

Failed Renal Denervation in a Dialysis Patient with Resistant Hypertension due to Severe Atretic Renal Arteries: A Rare Case Report

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Abstract:

Resistant hypertension is a common phenomenon that keeps emerging in cardiology practice, which remains a challenge because of the renal involvement, especially in patients with chronic kidney disease. Renal sympathetic activity is one of the significant components in the pathophysiology of resistant hypertension. Renal denervation (RDN) is one of the relatively new alternative measures that has emerged over the past two decades and is employed in the management of patients presenting with resistant hypertension despite the presence of multiple antihypertensive medications. However, its use is limited in routine clinical practices and is usually reserved for carefully selected patients. We reported a case of a 63-year-old female patient with Stage V renal disease on hemodialysis, presenting with resistant hypertension, where renal denervation was contemplated as one of the measures in the management of her hypertension. Her systolic blood pressure stayed above 180 mmHg over several visits despite treatment with antihypertensive medications. However, the patient underwent angiographic studies to assess the feasibility of catheter-based renal denervation as a management strategy for her hypertension. The imaging showed that her renal arteries were extremely small, with diameters of less than 3 mm, which is considerably less than the normal values of ≥ 3 –4 mm. Severe atretic changes in the renal vessels made the procedure unsafe, illustrating the rare anatomical limitation that may prevent patients from benefiting from RDN despite clinical indication.

Abbreviations: resistant hypertension - RH, CKD – Chronic Kidney Disease; ESRD – End-Stage Renal Disease; RDN – Renal Denervation; HTN – Hypertension; BMI – Body Mass Index

Key words: renal denervation; resistant hypertension; renal arteries; atretic; dialysis

Introduction

Hypertension is highly prevalent in patients with chronic kidney diseases (CKD) and especially in patients with end-stage renal diseases (ESRD), requiring dialysis therapy [1]. Resistant hypertension (hypertension that persists above target levels in patients getting prescribed multiple antihypertensive medications without change) has been commonly observed in patients with CKD and ESRD [1]. Resistant hypertension is believed to have a prevalence rate of 10-20% among individuals suffering from chronic kidney disease and has been linked to increased cardiovascular risk [1]. According to current practice guidelines, renal denervation should be reserved for well-chosen candidates based on their renal arterial anatomy due to the significance of their vessel size and structure [2].

Renal sympathetic denervation (RDN) has been used as a minimally invasive procedure to treat resistant hypertension by disrupting sympathetic nerve activity in the renal arteries. This further leads to lower systolic blood pressure numbers if successful [2]. The catheter-based RDN procedure involves inserting a catheter into the femoral artery and advancing it to the renal artery to denervate the sympathetic nerves in the renal artery wall [2]. Renal denervation has undergone a plethora of changes and has had significant progress over the past couple of decades [3]. From clinical trials to experiments, patients who have hypertension were able to experience the use of renal denervation. The Simplicity HTN- 1 Trial, a trial where patients with resistant hypertension underwent a procedure of subcutaneous renal denervation, was carried out and showed significant and promising results of lowering blood pressure [3]. On the contrary, the Simplicity HTN - 3 trial provided us with results that

showed no substantial difference between treatment and placebo groups, which raised doubt of the effectiveness of the procedure. Given this, it sent out a reassessment of different approaches for the procedure, patient selection criteria, and study methods/mechanics [3].

The success and safety of RDN therapy depend on proper renal artery anatomy to enable denervation of the sympathetic nerves in the renal artery wall [4]. Patients with advanced kidney diseases may have alterations in renal artery anatomy due to atrophic changes in the renal artery lumen. In patients with ESRD, it has been observed that patients may have compromised renal artery lumen due to atrophic changes (decrease in size of a body part, tissue, or organ) in the renal artery lumen, making it difficult to perform catheter-based RDN therapy [4].

Case Report:

A 63-year-old female patient with ESRD (Chronic Kidney Disease Stage V), who was undergoing hemodialysis, was referred to our clinic for her resistant hypertension [5]. Although she had been taking numerous different medications for her hypertension, including amlodipine 5 mg and nifedipine ER 60 mg, her systolic blood pressure had irregular levels, remaining at levels of 180 mmHg or higher. The patient also reported

symptoms of exertional chest discomfort, which is usually a symptom of angina.

Her past medical history includes hypothyroidism, which involves the body not being able to produce enough thyroid hormones, folic acid deficiency, and hyperlipidemia, all of which were treated with prescribed medications. The patient had a height of 60 inches (152 cm) and a weight ranging from 117-123 pounds from several different visits, with a BMI of about 22.8-24.0 kg/m². The heart exam showed a normal rhythm and normal S1 and S2 heart sounds, with no murmurs or other abnormal sounds. The lungs were clear on both sides, and the neurological exam showed no abnormalities.

