




Case Reports

Anterior Renal Nutcracker Syndrome in an Older Adult Treated with Endovascular Stenting

Karishma Vijay Rupani, MD, MMSc¹ , Maria Riasat, MD¹, Geetika Arora, MD¹, Sreelakshmi Vasudevan, MD¹, Dennis Kurian, MD¹, Sawan Vijay Rupani, MD²

¹ Department of Medicine, Icahn School of Medicine at Mount Sinai Beth Israel, New York, New York, USA, ² Division of Diabetes, Endocrinology and Metabolism, University of Nebraska Medical Center, Omaha, NE, USA

Keywords: nutcracker syndrome, endovascular stenting

<https://doi.org/10.56305/001c.37990>

Vol. 1, Issue 4, 2022

Anterior nutcracker syndrome occurs when the left renal vein is compressed between the abdominal aorta and the superior mesenteric artery. A 71-year-old woman presented to hospital with sudden-onset intense lower abdominal pain with radiation to the left flank region. Her lab work was significant for hemoglobin 9.8 G/DL (11.7 - 15.0 G/DL), creatinine 1.52 mg/dL (0.50 - 1.10 mg/dL) and microscopic examination of the urine contained red blood cells. Computed tomography scan of the abdomen & pelvis with contrast showed left renal vein narrowing as it crosses between the superior mesenteric artery and the aorta, consistent with nutcracker syndrome. The patient underwent a venogram study alongside intravascular ultrasound and was treated with left renal vein wall stenting and venoplasty. She tolerated the procedure well and was successfully discharged on daily anticoagulation with rivaroxaban for one month with close follow-up.

INTRODUCTION

The most common vascular etiology of abdominal pain is mesenteric ischemia from an arterial embolism, arterial or venous thrombosis, and non-occlusive ischemia secondary to intestinal hypoperfusion. Furthermore, both arterial and venous occlusion can lead to intestinal ischemia from volvulus around the mesenteric defect. Acute mesenteric ischemia may also be observed in the setting of an underlying vasculitis; however, it may be difficult to determine whether arterial occlusion or spasm-related hypoperfusion is the cause of segmental intestinal infarction. Anterior nutcracker syndrome (NCS) occurs when the left renal vein is compressed between the abdominal aorta and the superior mesenteric artery (SMA) and is a rare cause of vascular abdominal pain. Posterior nutcracker syndrome is less common and occurs when the left renal vein is compressed between the abdominal aorta and a lumbar vertebral body.¹⁻³ Renal nutcracker syndrome remains underdiagnosed with a poorly defined clinical course.⁴

CASE

A 71-year-old woman who presented to hospital with sudden-onset intense abdominal pain over the lower abdomen (right iliac region, hypogastric region and left iliac region) with radiation to the left flank region. She also reported nausea, non-bloody & non-bilious vomiting, and loss of appetite. She denied hematemesis, melena, bright red blood per rectum and back pain. Her past medical history included asthma, hypertension, hyperlipidemia, type 2 diabetes mellitus, liver cirrhosis associated with non-alcoholic

steatohepatitis and iron-deficiency anemia. Her medications at the time of admission were albuterol, rosuvastatin, empagliflozin, glimepiride, sitagliptan, furosemide, spironolactone, nadolol and omeprazole. On physical examination, her BMI was 20.45 kg/m². Vital signs were within normal limits and she was afebrile. She appeared to be in severe pain and was writhing in the hospital bed due to her discomfort. Her abdomen was soft and diffusely tender to palpation without guarding or rigidity. She had no back tenderness or costovertebral angle tenderness. Capillary refill time was <2 seconds on all 4 extremities. Radial, ulnar, brachial, subclavian and carotid pulses were 3+. There were no carotid bruits on auscultation. There was no radial-radial delay. Her femoral, popliteal, dorsalis pedis and posterior tibial pulses were also all 3+. There was no evidence of venous stasis and neuro-sensory examination was intact. Laboratory blood analysis was significant for serum hemoglobin 9.8 g/dL (11.7 - 15.0 g/dL), serum creatinine 1.52 mg/dL (0.50 - 1.10 mg/dL), serum lipase 128 U/L (8 - 78 U/L) and serum gamma-glutamyl transferase 124 U/L (8 - 35 U/L) with otherwise normal liver function tests. Microscopic examination of the urine showed evidence of hematuria. Abdominal imaging with a computed tomography (CT) scan of the abdomen & pelvis with contrast showed left renal vein narrowing as it crosses between the superior mesenteric artery and the aorta ([Figure 1](#)). There was no evidence of abdominal ascites. Anterior nutcracker syndrome of the left renal vein was diagnosed. The patient underwent a venogram study alongside intravascular ultrasound and was treated with left renal vein wall stenting (Boston Sci Wallstent 18 mm x 60 mm) and venoplasty. She tolerated the procedure well and was successfully dis-



