords: Acute kidney injury; renal infarction; thrombosis

ÖZET Amaç: Renal enfarktüs, renal arter okluzyonunun neden olduğu ve kalıcı renal parankim hasarına yol açabilen önemli bir klinik durumdur. Bu çalışmada, renal enfarktüsü tanısı alan hastaların demografik verilerini, etiyolojilerini, erken ve uzun dönem tedavi sonuçlarının sunulması amaçlandı. **Gereç ve Yöntemler:** Ocak 2021-2024 tarihleri arasında akut böbrek enfarktüsü nedeniyle kliniğimize başvuran hastaların dosyaları retrospektif olarak taranmıştır. Çalışmada, hastaların demografik bilgileri, laboratuvar sonuçları, etiyolojik değerlendirme amacıyla yapılan testler, uygulanan tedaviler ve takip süreçlerindeki klinik durumları hastane veri tabanlarından elde edilmiş ve istatistiksel analizlerle değerlendirilmiştir. Çalışmamız Van Yüzüncü Yıl Üniversitesi Girişimsel Olmayan Klinik Araştırmalar Etik Kurulundan onay alınmıştır. (tarih: 4 Şubat 2025; no: 2025/01-13). Çalışmamız Helsinki Deklarasyonu prensiplerine uygun olarak yapılmıştır. **Bulgular:** 20 hasta çalışmaya dâhil edildi. Ortalama yaş 64,3±11,3. İki (%10) hasta diyabet, 12 (%60) hasta hipertansiyon, 4 (%20) hasta atriyal fibrilasyon hastasıydı. On (%50) hastada sağ böbrek enfarktüsü, 8 hastada (%40) sol böbrek enfarktüsü ve 2 (%10) hastada bilateral böbrek enfarktüsü vardı. Etiyolojiler için yapılan incelemelerde şunlar tespit edilmiştir: 1 (%10) hastada tromboza yol açan genetik anomali, 1 (%10) hastada travma, 1 (%10) hastada hematolojik hastalık ve 1 (%10) hastada etiyolojik neden saptanmadı. Ortalama takip süresi 10 aydı. Ortalama kreatinin ve glomerüler filtrasyon hızı [glomerular filtration rate (GFR)] değerleri üçüncü ayda sırasıyla 1,33 mg/dl ve 65 ml/dk olarak bulunmuştur. Son ortalama kreatinin ve GFR değerleri sırasıyla 1,1 mg/dl ve 68 ml/dk olarak bulundu. Başvuru sırasındaki ortalama serum laktat dehidrogenaz 1.049 (U/l) bulundu. Tüm hastalara erken dönemde antikoagülan tedavi başlatıldı. Total renal enfarktüs bulunan 8 (%40) hastaya, başvuru sırasında renal anjiyografi ve perkütan translüminal anjiyoplasti (PTA) uygulandı. Hastalar taburcu edildikten sonra en az 6 ay boyunca antikoagülan tedaviye devam edildi. Ortalama 10 aylık takip süresince hastaların %10'unda (2 hasta) kronik böbrek hastalığı gelişti. Erken tanı alıp girişimsel radyoloji tarafından PTA ve trombektomi yapılan 8 (%40) hastanın 6'sında (%75) böbrek fonksiyonları daha iyiye doğru giderken, renal arteri açılamayan 2 (%25) hastanın böbreği atrofiye gitmiştir. Sadece uzun dönem antikoagülan tedavi verilen 12 hastamızın yarısında böbrek fonksiyonların korunduğu görüldü. **Sonuç:** Erken tanı, erken girişimsel müdahale, antikoagülan tedavi böbrek fonksiyon kaybını önemli ölçüde azaltmaktadır.