Due to the high levels of her hypertension, renal sympathetic denervation was taken into consideration. The patient was referred to our clinic to determine if she qualified as a candidate for catheter-based procedures based on her unique situation. During the procedure, the abdominal aortography and bilateral renal artery angiography were performed to evaluate her vascular anatomy. The imaging of these procedures revealed that her renal arteries were severely small, with diameters of less than 3 mm, which is considerably less than the normal values of ≥ 3 –4 mm.



Figure 1: Bilateral renal artery angiography showing severely small (atretic) renal arteries with diameters <3 mm and thin, irregular branching

The patient also had many smaller than usual branches of the arteries, which was also atypical.

Since the arterial sizes were not safe for catheter-based ablation, the renal denervation was not performed. Following the evaluation, the catheter-

based renal denervation was not performed. The patient's hypertension was managed medically, including giving amlodipine 10 mg daily in addition to her existing medications. At the follow-up, her blood pressure improved to 177/81 mmHg and later to 148/73 mmHg during telehealth.

Parameter	Findings
Age / Sex	63-year-old female
Diagnosis	End-stage renal disease (Stage V CKD) on hemodialysis
Condition	Resistant hypertension
Blood Pressure (Initial)	≥180 mmHg systolic
Symptoms	Exertional chest discomfort
Medications (Initial)	Amlodipine 5 mg, Nifedipine ER 60 mg
Imaging Findings	Severely atretic renal arteries with diameters <3 mm and multiple small branches
Intervention Considered	Renal sympathetic denervation (RDN)
Procedure Outcome	Not performed due to unsafe vascular anatomy
Management	Medical therapy (amlodipine increased to 10 mg)
Follow-up Blood Pressure	Improved to 148/73 mmHg

Table 1: Clinical Summary of the Patient

Results:

Table 1 summarizes the patient’s clinical presentation and management.

Resistant hypertension in patients with end-stage chronic kidney disease often poses challenges in the management of the condition, especially when conventional pharmacological management is not effective in controlling the blood pressure. Renal denervation has proven to be an effective interventional procedure in the management of patients with resistant hypertension. However, this case is an example that anatomical variations in the renal vessels may pose challenges in the management of patients with resistant hypertension. This is especially true when the patient has severely atretic renal vessels with diameters that are well below the threshold for safe catheter-based ablation. This is an unusual condition that may pose challenges in the management of patients with resistant hypertension. In rare cases such as this, the number of available interventional options may be limited even when the indications are appropriate. Further studies are needed to establish the prevalence of anatomical variations in patients with resistant hypertension and to establish alternative management strategies for patients who are not suitable candidates for renal denervation.

Discussion:

Resistant hypertension continues to be a clinical challenge in patients with advanced chronic kidney disease, especially those who also undergo hemodialysis [1]. In these patients, renal sympathetic denervation has been used as a potential treatment when blood pressure remains uncontrolled despite the prescription of several drugs [6]. In this case, the patient had excessively high systolic blood pressure, which was above 180 mmHg, along with angina-like symptoms such as chest pain and tightness in the chest area. Due to the unique presentation of the patient, the intervention of renal sympathetic denervation was considered. However, the angiographic assessment revealed that the atretic renal vessels were significantly shrunk, with diameters less than 3 mm, along with tiny branches, which made the intervention of catheter-based radiofrequency unsafe [4]. Current scientific studies emphasize that correct renal artery diameter and anatomy are needed for safe catheter-based renal denervation, and that patients with abnormal arteries are not suitable candidates [6]. Renal denervation, despite its promising results, demonstrated in this case an uncommon anatomical limitation that may

prevent the procedure from being performed [7]. This case illustrates how atypical renal artery anatomy can significantly limit procedural options and reinforces the need for evaluation of the patient when considering device-based therapies for resistant hypertension. Although similar cases may have been reported, this particular case highlights the importance of careful vascular assessment in patients with ESRD being considered for renal denervation. [8]. This is particularly crucial in cases with anatomical limitations that may prevent such procedures from being performed. Some limitations of this case report include it being solely on one patient, along with not having a long term follow up plan, which may limit the generalizeability of this study.

Conclusion:

This case highlights an uncommon anatomical limitation to renal denervation with patients that have resistant hypertension and ESRD. To determine if renal denervation is viable for a patient, vascular assessments must be performed to prevent risk of further damage or injury. Findings from this case emphasize the importance of evaluation for each patient when determining appropriate candidates for such procedures. It further cautions similar treatments of patients to also carefully assess limitations before any interventions.

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