Figure 1. Computed tomography scan of the abdomen & pelvis with contrast showed left renal vein narrowing (red arrow) as it crosses between the superior mesenteric artery (SMA) and the aorta.

charged on systemic anticoagulation with rivaroxaban 20 mg daily for one month with close follow-up.

DISCUSSION

Nutcracker phenomenon (NCP), also known as left renal vein entrapment, is characterized by obstructed outflow from the left renal vein (LRV) into the inferior vena cava (IVC) due to extrinsic LRV compression. The term “nutcracker” is used to describe these anatomic findings as this compression of the LRV is akin to a nutcracker crushing a nut. Nutcracker syndrome describes patients with clinical symptoms associated with nutcracker anatomy. Although the terms nutcracker phenomenon and nutcracker syndrome are frequently used interchangeably, nutcracker anatomy is not always associated with clinical symptoms and may represent a normal variant. The classical presentation of NCS usually includes hematuria associated with left flank pain. Patients may present with a wide variety of symptoms including varicocele, pelvic congestion syndrome and orthostatic proteinuria.⁵ The prevalence of NCS is unknown, however it has been described as more common in women.^{6–8} Anterior NCS results from compression of the LRV between the SMA and the aorta, while posterior NCS results from compression of the LRV between the aorta and the lumbar spine. Furthermore, conditions associated with an increased risk of NCS include retroperitoneal tumors, para-aortic lymphadenopathy, abdominal aortic aneurysm, left renal vein duplication, nephroptosis, lordosis and decreased retroperitoneal and mesenteric adipose tissue.⁹ Diagnostic tools commonly used to identify NCS include CT, magnetic resonance imaging (MRI) and Doppler ultrasonographic assessment of left renal vein diameter and peak velocity.^{6,8,10} Venography used to be the gold standard to confirm the diagnosis, but it is invasive and is now reserved for treatment purposes. During venography, the

pressure gradient between the IVC and the LRV is measured, which should be > 3 mm Hg in NCS (normal pressure gradient is 0–1 mm Hg).⁶ Management of nutcracker syndrome remains controversial. Patients with mild symptoms are usually managed conservatively with regular surveillance and a focus on weight gain to increase retroperitoneal adiposity, leading to decompression of the left renal vein due to adjustment in position of the left kidney. If symptoms such as significant hematuria and left flank pain persist, such as in our patient, intervention with endovascular stenting or surgery may be necessary.^{11,12} In patients treated surgically with open repair, excellent long-term outcomes have been reported. Less-invasive endovascular stent placement appears to offer good results in the short term and long-term outcomes are still being investigated. Advances in venous stent technology are anticipated and may result in endovascular treatment of additional cases in the future.¹³

AUTHOR CONTRIBUTION

All Authors (KVR, MR, GA, SV, DK, SVR) have reviewed the final manuscript prior to submission. All the authors have contributed significantly to the manuscript, per the ICJME criteria of authorship.

- Substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data for the work; AND
- Drafting the work or revising it critically for important intellectual content; AND
- Final approval of the version to be published; AND
- Agreement to be accountable for all aspects of the work in ensuring that questions related to

DISCLOSURES/CONFLICTS OF INTEREST

None

FUNDING INFORMATION

None

CORRESPONDING AUTHOR

Karishma Vijay Rupani, MD MMSc
Resident Physician in Internal Medicine
Department of Medicine
Mount Sinai Beth Israel
350 East 17th Street
20th Floor
New York, NY 10003
karishma.rupani@mountsinai.org

Submitted: June 21, 2022 EST, Accepted: August 29, 2022 EST



This is an open-access article distributed under the terms of the Creative Commons Attribution 4.0 International License (CCBY-NC-4.0). View this license's legal deed at <https://creativecommons.org/licenses/by-nc/4.0> and legal code at <https://creativecommons.org/licenses/by-nc/4.0/legalcode> for more information.

