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MEDICAL SCIENCES / DAHİLİ TIP BİLİMLERİ

Short-Term Renal Function Outcomes after Renal Artery Stenting in Atherosclerotic Renal Artery Stenosis

Aterosklerotik Renal Arter Stenozunda Renal Arter Stentleme Sonrası Kısa-Dönem Renal Fonksiyon Sonuçları

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Abstract

Objectives: Renal artery stenosis (RAS) poses significant challenges due to decreased renal perfusion, leading to various disease processes. We aimed to evaluate the safety and effectiveness of renal artery stenting in patients with atherosclerotic RAS, focusing on early renal function changes and identifying factors influencing treatment response.

Materials and Methods: This single-center, retrospective, observational study included patients undergoing renal artery stenting for atherosclerotic RAS over a 10-year period. Clinical and procedural data were analyzed, and renal function outcomes were assessed at the 1-month follow-up. Statistical analysis was performed to identify correlations between patient characteristics, procedural factors, and treatment outcomes.

Results: Forty-nine patients were included, with a mean age of 67.08±8.73 years. Successful stenting was achieved in all patients, with no major adverse clinical events reported. At the 1-month follow-up, 67.3% of patients had stable renal function, while 12.2% showed improvement and 20.4% experienced worsening. A significant correlation was found between age and treatment response (p=0.045). However, no significant associations were observed between changes in renal function and other patient characteristics or procedural factors.

Conclusion: Renal artery stenting in patients with atherosclerotic RAS resulted in successful procedural outcomes with minimal complications. While age was identified as a significant predictor of treatment response, no other patient or procedural factors showed significant correlations with changes in renal function. Our findings emphasize the need for further research to refine patient selection criteria in this population.

Keywords: Renal artery stenosis, renal artery stenting, atherosclerotic RAS, renal function outcomes, patient selection

Öz

Amaç: Renal arter stenozu (RAS), azalmış renal perfüzyon nedeniyle çeşitli hastalık süreçlerine yol açarak önemli zorluklar teşkil etmektedir. Aterosklerotik RAS'li hastalarda renal arter stentlemenin güvenliğini ve etkinliğini değerlendirerek, erken dönem renal fonksiyon değişikliklerine odaklanmayı ve tedavi yanıtını etkileyen faktörleri belirlemeyi amaçladık.

Gereç ve Yöntem: Bu tek merkezli, retrospektif, gözlemsel çalışma, 10 yıllık bir dönemde aterosklerotik RAS için renal arter stentleme yapılan hastaları içermektedir. Klinik ve prosedürel veriler analiz edilmiş ve 1 aylık takipte renal fonksiyon sonuçları değerlendirilmiştir. Hasta özellikleri, prosedürel faktörler ve tedavi sonuçları arasındaki korelasyonları belirlemek için istatistiksel analiz yapılmıştır.

Bulgular: Kırk dokuz hasta dahil edilmiş olup, ortalama yaş 67,08±8,73 yıl olarak belirlenmiştir. Tüm hastalarda başarılı stentleme gerçekleştirilmiş ve majör advers klinik olay bildirilmemiştir. Bir aylık takipte, hastaların %67,3'ünde stabil renal fonksiyon gözlenirken, %12,2'sinde iyileşme ve %20,4'ünde kötüleşme görülmüştür. Yaş ile tedavi yanıtı arasında anlamlı bir korelasyon bulunmuştur (p=0,045). Ancak, diğer hasta özellikleri veya prosedürel faktörler ile renal fonksiyon değişiklikleri arasında anlamlı bir ilişki gözlenmemiştir.

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Sonuç: Aterosklerotik RAS'li hastalarda renal arter stentleme, minimal komplikasyonlarla başarılı prosedürel sonuçlar sağlamıştır. Yaş, tedavi yanıtının önemli bir belirleyicisi olarak tanımlanırken, diğer hasta veya prosedürel faktörler ile renal fonksiyon değişiklikleri arasında anlamlı bir korelasyon bulunamamıştır. Bulgularımız, bu popülasyonda hasta seçim kriterlerini iyileştirmek için daha fazla araştırma yapılması gerektiğini vurgulamaktadır.