Anahtar Kelimeler: Akut böbrek hasarı; renal enfarktüs; tromboz

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Renal infarction is a serious clinical event that causes irreversible kidney damage due to renal artery embolism. In the literature, the incidence of renal infarction is 0.007%, which is quite low.[1] Delayed diagnosis is common in renal infarction because it is a rare condition. While the average age of onset is typically above 40 years, it may vary depending on the underlying etiology. It often starts with pain in the flank region and most patients also have malaise, fatigue, fever, vomiting and sudden onset of hypertension. Laboratory data show that the majority of patients exhibit severe elevations in blood urea/creatinine and lactate dehydrogenase (LDH) levels.[2] Contrast-enhanced computed tomography (CT) is used radiologically to diagnose renal infarction. Contrast CT shows the presence of a wedge-shaped hypodense lesion in the peripheral area. The most common causes of renal infarctions fall into 3 main etiological categories: Cardio vascular diseases renal trauma and coagulation disorders.[3] However, there is also a group of renal infarctions whose etiology cannot be classified into these 3 categories. Cardioembolic diseases are the most common etiological cause of renal infarctions, with a large portion of this group being atrial fibrillation. In many previous studies, an association between renal infractus and systemic arthritis involving the vessels such as Behçet's disease, Takayasu's disease and infectious diseases such as syphilis has been reported.[2,3] In 1956, the first case of renal infractus was reported. Since then, a small number of case studies have been reported.[2-4] the aim of this study was to demonstrate the demographic and clinical characteristics, aetiology, early and long-term treatment results of patients diagnosed with renal infarction.

MATERIAL AND METHODS

The data of patients admitted to our clinic with acute renal infarction between January 2021-2024 were retrospectively reviewed. Based on these data, patients with renal infarction diagnosed on the basis of clinical findings, imaging methods and laboratory data were included in this study. Patients for whom sufficient data could not be obtained, who were unable to undergo contrast-enhanced CT, or who did not comply with follow-up treatment were excluded. Acute renal infarction was diagnosed by flank pain, elevated serum LDH levels and partial or complete absence of renal blood flow on contrast-enhanced CT. Acute kidney injury diagnosis was made according to the Kidney Disease: Improving Global Outcomes (KDIGO) 2012 criteria (based solely on changes in creatinine, either 2 or 7 days after). The patients' age, gender, comorbidities such as diabetes, hypertension, coronary artery disease, rheumatologic diseases, as well as the localization, side, and size of the infarction, were recorded. Laboratory data at the time of admission (creatinine, LDH, etc.) were obtained. Cardiac evaluation was performed by a cardiology specialist using echocardiography and electrocardiogram. Immunological tests, including antinuclear antibody, anti-dsDNA, C3, C4, and anticardiolipin antibodies, were conducted, and all patients underwent hematologic evaluation (protein C, protein S, antithrombin 3, homocysteine, activated protein C resistance) and genetic evaluation [methylenetetrahydrofolate reductase (MTHFR) mutation, Factor V Leiden mutation, etc.]. The etiology of renal infrastructure in these cases was investigated in detail on the basis of patient history and clinical data. The medications prescribed at the time of diagnosis and after discharge (low-molecular-weight heparin, thrombolytic therapy, heparin, etc.), average hospital stay duration, kidney function during follow-up (dialysis requirements, creatinine and estimated glomerular filtration rate (eGFR) values at the 3rd month and at the end of the average follow-up period), and treatment outcomes were evaluated. This study was accepted by the Van Yüzüncü Yıl Ethics Committee University Non-Interventional Clinical Research Ethics Committee (date: February 4, 2025; no: 2025/01-13) and this study was conducted in accordance with the Helsinki Declaration criteria.

RESULTS

20 patients were enrolled in this study. In the Table 1, the clinical and demographic data of the cases are briefly described. Majority of patients (90%) come to clinic with severe side pain, nausea, and vomiting. A diagnosis was made based on clinical findings and the infarction areas observed in the computed tomography. As shown in the table, the majority of the

TABLE 1

Parameter	Value
Number of patients	20
Age (years), mean	64.3±11.3 (30-88)
Gender (male/female)	8/12
DM, n (%)	2 (10%)
HT, n (%)	12 (60%)
Kidney infarction localization, n	Right: 10 (50%) Left: 8 (40%) Bilateral: 2 (10%)
Admission serum creatinine (mg/dl) Mean	1.42±0.1
Admission eGFR (ml/min) Mean	65±3.1
AKI rate, n (%)	10 (50%)
Acute dialysis requirement	0
Mean serum LDH (U/l)	1.049
Mean length of hospital stay (days)	6.6
Etiology of patients, n (%)	Atrial fibrillation: 4 (20%) Genetic anomalies: 2 (10%) Trauma: 2 (10%) ITP: 2 (10%) CVD: 2 (10%) CVD: 12 (60%) Idiopathic: 2 (10%)

DM: Diabetes mellitus; HT: Hypertension; eGFR: Estimated glomerular filtration rate; AKI: Acute kidney injury; LDH: Lactate dehydrogenase; ITP: Immune thrombocytopenic purpuras; CVD: Cardiovascular disease

patients had at least 1 cardiovascular disease (CVD). Hypertension and atrial fibrillation were the most common cardiovascular diseases. Both the right and left kidneys were affected in a similar proportion. Additionally, in the majority of patients, only one kidney was affected. Total renal infarction was present in 8 (40%) patients, and partial infarction was found in 12 (60%) patients.

