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# Renal salvage using stent graft placement after acute renal artery occlusion with prolonged ischemic time

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## Abstract

**Purpose:** To describe a patient with acute renal artery occlusion who underwent successful revascularization procedure after experiencing a protracted ischemic period, which resulted in successful retrieval of renal function.

**Case report:** A 58-year-old male with a history of left renal artery stenosis and stent graft placement presented with symptoms of chest pain, shortness of breath, and flank pain. The patient was admitted to the Intensive Care Unit with the diagnosis of multiorgan failure and subsequent anuria that led to the initiation of hemodialysis. Computed tomography angiography demonstrated an aortic occlusion along with bilateral proximal renal artery occlusion with reconstitution of the mid to distal renal arteries via collateralization. The patient underwent angioplasty with bilateral renal artery stent-graft placement and successful revascularization of proximal renal arteries. Post-operatively, his renal function and urine output improved, and the patient was able to be weaned off hemodialysis along with the benefit of concurrent amelioration of his renovascular hypertension.

**Conclusion:** For select patients with renal artery occlusion, revascularization of the renal arteries may result in dialysis independence and stabilization of renovascular hypertension, despite prolonged time of ischemia.

## Keywords

Renal artery occlusion, angioplasty, kidney disease, renal salvage, endovascular management

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## Introduction

Acute renal artery occlusion (RAO) is an infrequently encountered condition that often invariably progresses to renal failure with eventual dependence on hemodialysis. Factors that result in the development of occlusion are commonly secondary to embolic, traumatic, or thrombotic events.[1] The basic tenant in the treatment of RAO is the preservation of renal function and avoidance of further insults. Clinical presentations of RAO are non-specific since patients can often present with a combination of flank/abdominal pain, hypertension, leukocytosis, fever, and hematuria.[2] Due to the non-specific nature of the presentation, diagnosis of the disease is often delayed. Animal studies have demonstrated that up to a quarter of glomeruli are lost after 30 min of renal warm ischemia.[3] Small prospective series have shown that human kidneys can tolerate approximately 30–60 min of clamp ischemia,[4,5] but this may not hold for specific cases where there is collateral development to assist in renal perfusion. There are limited case reports on the treatment of acute RAO.[6] Traditional recommendation is early intervention after diagnosis of RAO; however, the time cutoff for intervention is poorly understood and is variable depending on the cause of the occlusion (embolic versus thrombotic).[2]

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Therapeutic options include management with anticoagulation, thrombolytics, and surgical thrombectomy or catheter-based treatments. Controversy persists over the real benefits of after protracted ischemic time. Literature is also scant on long-term results after intervention.

Our purpose is to present a patient with bilateral RAO, along with hemodialysis dependency and uncontrolled hypertension, who we were able to successfully revascularize flow to the renal arteries, resulting in sustained long-term retrieval of the patient's renal function and resolution of renovascular hypertension.

## Case report

A 58-year-old male with medical history of a coronary artery disease, peripheral artery disease, renal artery stenosis, chronic kidney disease, hypertension with hypertensive urgency, history of tobacco use, and history of left renal artery stent placement presented to our hospital on 5 December 2017 for symptoms of chest pain, shortness of breath, and left-sided flank pain.His creatinine (Cr) was 3.02 mg/dl at this presentation, compared to his baseline value of 1.2–1.7 mg/dl two years prior in 2015, during which he was urgently admitted for a coronary artery