REFERENCES

1. Gulleroglu K, Gulleroglu B, Baskin E. Nutcracker syndrome. *World J Nephrol.* 2014;3(4):277-281. doi:[10.5527/wjn.v3.i4.277](https://doi.org/10.5527/wjn.v3.i4.277)
2. Ananthan K, Onida S, Davies AH. Nutcracker Syndrome: An Update on Current Diagnostic Criteria and Management Guidelines. *Eur J Vasc Endovasc Surg Off J Eur Soc Vasc Surg.* 2017;53(6):886-894. doi:[10.1016/j.ejvs.2017.02.015](https://doi.org/10.1016/j.ejvs.2017.02.015)
3. Atkinson TH, Love M, Messer J. Gross hematuria caused by nutcracker syndrome and segmental pseudoaneurysm. *Can J Urol.* 2015;22(2):7745-7747.
4. del Canto Peruyera P, Vaquero Lorenzo F, Vallina-Victorero Vazquez MJ, et al. Recurrent hematuria caused by nutcracker syndrome. *Ann Vasc Surg.* 2014;28(4):1036.e15-19. doi:[10.1016/j.avsg.2013.05.021](https://doi.org/10.1016/j.avsg.2013.05.021)
5. Kurklinsky AK, Rooke TW. Nutcracker Phenomenon and Nutcracker Syndrome. *Mayo Clin Proc.* 2010;85(6):552-559. doi:[10.4065/mcp.2009.0586](https://doi.org/10.4065/mcp.2009.0586)
6. Shin JI, Park JM, Lee JS, Kim MJ. Effect of renal Doppler ultrasound on the detection of nutcracker syndrome in children with hematuria. *Eur J Pediatr.* 2007;166(5):399-404. doi:[10.1007/s00431-006-0252-7](https://doi.org/10.1007/s00431-006-0252-7)
7. Shin JI, Lee JS, Kim MJ. The prevalence, physical characteristics and diagnosis of nutcracker syndrome. *Eur J Vasc Endovasc Surg Off J Eur Soc Vasc Surg.* 2006;32(3):335-336. doi:[10.1016/j.ejvs.2006.04.030](https://doi.org/10.1016/j.ejvs.2006.04.030)
8. Okada M, Tsuzuki K, Ito S. Diagnosis of the nutcracker phenomenon using two-dimensional ultrasonography. *Clin Nephrol.* 1998;49(1):35-40.
9. Basile A, Tsetis D, Calcara G, et al. Nutcracker Syndrome Due to Left Renal Vein Compression by an Aberrant Right Renal Artery. *Am J Kidney Dis.* 2007;50(2):326-329. doi:[10.1053/j.ajkd.2007.05.016](https://doi.org/10.1053/j.ajkd.2007.05.016)
10. Kim SH, Cho SW, Kim HD, Chung JW, Park JH, Han MC. Nutcracker syndrome: diagnosis with Doppler US. *Radiology.* 1996;198(1):93-97. doi:[10.1148/radiology.198.1.8539413](https://doi.org/10.1148/radiology.198.1.8539413)
11. Erben Y, Gloviczki P, Kalra M, et al. Treatment of nutcracker syndrome with open and endovascular interventions. *J Vasc Surg Venous Lymphat Disord.* 2015;3(4):389-396. doi:[10.1016/j.jvsv.2015.04.003](https://doi.org/10.1016/j.jvsv.2015.04.003)
12. Cronan JC, Hawkins CM, Kennedy SS, Marshall KW, Rostad BS, Gill AE. Endovascular management of nutcracker syndrome in an adolescent patient population. *Pediatr Radiol.* 2021;51(8):1487-1496. doi:[10.1007/s00247-021-04986-0](https://doi.org/10.1007/s00247-021-04986-0)
13. Policha A, Lamparello P, Sadek M, Berland T, Maldonado T. Endovascular Treatment of Nutcracker Syndrome. *Ann Vasc Surg.* 2016;36:295.e1-295.e7. doi:[10.1016/j.avsg.2016.04.005](https://doi.org/10.1016/j.avsg.2016.04.005)