At the time of admission, there was a mild increase in average serum creatinine levels and a mild decrease in eGFR values. Additionally, the average serum LDH level at presentation was found to be quite high. All patients were admitted for inpatient treatment, and early anticoagulant therapy was initiated. Eight patients (40%) with total renal infarction underwent renal angiography and percutaneous transluminal angioplasty (PTA) at the time of admission. After discharge, anticoagulant therapy was continued for at least 6 months (Table 2).

The average hospital stay was 6.6 days. Upon discharge, Warfarin was initiated, consistent with previous literature warfarin was prescribed to 4 patients diagnosed with atrial fibrillation, who had a history of previous warfarin use, and low-molecular-weight heparin was prescribed to 16 patients.[7] The average follow-up duration was 10 months. During the average 10-month follow-up, chronic kidney disease (CKD) developed in 10% of the patients (2 patients). Bilateral renal infractus was present in these 2 patients who developed CKD. Upon reviewing the etiology of the patients who developed CKD, it was found that they had CVDs. The patient who developed CKD could not return to baseline kidney function; however, routine dialysis was not required. Additionally, among the 8 patients (40%) who received early diagnosis and underwent PTA and thrombectomy by interventional radiology, 6 (75%) showed improvement in kidney function, while 2 (25%) patients, whose renal arteries could not be opened, experienced renal atrophy. A dimercapto succinic acid (DMSA) renal scintigraphy of this patient showed that the kidney was nonfunctional. In the Doppler ultrasound results of the 6 patients whose arteries were reopened after thrombectomy, the kidney size, echogenicity, and blood flow were within normal limits. DMSA renal scintigraphy showed no significant loss of function in the treated kidneys. In this study, the combination of interventional procedures and long-term anticoagulant therapy yielded a complete success rate of 75%. In the 12 patients who received only long-term anticoagulant therapy, Doppler ultrasound during follow-up showed decreased blood flow, reduced kidney size, and increased echogenicity in the affected kidneys of 6 patients. DMSA renal scintigraphy in these patients revealed that kidney function was less than 15% in 4

TABLE 2

Parameter	PTA+anticoagulation patients, (n=8)	Anticoagulation only patients, (n=12)
Dialysis requirement	0	0
Number of patients with AKI	0	2
Number of patients with recurrent renal infarction	0	0
Average creatinine value at admission (mg/dl)	1.51	1.36
Average creatinine value at discharge (mg/dl)	1.24	1.40
Average creatinine value at 6 months (mg/dl)	0.99	1.09