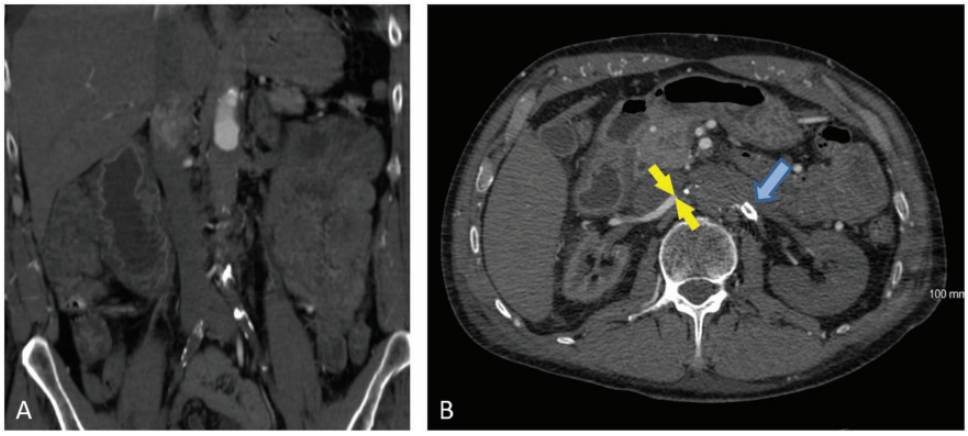


**Figure 1.** (a,b) Coronal and axial CT scan views demonstrating occlusion of the pararenal and infrarenal aorta and common iliac arteries. The proximal renal arteries are occluded bilaterally. The blue arrow points to previously placed left renal stent that is now thrombosed. There is flow in the right renal artery and branches of the left renal artery (yellow arrows). The left kidney is edematous and without enhancement. There is cortical enhancement in the right kidney.

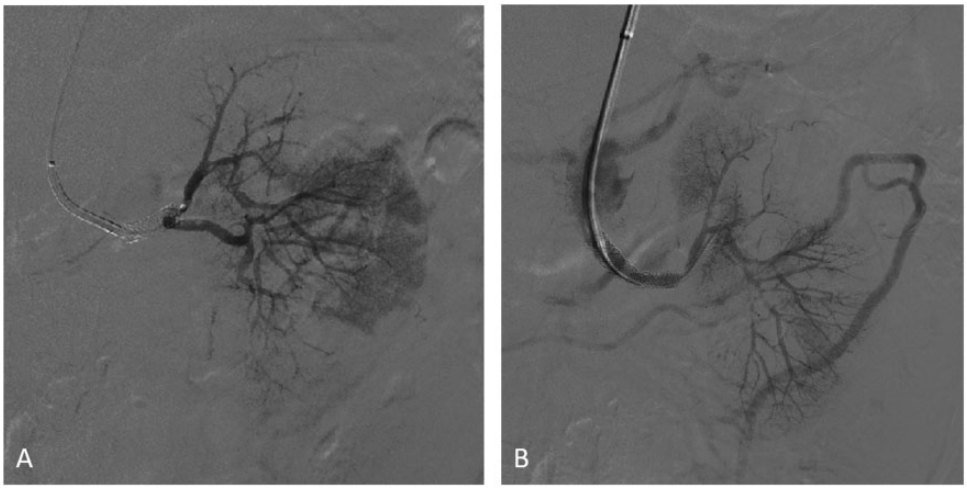


**Figure 2.** (a) Pre-intervention angiogram of the left kidney showing prior stent encroaching on the renal artery bifurcation. Cortical opacification was noted only once mid-renal artery was injected. (b) Post-intervention angiogram showing restoration of renal artery flow accomplished after angioplasty and the additional placement of a Gore VBX stent graft (6 mm × 39 mm). Improvement of cortical enhancement is noted.

bypass grafting (CABG) along with subsequent placement of a left renal stent for arterial stenosis. The patient was lost to follow-up after discharge from his CABG and had been non-compliant with his medications (including aspirin and plavix and his antihypertensives) per patient report.

Pertaining to the current presentation, he initially left the Emergency Department against medical advice and represented approximately 18 h later, on 7 December 2017, with worsening symptoms and Cr level of 8.28 mg/dl. The possible culprits of his acute kidney injury were discussed, with cardiac etiology ruled out with normal electrocardiogram and unchanging echocardiogram. The patient was admitted to the Intensive Care Unit with a diagnosis of multi-organ failure. He became progressively worse along with subsequent development of anuria, leading to hemodialysis initiation on 12/10/2017. A computed tomography angiography (CTA) on 11 December 2017 demonstrated a chronic aortic occlusion along with bilateral proximal RAO that reconstituted to the mid to distal renal arteries via collateralization from the middle supra-renal/capsular arteries (Figure 1). Vascular surgery was consulted for findings of new renal occlusions. After extensive discussion and evaluation of the patient, it was determined that the best course was to proceed with renal revascularization due to the presence of flow in the renal arteries and branches and the partial cortical enhancement, indicating possibly viable renal parenchyma. On 13 December 2017, the patient underwent arteriogram via left brachial artery access with subsequent placement of bilateral renal artery stent-grafts consisting of Gore Viabahn VBX 6 mm × 39 mm stent (W. L. Gore & Associates, Flagstaff, Arizona) on the left and a Gore Viabahn VBX 6 mm × 29 mm stent on the right.

