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CASE REPORT

Percutaneous angioplasty and stenting of the renal artery in a dialysis patient with recovery of residual renal function: a case report

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ABSTRACT

INTRODUCTION: Renal artery stenosis is the leading cause of secondary hypertension. The prevalence of this condition varies, being higher in patients with refractory hypertension and in those with atherosclerotic involvement of other territories. Revascularisation with stenting is the main therapeutic option; however, the benefits regarding the recovery of renal function in patients already on dialysis remain controversial.

CASE-REPORT: This is a case of a 72-year-old female patient with a history of refractory hypertension and chronic kidney disease, with a single kidney. After multiple hospitalisations due to hypertensive crises and acute pulmonary oedema, she was admitted for worsening renal function requiring dialysis. Diagnostic exams revealed partial aortic thrombosis with critical stenosis of the right renal artery. She underwent angioplasty and stenting of the renal artery, resulting in blood pressure control and discontinuation of dialysis. Two years post-procedure, the patient maintains controlled blood pressure with two medications and stable renal function.

CONCLUSIONS: Renal revascularisation can be beneficial in patients with renal artery stenosis on dialysis if performed within three months of initiating renal replacement therapy. The decision to revascularise a patient already on dialysis due to renal ischaemia should consider factors such as the duration of dialysis, kidney size, and the presence of residual arterial flow.

Keywords: Renovascular disease; Renal artery stenosis; Haemodialysis; Renal artery stenting; Endovascular

BACKGROUND

Renal artery stenosis (RAS) is the leading cause of secondary hypertension, with atherosclerosis accounting for over 90% of cases.[1] This condition is frequently associated with atherosclerosis in other vascular territories, with the arterial ostium being the preferential site of involvement.[2] Concurrently, it is well recognised that renovascular disease is a significant and growing cause of renal failure. It is estimated that 12–18% of patients with end-stage renal disease (ESRD) have ischemic nephropathy caused by RAS.[3] Furthermore, among patients enrolled in dialysis programs, approximately 6% present with atherosclerotic renovascular disease as the underlying condition.[4]

The most common clinical manifestations of RAS are refractory hypertension, congestive heart failure (CHF),

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ischemic nephropathy, and cardiorenal syndrome.[5] Among these, hypertension is the most frequent presentation; however, ischemic nephropathy and chronic kidney disease are markers of poor prognosis.[6]

Renovascular hypertension management involves optimising medical therapy to control blood pressure and percutaneous revascularisation with stent placement when indicated.[7] Although revascularisation may improve renal function and blood pressure control, its effectiveness in patients on dialysis remains questionable. Several small studies have shown that renal artery revascularisation can prevent progression to dialysis.[8,9] However, identifying patients who will benefit the most from this therapy continues to be challenging.

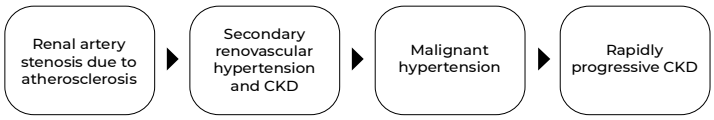
CASE REPORT

This is the case of a 72-year-old female patient with Kidney Disease Improving Global Outcomes (KDIGO) class 3 Chronic Kidney Disease (CKD) of unknown duration and long-standing refractory hypertension. Her current medications upon admission were: moxonidine 0.2 mg (twice daily), carvedilol 25 mg (twice daily), nifedipine 20 mg (three times daily), and furosemide 80 mg (three times daily). She had a recent hospitalisation due to anuria and worsening hypertension over the previous six months, requiring three haemodialysis sessions, with diuresis improvement thereafter. She was discharged without renal replacement therapy but was advised to undergo further evaluation in a nephrology outpatient clinic.

The patient was readmitted during the follow-up evaluation. Upon admission, her blood pressure was 210/98 mmHg, and she was tachycardic, dyspnoeic and presented with bilateral lower limb oedema. Laboratory results showed urea levels of 227 mg/dL, creatinine levels of 7.11 mg/dL, and sodium levels of 126 mg/dL.

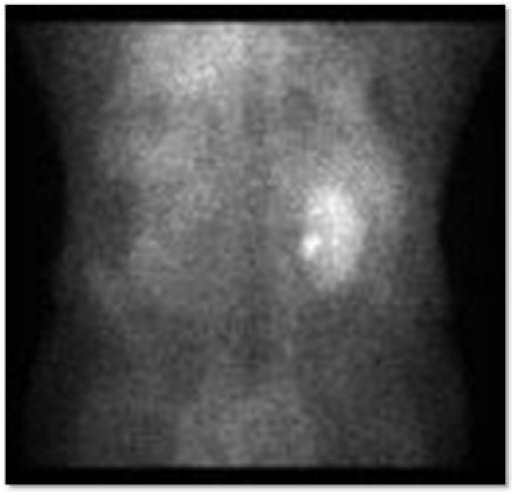
Three years earlier, her baseline creatinine level was 0.8 mg/dL and 1 year before presentation, it was 1.1 mg/dL. Haemodialysis was initiated and performed over 11 days, along with an investigation of her CKD, Figure 1.

