Incidental Finding of a Retroaortic Left Renal Vein with Pelvic Venous Congestion Consistent with Posterior Nutcracker Syndrome: A Case Report

Antonia Berz[1], Théo Sartoretti[1], Rami Hajri[1]*[#], Guillaume Fahrni[1]*[#]

[1]*Department of Diagnostic and Interventional Radiology, Lausanne University Hospital and University of Lausanne, Switzerland*

[#]*Equal Contributed*

***Correspondence:** Rami Hajri, Department of Diagnostic and Interventional Radiology, Lausanne University Hospital and University of Lausanne, Rue du Bugnon 46, 1011 Lausanne, Switzerland

rami.hajri@chuv.ch

Radiology Case. 2025 December ; 19(12):1-10 :: DOI: 10.3941/jrcr.5888

AUTHORS' CONTRIBUTIONS

Antonia Berz: Reporting radiologist and primary author of the manuscript, preparation of figures and tables.
Théo Sartoretti: Patient interview and clinical data collection; critical revision and editing of the manuscript.
Rami Hajri: Reporting radiologist and supervisor; critical revision and editing of the manuscript.
Guillaume Fahrni: Reporting radiologist and supervisor; critical revision and editing of the manuscript.

ACKNOWLEDGEMENTS

N/A.

DISCLOSURES

All authors declare no potential conflict of interest.

CONSENT

Yes.

HUMAN AND ANIMAL RIGHTS

No experiments on human or animal subjects were carried out.

ABSTRACT

Posterior nutcracker syndrome is a rare vascular disorder caused by compression of the retroaortic left renal vein between the aorta and the vertebral column. While many patients remain asymptomatic, it can lead to pelvic congestion in some cases.

We report the case of a 31-year-old woman undergoing routine oncologic staging following curative resection of a sigmoid adenocarcinoma. She was asymptomatic, with normal laboratory findings. Contrast-enhanced CT demonstrated compression of the retroaortic left renal vein, with a diameter ratio of 1:3.3. Prominent pelvic varices and a dilated left ovarian vein measuring up to 8 × 8 mm were also noted, consistent with posterior nutcracker syndrome. Due to the incidental nature of the findings and the absence of symptoms, conservative management was chosen.

This case highlights the incidental radiological detection of posterior nutcracker syndrome and underscores the diagnostic challenge posed by its frequently asymptomatic course and the absence of standardized diagnostic criteria.

CASE REPORT

BACKGROUND

Posterior nutcracker syndrome (PNCS) is a rare vascular disorder resulting from compression of a retroaortic left renal vein (RLRV) between the aorta and the vertebral body. Unlike its more common anterior form, PNCS lacks standardized diagnostic criteria and is frequently asymptomatic, posing a diagnostic challenge in clinical practice. The incidental detection of PNCS in asymptomatic individuals during routine imaging, such as oncological follow-up, remains insufficiently documented in the literature. This case underscores the importance of recognizing PNCS as an anatomical variant characterized by a RLRV and associated pelvic venous congestion, even in the absence of clinical symptoms, given its potential clinical relevance.

CASE REPORT

A 31-year-old woman underwent routine imaging staging as part of oncological surveillance in the context of a recent diagnosis of sigmoid colon adenocarcinoma. She had previously undergone laparoscopic left hemicolectomy with curative intent and was asymptomatic at the time of evaluation. Notably, she reported no symptoms suggestive of pelvic venous disorder, including chronic pelvic discomfort, hematuria, or flank pain. There were no known risk factors and laboratory investigations were unremarkable, with no evidence of hematuria and normal renal function, including serum creatinine.

Imaging Findings

A contrast-enhanced portal venous phase computed tomography (CT) of the abdomen and pelvis incidentally revealed a retroaortic left renal vein coursing between the aorta and the vertebral column, with measurable narrowing at the point of compression (10 vs 3 mm, diameter ratio of 1: 3.3) (Figures 1,3), consistent with posterior nutcracker phenomenon. Prominent pelvic venous varices were observed, indicating downstream venous congestion with left ovarian vein dilatation measuring up to 8 × 8 mm in diameter (Figures 2,3). There was no evidence of complications such as secondary left renal vein (LVR) thrombosis.

Management

Given the absence of symptoms, no specific intervention was undertaken. The pelvic venous congestion was interpreted as an incidental radiological finding.