On the left, the prior stent encroached on the renal artery bifurcation with the proximal end flared using an 8 mm balloon (Figure 2). For the right renal artery, we were able to deploy a stent-graft across the occluded segment, achieving good flow at the end without any significant stenosis (Figure 3). The proximal end was also flared using an 8 mm balloon. Intraoperatively, we found diffuse pruning of the vessels consistent with chronic renal disease. Once we were satisfied with our stent-grafts, we then decided to infuse tissue plasminogen activator, as his renal occlusions were considered acute. No protection basket was utilized due to concern of the device causing complete occlusion of the native vessels and causing further insult to the kidneys.

The patient tolerated the procedure well. Post-operatively, he began to recover his renal function with an increase in urine output. The retrieval of the patient's renal function eventually resulted in the ability to wean him off intermittent hemodialysis. Concurrent to his improved renal function with improved Cr level and urine output, the patient was also able to be transitioned from a parenteral nicardipine drip and hydralazine to an enteral antihypertensive regimen consisting of carvedilol and amlodipine. During his post-operative course, the patient experienced an episode of melena with anemia while on warfarin and dual antiplatelet therapy. He underwent an upper esophageal endoscopy and a colonoscopy that lead to the finding of mucosal bleeding at the periampullary region. The patient's warfarin and aspirin were held, and he was restarted on clopidogrel. Thereafter, the hemoglobin stabilized, and no subsequent bleeding episodes reoccurred. The patient continued to remain off hemodialysis with control of his hypertension while on oral medications at his five months follow-up visit. The patient's Cr and glomerular filtration rate on day

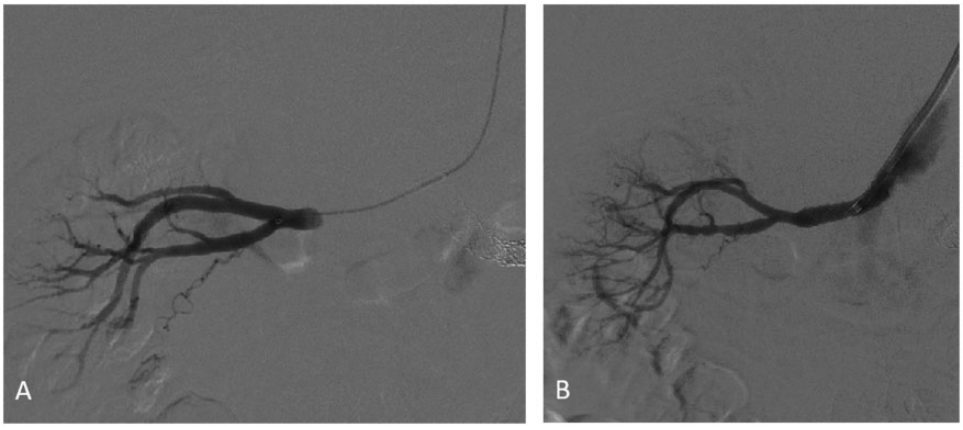


**Figure 3.** (a) Pre-intervention angiogram demonstrating robust right distal renal artery. Selective catheterization of right renal artery with intraluminal access confirmed. The distal renal artery was of good quality. (b) Post-intervention angiogram demonstrating restoration of flow throughout the renal artery and improvement of the cortical enhancement.

stent placement were 11.48 and 5, respectively, and were 5.53 and 11 on day of discharge, and at the five months follow-up, they improve to 2.63 and 25 (Figure 4).

## Discussion

Thrombotic RAO often represents the end-stage of progressive chronic atherosclerotic disease. Traumatic or embolic RAO denotes a more drastic process. It is believed that in chronic renal disease with the development of RAO, the ability to mount an adaptive repair process via collateral formation helps to lessen the renal parenchymal injury versus that of a more acute process. The gold standard for diagnosis of RAO is renal arteriogram; however, CTA often replaces conventional arteriogram as the predominant diagnostic imaging modality.[7]

A single-institution retrospective data analysis of patients who underwent intervention for atherosclerotic renovascular disease at Wake Forest University Medical Center has demonstrated that in the situation of chronic atherosclerotic disease with the development of RAO; there can be benefits in revascularization procedures that can lead to the improvement of hypertension and renal excretory function.[8] Despite these salutary findings, enthusiasm for renal artery intervention has been tempered substantially after the publication of three landmark randomized trials (ASTRAL, CORAL, STAR) that failed to show the benefit of endovascular intervention in patients with renal atherosclerotic disease.[9–11]