Figure 1. Probable aetiology and progression of chronic kidney disease in the presented case



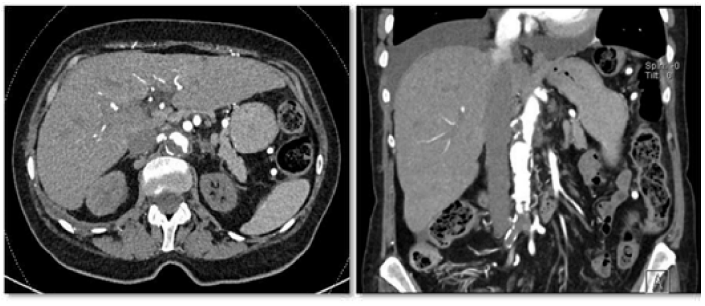
A renogram demonstrated severely diminished bilateral renal glomerular function relative to expected levels, with marked asymmetry. The right kidney almost exclusively sustained the remaining renal function (Figure 2).

Figure 2. Renogram prior to intervention



A computed tomography angiography (CTA) was subsequently performed, revealing prominent thrombus in the juxta and infrarenal aorta, with occlusion of the terminal portion of the aorta and occlusion of the left renal artery with an atrophic left kidney. The right renal artery was patent but showed greater than 90% stenosis in its proximal portion, associated with aortic atheromatosis. Additionally, renal pallor and delayed nephrography were reported bilaterally, more pronounced on the left, consistent with renal volumetric asymmetry (right kidney: 9.5 cm; left kidney: 7.6 cm), Figure 3. Notably, CTA revealed reconstitution of the internal iliac arteries through prominent lumbar collaterals (6 mm in diameter) originating from the abdominal aorta, immediately proximal to the occlusion. Additionally, the proximal segment of the left external iliac artery was reconstituted by the ipsilateral internal iliac artery.

Figure 3. Computed tomography angiography prior to intervention



On the left, axial view revealing renal artery stenosis and aortic thrombus; on the right, coronal view revealing renal artery stenosis and occlusion of the infra-renal aorta.

The examination findings suggested ischemic nephropathy, supporting the need for renal revascularisation to improve blood pressure and renal function.

Renal artery stenting was decided. A 5×22 mm Bentley B-Graft stent at the origin of the right renal artery was placed via radial access under local anaesthesia, Figure 4. Lower limb revascularization was not performed, as the patient did not present with chronic limb-threatening ischemia.

Figure 4. Intra-operative selective angiography post renal stenting

The potential for proximal thrombus propagation was taken into consideration during surgical planning. However, given the preserved patency of the visceral arteries, including the celiac trunk and superior mesenteric artery, stent placement in these branches was deemed unnecessary, as adequate perfusion was maintained. Importantly, the superior mesenteric artery originated from an aortic segment affected by a thrombus involving the posterior wall. Endovascular intervention utilising a potential chimney technique was ultimately considered to pose a greater risk of embolisation, dissection, or thrombosis within these patent branches compared to a conservative approach. This decision was further supported by the anticipated increase in surgical time and procedural complexity.

Haemodialysis was discontinued the following day. One week after revascularisation, the patient was asymptomatic, with controlled blood pressure and significantly improved renal function (creatinine: 2.2 mg/dL, urea: 55 mg/dL), along with recovery of diuresis. She was discharged on aspirin, clopidogrel, and a statin. Close surveillance of the aortic thrombus, including blood pressure control, serial laboratory examinations, and CTA, was planned. The patient remained dialysis-free with controlled hypertension at the two-year follow-up; to date, no further vascular complaints have been reported.

DISCUSSION

Renal artery stenting for the treatment of stenosis in patients undergoing haemodialysis is not routinely performed. While retrospective studies indicate potential benefits of revascularisation in atherosclerotic renovascular disease, randomised clinical trials, including ASTRAL, STAR, and CORAL, have failed to demonstrate clear and significant advantages[9]. These trials have been criticised for methodological limitations, particularly patient selection bias and the lack of hemodynamic evaluation of the treated lesions. According to the “Agency for Healthcare Research and Quality comparative effectiveness statement on renal artery stenting”, selection bias may have excluded patients who could benefit from revascularisation (e.g., those with severe stenosis, refractory hypertension, or flash pulmonary oedema).[10] The procedural success rate (renal artery stenting) was 98%, but clinical improvement in hypertension was approximately 70%, and renal function improvement was observed in only 30% of patients.[4,9] These findings have raised questions about the routine revascularisation of RAS. After the CORAL trial, best medical therapy became the standard of care for patients with controlled hypertension and stable renal function.[9] The American College of Cardiology (ACC), American Heart Association (AHA), and Society of Cardiovascular Angiography Interventions (SCAI) guidelines recommend that revascularisation is most beneficial in cases of CHF, flash pulmonary oedema, resistant hypertension, or progressive chronic kidney disease due to significant stenosis.[1,11]