PTA: Percutaneous transluminal angioplasty; AKI: Acute kidney injury

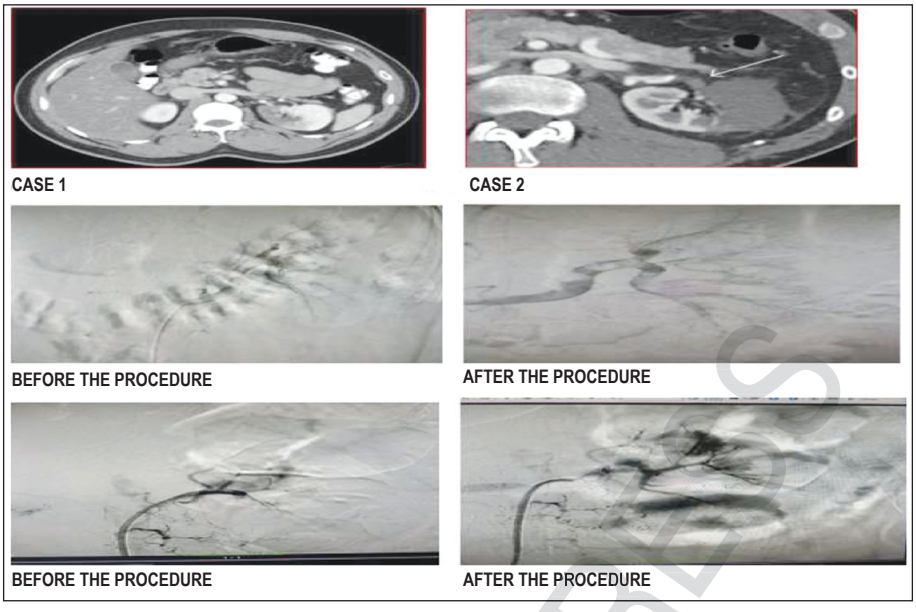

FIGURE 1: The pre- and post-intervention imaging findings of our patients who underwent PTA and Initial diagnostic images

kidneys and 30% in 2 kidneys. Among the patients who received only long-term anticoagulant therapy, a success rate of 50% was observed.

DISCUSSION

Renal infractus is not a common condition. One reason for the low incidence is that renal infractus does not produce clinical signs that are very distinctive from other clinical conditions.[4] Since it shares similar symptoms and signs with more common conditions like urolithiasis, musculoskeletal pains, disc herniation or acute abdominal pains, it is not initially considered during differential diagnosis.[5] Previous studies have shown that the most common cause of renal infarction is cardiologic-embolic diseases.[6] In our study, most patients had at least 1 cardiovascular disease, and many presented with symptoms primarily indicative of urinary tract stone disease, such as flank pain, nausea, and vomiting. Initially, these patients were assessed based on this pre-diagnosis. Upon physical examination and imaging, no pathologies like kidney-ureteral stones or lumbalgia were found. The diagnosis was confirmed with contrast-enhanced CT or renal Doppler ultrasound, considering the possibility of acute renal infarction.

In various retrospective studies, about 20% of patients had bilateral renal infarction.[6,7] Patients with renal infarction are at risk for acute kidney failure and the development of CKD in the long term. This risk is even greater in those with bilateral infarction. Reported studies show that more than 30% of patients with acute renal infarction have acute kidney failure at the time of diagnosis, and the development of CKD in the long term is reported to be around 20%.[6,7] Acute renal failure was seen in half of the patients in our study, and CKD was seen in 20% of our patients who developed bilateral infarction. The relatively small number of patients in our study might influence this result; however, since a significant portion of the patients received early renal angiography and PTA combined with anticoagulant therapy, we believe that the development of CKD was significantly reduced.

Renal infractus usually affects middle-aged and elderly patients with atrial fibrillation and chronic cardiovascular disorders.[6,8] In our study, 60% of patients had hypertension, and 20% had atrial fibrillation. If atrial fibrillation is present in patients with renal infractus, the patient should be evaluated by echocardiography. Thus assessing whether thrombus are present in the atrial cavities or on the heart valves. Our patients were evaluated with echocardiography, and no thrombus was detected in the heart. In cases of renal infractus with a diagnosis of atrial fibrillation, investigation of other etiological causes may not be

necessary. However, further evaluation may be required in cases with clinical findings other than atrial fibrillation. In this study, further evaluation was required in very few of our patients with atrial fibrillation.

Case reports of renal infractus secondary to blunt renal trauma have been reported, but the incidence is unclear. In a study, renal trauma was accused as the etiological cause in 9% of patients with renal infractus.[3] This proportion is similar to our study. In our study, blunt renal trauma was found to be the etiological factor in only 1 patient (10%). Infarctions due to trauma may be unilateral or bilateral, depending on the size and location of the injury. In our study, renal infarction due to trauma was unilateral in all patients. Traumatic renal artery injury can lead to renal infarction both in the acute phase and later. In these patients, detailed investigation of other causes that could lead to renal infarction is necessary before attributing it solely to trauma. In our series, the diagnosis of traumatic renal infarction was made after other potential causes were thoroughly investigated and excluded.