For cases in which there is acute occlusion of the renal artery, expeditious renal revascularization is essential from a physiological standpoint since it has been demonstrated that the human kidney can tolerate less than one hour of total ischemia time.[4] There have been cases of renal function recovery after delayed intervention in patients with baseline atherosclerotic disease developing RAO; however, in those instances, it is believed that the formation of a collateral network was able to maintain the viability of the native renal parenchyma.[12] The collateral circulation is mainly supplied by the adrenal, lumbar, and periureteric arteries.[13] Evidence for the achievement of hemodialysis independence after renal revascularization is scant in literature; nevertheless, there have been reports of previously dialysis-dependent patients achieving independence after revascularization procedures.[14,15] Better renal function preservation and outcomes have been reported for patients with acute renal embolism when collateral perfusion to the renal parenchyma is preserved.[16,17]

Our case presents a unique perspective and challenges the conventional wisdom regarding renal revascularization for RAO in the setting of chronic atherosclerotic disease. We do not advocate revascularization for all such patients, but for this singular case, it was the favorable indicator of significant cortical enhancement even after the development of anuria that helped to sway our decision towards an intervention for this case. The initiation of hemodialysis and the development of renovascular hypertension were negative prognostic factors; however, we believed with this patient's remnant functional renal parenchyma to stimulate the renin-angiotensin response and combined with a revascularization procedure, we could retrieve the renal function and ameliorate

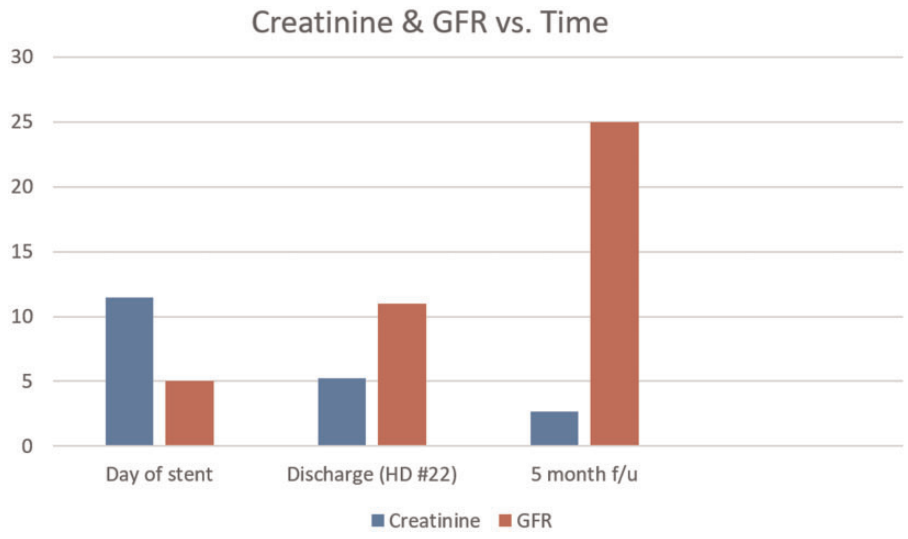


**Figure 4.** The patient's creatinine and glomerular filtration rate (GFR) on day stent placement were 11.48 and 5.0, respectively, and were 5.53 and 11.0 on the day of discharge. At the five months follow-up, they improved to 2.63 and 25.

renovascular hypertension. Our decision to intervene proved beneficial for this case as supported by the drastic improvement in the post-operative urine output and the elevation of the patient to a state of oliguric renal failure, which holds a much improved long-term prognosis than a state of anuric renal failure. The limitation of this case is the singular nature of this report and the limitation to extrapolate substantive guidelines based on a single case.

## Conclusion

This case demonstrates the benefit of renal revascularization and the salutary effects of achieving restoration of flow in the retrieval of renal function and the control of renovascular hypertension. It points to the idea that despite circumstances such as dialysis dependency, renovascular hypertension, and prolonged ischemia period, the utilization of revascularization should be entertained in select cases, particularly in cases where there is noticeable collateralization. The ability to achieve revascularization can impart significant benefits for the patients and possess the potential in reversing recalcitrant conditions.

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### Contributorship

YG, DM, GML, NG conceived and contributed equally.

### Declaration of conflicting interests

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### Ethical approval

Written consent was provided by patient to report and publish this case.

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