Anahtar Kelimeler: Renal arter stenozu, renal arter stentleme, aterosklerotik RAS, renal fonksiyon sonuçları, hasta seçimi

Introduction

Renal artery stenosis (RAS) poses a significant clinical challenge, precipitating a decline in renal perfusion and initiating various pathological cascades (1). The condition directly induces ischemic atrophy due to reduced renal perfusion, while also triggering systemic hypertension and cardiovascular complications through the renin-angiotensin-aldosterone system and the systemic nervous system. These mechanisms collectively contribute to end-organ damage, including glomerulosclerosis (2).

Atherosclerosis stands out as the primary etiology of RAS, detectable on imaging in approximately 50% of patients with coronary artery disease (3). Atherosclerotic renovascular disease carries a substantial mortality rate, predominantly attributable to associated cardiovascular conditions (4-6). It ranks as the second most common cause of fibromuscular dysplasia (FMD) following atherosclerosis (3).

The clinical presentation of organ dysfunction resulting from impaired renal perfusion and its progression remains multifaceted and not entirely understood (4). Presently, the primary management approach for significant RAS primarily involves medical intervention with antihypertensive agents (7). While angioplasty without stenting suffices for FMD-induced RAS, the preferred approach in atherosclerotic stenosis involves concurrent stenting to mitigate potential recoil and restenosis post-angioplasty.

Renal artery stenting remains a contentious topic in the medical literature. Our study seeks to contribute to this ongoing discourse by evaluating the safety and efficacy of renal artery stenting in patients with atherosclerotic RAS and identifying subpopulations poised to derive the greatest benefit.

This single-center, retrospective, observational study aims to assess the early changes in renal function among patients undergoing renal stenting for atherosclerotic RAS at our institution over a decade-long period.

Materials and Methods

Patients aged 18 and above who underwent renal artery stenting at our institution between July 25, 2012, and October 7, 2022, due to RAS exceeding 50%, were included in this study. We opted not to stratify patients based on the degree of stenosis, encompassing all individuals with RAS greater than 50%, aiming to minimize exclusions during our retrospective review. Exclusion criteria comprised patients with FMD, total arterial occlusion, spontaneous dissection, stenosis in a transplant or bypass graft anastomosis, abdominal aortic aneurysm larger than 45 mm in diameter, and those lacking follow-up after 1 month. This study adhered to the principles outlined in the Declaration of Helsinki.

Approval for the protocol was obtained from the Human Research Ethics Committee of Ankara University Faculty of Medicine (date: 28.01.2023, approval no.: İ02-73-23) the participating hospitals, and written informed consent was acquired from all patients before stent implantation.

Renal artery stenting decisions at our center were made through consensus between the interventional radiologist and the primary clinician following the patient. Stent implantation utilized a standard retrograde femoral approach. Stent deployment adhered to recommended pressure, with stent size selection based on visual assessment. Peri-procedural and post-procedural anticoagulant and antiplatelet therapy followed routine hospital practice and were at the discretion of the treating physician.

The primary endpoint, acute technical success, was defined as angiographic residual diameter stenosis <30%. Secondary endpoints encompassed major complications within 48 hours post-stent implantation and changes in renal function at the 1-month follow-up.

Renal function outcomes were categorized as improvement [≥20% increase in baseline estimated glomerular filtration rate (eGFR)], worsening (≥20% decrease in baseline eGFR), or stabilization (no deterioration).

Major clinical adverse events (MACE) included events necessitating additional procedures, prolonged hospitalization, or death, encompassing deaths within 30 days post-procedure or during hospitalization.

Statistical Analysis

Statistical analysis utilized SPSS version 23.0. Descriptive statistics were presented as mean ± standard deviation or median (minimum-maximum) for numerical variables and as percentages for categorical variables. Non-parametric data underwent analysis using the Mann-Whitney U test, while categorical variables were assessed using the chi-square test or Fisher's exact test. Statistical significance was considered at $p<0.05$.

Results

Demographic and clinical characteristics: A total of 49 patients were retrospectively evaluated, with a mean age of 67.08±8.73 years. Among them, 34 (69.4%) were male, and 15 (30.6%) were female. Hypertension was prevalent in 40 (81.6%) patients, diabetes mellitus in 21 (42.9%), hyperlipidemia in 17 (34.7%), and atrial fibrillation in 4 (8.2%). Nineteen (38.8%) patients had a history of previous myocardial infarction. Regarding antihypertensive medication, 19 (38.8%) patients received monotherapy, 21 (42.9%) received combination therapy, and 9 (18.4%) did not use any hypertensive medication. Additionally, 15 (30.6%) patients were using statins, 11 (22.4%) were using insulin, 34 (69.4%) were using antiplatelets, and 2 (4.1%) were taking anticoagulants. The mean estimated eGFR before the procedure was 77.31±36.98, and the mean creatinine value was 1.35±0.52 mg/dL.