Congenital predisposition to thromboembolism is a rare factor in the etiology of renal infractus. Cases of renal infractus due to some genetic mutations (MTHFR C677T ve Factor V Leiden mutations) have been reported in the literature.[10,11] Two patients (10%) in our study had genetic backgrounds that could predispose them to renal infarction. In our clinic, genetic and immunological tests could not be routinely performed. One of our patients had been diagnosed with Factor V Leiden mutation at an external center. MTHFR C677T mutation may lead to hyperhomocysteinemia, which can facilitate the development of renal infarction. However, homocysteine levels could not be measured in our clinic. Primary or secondary antiphospholipid syndrome (APS) can also lead to renal infarctions.[12] Secondary forms are usually associated with systemic lupus erythematosus (SLE). No SLE or APS was detected in the patients of our study. Drug addiction is also a very rare cause of kidney infarction. Two cases of renal infarction due to ecstasy use have been reported in the literature.[13] While the exact mechanism is unknown, vasospasm and increased susceptibility to thrombosis induced by 3, 4-methylenedioxymethamphetamine could be responsible. In our study, no specific etiological cause was found in 10% of the patients. In a study by Yang et al. this proportion was 11.2%.[8]

Interventional angio procedures and anticoagulant use in the management of renal infarctions hold a significant place in the literature. In cases of acute renal infarction, interventional methods such as PTA and thrombectomy, especially when applied in the early period following symptom onset, offer potential benefits in the restoration of renal blood flow and the preservation of kidney function. Angiographic evaluation plays a critical role in determining the localization and extent of vascular occlusion. Concurrent or subsequent anticoagulant therapy is a fundamental strategy in preventing the recurrence of thromboembolic events and maintaining residual renal function. In cardioembolic renal infarctions, long-term anticoagulation, typically initiated with heparin and continued with warfarin or direct oral anticoagulants, is generally recommended. However, the duration and intensity of anticoagulant therapy should be tailored according to the patient's individual risk factors, the etiology of the infarction, and the clinical presentation. The combined use of interventional and pharmacological approaches is frequently necessary to achieve optimal clinical outcomes.[7,14] In our study, 40% of our patients who were diagnosed early in our study and who could be given a contrast agent were treated with PTA and anticoagulant therapy combination. The rest of our patients were given only medical treatment because some of them were diagnosed late and some of them were not suitable for contrast agent administration. It is seen that renal functions are better preserved in patients with combined PTA and medical treatment.

CONCLUSION

In this study, the rate of development of acute renal failure as a result of renal infractus was high, but the rate of development of chronic renal failure in the late period was low. Renal function was preserved in most of the patients who received PTA+anticoagulation. Laboratory data (creatinine, LDH, etc.) and imaging (renal Doppler ultrasonography, contrast-en-

hanced CT) at the time of admission are highly useful in making the diagnosis. Acute renal infractus should be considered in the differential diagnosis in patients with side pain and acute renal failure. Early diagnosis, early interventional intervention, and anticoagulant therapy significantly reduce kidney function loss. Patients should be thoroughly examined for etiological factors and treated appropriately. Atrial fibrillation and thromboembolism are the most important causes of acute renal infarction, but patients with renal infarction who do not have these risks require further evaluation.

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Conflict of Interest

No conflicts of interest between the authors and / or family members of the scientific and medical committee members or members of the potential conflicts of interest, counseling, expertise, working conditions, share holding and similar situations in any firm.

Authorship Contributions

Idea/Concept: *Rahmi Aslan, Nedim Bedir, Veli Duman, Recep Eryılmaz, Kasım Ertaş, Kerem Taken;* ***Design:*** *Rahmi Aslan, Veli Duman, Nedim Bedir;* ***Control/Supervision:*** *Murat Demir, Rahmi Aslan, Veli Duman;* ***Data Collection and/or Processing:*** *Murat Demir, Rahmi Aslan, Veli Duman;* ***Analysis and/or Interpretation:*** *Murat Demir, Veli Duman, Rahmi Aslan;* ***Literature Review:*** *Rahmi Aslan, Nedim Bedir, Veli Duman, Recep Eryılmaz, Kasım Ertaş, Kerem Taken;* ***Writing the Article:*** *Rahmi Aslan, Nedim Bedir, Veli Duman;* ***Critical Review:*** *Rahmi Aslan, Veli Duman, Nedim Bedir;* ***References and Fundings:*** *Nedim Bedir, Veli Duman, Rahmi Aslan;* ***Materials:*** *Nedim Bedir, Veli Duman, Rahmi Aslan.*

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