Despite these randomised studies, Adel *et al.* demonstrated significant improvement in renal function and blood pressure control one year after renal angioplasty.[7] This study only included significant stenosis ≥70%, and 3.66% of hospitalised patients with flash pulmonary oedema and/or acute renal failure requiring acute haemodialysis could discontinue renal replacement therapy. Female sex, hypertension, and the absence of extensive renal damage were predictors of better blood pressure control.[5]

The optimal timing for revascularisation in patients undergoing haemodialysis due to ischemic nephropathy remains a key question. Current consensus advises against revascularisation in cases of end-stage renal disease with dialysis dependence exceeding three months. However, the decision is complex and depends on various factors. In the study from Thatipelli *et al.*, renal revascularisation with stenting was performed on patients undergoing acute haemodialysis (less than 30 days of renal replacement therapy) and chronic haemodialysis (more than 30 days of dialysis).[12] Fifty per cent of the intervened patients remained dialysis-free. Predictors of successful haemodialysis discontinuation included pre-intervention renal size ($p = 0.03$), baseline glomerular filtration rate ($p = 0.01$), and 24-hour proteinuria ($p = 0.01$). Importantly, no differences were observed between patients on acute versus chronic haemodialysis.

For a patient on dialysis due to ischemic nephropathy, the decision to intervene requires a comprehensive evaluation of clinical, anatomical, and functional factors, including the duration of dialysis. Intervention is generally recommended for patients on dialysis for less than three months. In cases

of dialysis lasting beyond six months, the potential for renal functional recovery significantly diminishes due to atrophy and fibrosis of the renal parenchyma, which impair the tissue's ability to respond to improved blood flow. Furthermore, the presence of residual arterial flow, even if of low amplitude, is considered a positive indicator of viable renal tissue, suggesting a potential for functional recovery following the procedure.[7]

Patients who maintain some level of diuresis typically exhibit better outcomes following revascularisation, suggesting the presence of viable nephrons that may benefit from enhanced renal perfusion. Additional factors to consider include assessing the stenosis anatomy (such as degree, location, and extent) and the patient's surgical risk.6 Proximal stenoses, particularly those involving the renal artery ostium, are more favourable candidates for stenting due to a higher likelihood of restoring adequate flow.[2]

Ultimately, it is essential to weigh the balance between procedural risks and anticipated benefits carefully. Percutaneous renal revascularisation demonstrates a technical success rate exceeding 95%.[13] However, potential complications may include issues with arterial access, atheroembolism, and contrast-induced nephropathy. Radial access could represent a viable alternative in cases involving extensive infrarenal aortic thrombosis, as performed in the present case. A multidisciplinary approach is essential to adequately balance the risks and benefits, to reduce dialysis dependence, control hypertension, and enhancing the patient's quality of life.

This clinical case illustrates a scenario in which the intervention proved highly beneficial. The patient, a 72-year-old woman with refractory hypertension, exhibited both clinical and anatomical factors that warranted the decision for revascularisation. These included significant stenosis (>90%) in a solitary functioning kidney, rapid renal function deterioration, and recent dependence on dialysis. It is essential to emphasise that an earlier and more thorough diagnostic evaluation during the initial episodes of acute pulmonary oedema and the diagnosis of refractory arterial hypertension could have enabled a more timely renal revascularisation procedure.

CONCLUSION

Atherosclerotic renal artery stenosis (RAS) is a major cause of secondary hypertension and plays a key role in the progression of renal insufficiency through ischemic nephropathy. For asymptomatic patients or those with stenoses less than 70%, optimised medical therapy remains the first-line treatment. However, in patients with refractory hypertension, episodes of flash pulmonary oedema, significant renal function decline, or those on dialysis for less than six months, percutaneous transluminal angioplasty with renal artery stenting should be considered. This decision should follow a comprehensive hemodynamic assessment of the stenosis and an individualised evaluation of the patient.

In conclusion, there is currently insufficient evidence to definitively conclude that renal revascularisation is not beneficial, even for patients already undergoing dialysis. The case presented demonstrates the successful outcome of renal revascularisation in a dialysis-dependent patient who experienced two years of dialysis-free survival following the intervention.

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