Renal artery stenting was performed on the left side in 23 (46.9%) patients, on the right side in 19 (38.8%), and bilaterally in 7 (14.3%) patients. The mean stent diameter used was 5.54±0.64 mm, with a mean stent length of 16.38±5.36 mm. Successful stenting was achieved with less than 30% residual stenosis in all patients, and no major MACE were observed.

Thirty-three (67.3%) patients maintained stable renal function, while improvement was noted in 6 (12.2%) patients, and 10 (20.4%) patients experienced worsening post-stenting. No significant correlations were found between changes in renal function and patient characteristics or procedural data, including gender, comorbidities, medication use, pre-procedural renal function parameters, stent characteristics, or side of stenting (all $p>0.05$).

At the 1-month follow-up, patients with improved renal function (12.2%) had a mean age of 63.17±12.15 years, while those with stable renal function (67.35%) had a mean age of 67.00±8.56 years, and patients with worsened renal function (20.4%) had a mean age of 69.70±6.80 years. Statistical analysis revealed a significant correlation between age and treatment response ($p=0.045$).

Discussion

RAS presents a complex clinical scenario characterized by diminished renal perfusion and subsequent renal dysfunction. Patients with RAS often exhibit parenchymal changes such as interstitial fibrosis, tubular atrophy, glomerulosclerosis, periglomerular fibrosis, and arteriolar abnormalities (8). The optimal approach to managing RAS, whether through medical or interventional therapy, remains a subject of debate in the literature (9,10).

The STAR trial, focusing on 140 patients over 2 years, did not demonstrate a clear benefit of stenting over medical treatment alone (11). Similarly, the ASTRAL trial involving 806 patients and the CORAL trial with 947 patients found no significant differences in renal or cardiovascular outcomes between stenting and medical therapy alone (1,12). Moreover, The STAR trial reported a significant increase in procedure-related complications (11). These trials collectively suggest that renal artery stenting may not provide additional benefits when added to high-quality medical therapy.

However, recent insights from the CORAL trial's 5-year follow-up introduced the urine albumin-to-creatinine ratio (UACR) as a potential marker for treatment response. This metric proposes that patients with RAS and healthy kidneys may benefit from stenting, while those with poor organ function, indicated by an elevated UACR, may not. Our study's correlation between age and treatment response aligns with this hypothesis, suggesting that younger patients with healthier kidneys may experience improved renal function following stenting (13).

Our study may contribute to the patient selection process in managing RAS with renal artery stenting. Notably, our findings indicate that, in experienced hands, the risk of complications can be minimal.

Study Limitations

Nevertheless, our study acknowledges several limitations, including its retrospective design, lack of stratification based on stenosis severity, and short-term follow-up. Additionally, the multifactorial nature of eGFR changes underscores the need for cautious interpretation. Similar to prior literature, our findings suggest that stent placement may not consistently improve early renal function, emphasizing the necessity for rigorous patient selection criteria. Incorporating patient age into these criteria may offer valuable insights into treatment response and guide personalized management strategies for atherosclerotic RAS.

Conclusion

Our study supports the safety and potential benefits of renal artery stenting in preventing kidney function decline in select patient populations. Determining factors such as UACR and age may be beneficial in selecting suitable candidates for stent intervention. Future studies should aim to address these limitations by employing rigorous patient stratification methods, longer follow-up periods, and comprehensive outcome assessments to provide further insights into the optimal management of RAS.

Ethics

Ethics Committee Approval: The study was carried out with the permission of Ankara University Faculty of Medicine Human Research Ethics Committee (date: 28.01.2023, approval no.: İ02-73-23, registration no: 2023/40).

Informed Consent: Because the study was designed retrospectively, no written informed consent form was obtained from patients. However, patients' procedure consents were available.

Authorship Contributions

Surgical and Medical Practices: E.C.Ç., S.B., Concept: E.U.B., E.C.Ç., Ö.A.Ç., K.A., E.Ö., S.B., Design: E.U.B., E.C.Ç., Ö.A.Ç., K.A., E.Ö., S.B., Data Collection and/or Processing: E.U.B., E.C.Ç., Analysis and/or Interpretation: E.U.B., E.C.Ç., Literature Search: E.U.B., E.C.Ç., Writing: E.U.B., E.C.Ç.

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