Follow-Up

The dilatation of the left renal and ovarian vein remained stable at the three months follow-up, and the patient stayed asymptomatic. Clinical and imaging surveillance was maintained within the framework of her routine oncological assessments. To date, no progression of the venous dilatation or development of related symptoms has been observed.

DISCUSSION

The nutcracker syndrome (NCS) is a rare vascular compression disorder that forms part of the broader group of pelvic vascular compression syndromes, which also includes more common entities such as May-Thurner syndrome [1]. NCS results from extrinsic compression of the LRV, leading to impaired venous drainage and potential development of venous hypertension; it can be either congenital or acquired in origin [2]. Two anatomical variants of NCS are described:

Firstly, the anterior NCS (ANCS), more frequently encountered, involves compression of the LRV between the abdominal aorta and the superior mesenteric artery (SMA). This typically results from a narrow aorto-mesenteric angle (<35–39°) and an aorto-mesenteric distance of less than 8 mm, which can impede venous outflow and lead to the development of collateral venous circulation [3].

Secondly, the PNCS, also referred to as "pseudo-nutcracker syndrome", is a less common variant in which a RLRV is compressed between the aorta and the vertebral body [2].

The RLRV represents a developmental venous anomaly wherein the left renal vein courses posterior to the abdominal aorta, as opposed to its usual anterior (preaortic) course. RLRV variants are categorized into four subtypes based on embryological development and venous drainage patterns [4]:

· *Type I:* Obliteration of the anterior (preaortic) limb of the LRV with persistence of the posterior (retroaortic) limb draining into the inferior vena cava (IVC) at its typical orthotopic position.

· *Type II:* Similarly, obliteration of the preaortic limb, with the retroaortic vein coursing more caudally at the level of L4–L5, draining into the IVC after receiving collaterals such as the gonadal and ascending lumbar veins.

· *Type III (circumaortic renal vein):* Persistence of subsupracardial and intersupracardial anastomoses of the left renal vein which form a venous collar encircling the aorta. This is the most frequently reported variant, with an estimated incidence of up to 16%.

· *Type IV:* The retroaortic vein bypasses the IVC entirely and drains into the left common iliac vein, following an oblique and caudal course. This is the rarest form.

Among these retroaortic variants, particularly Type I, is the anatomical configurations which are the most prone to impaired venous outflow from the left kidney. Their clinical relevance may be primary, in cases of significant congenital left renal vein compression, or secondary to pathological alterations of the aorta or spine, including aortic aneurysms or osteophytosis [5-7].

Etiology & demographics

PNCS is a rare condition and its exact prevalence remains unknown, partly because of an absence of definitive diagnostic criteria and partly because of the variability in symptomatic presentation, and only a limited number of cases have been reported in the literature; e.g., a recently published systematic review identified just 27 documented cases, with equal gender distribution (male : female) and affecting all ages, but most commonly > 18 years (Table 1) [8]. Predisposing factors for PNCS include a retroaortic left renal vein (necessary underlying condition), rapid growth during puberty, pregnancy, abdominal aortic aneurysm, pancreatic neoplasms, para-aortic lymphadenopathy, retroperitoneal tumors, and compressive fibrolymphatic tissue between the aorta and vertebrae [9-10]. The reported incidence of RLRV on the other hand side ranges from 0.5 to 6.8% in the general population and is increasingly detected incidentally, owing to the enhanced spatial resolution of modern cross-sectional imaging techniques, particularly contrast-enhanced CT [11].

Clinical findings

The clinical presentation of PNCS is similar to that of NCS and is highly variable. Many cases are asymptomatic; however,

patients may experience chronic pelvic discomfort, hematuria, or flank pain, dyspareunia, post-coital ache, which can significantly affect a patient's quality of life [8,12,13]. In female patients, pelvic congestion syndrome with pelvic varicosities, is the typical manifestation [14]. In male patients, it is responsible in 9% of patients for left-sided varicocele [2,3,14]. Some cases of secondary hypertension attributed to PNCS have also been reported [15-16]. Moreover, although uncommon, PNCS can lead to severe complications, including left renal vein thrombosis and pulmonary embolism [17].

Nonetheless, these vascular abnormalities are often detected incidentally on imaging studies without associated symptoms, a condition often referred to as the "nutcracker phenomenon" [2,5,14].

Imaging findings

Doppler ultrasound serves as the initial imaging modality, enabling the identification of LRV stenosis, signs of renal venous congestion, associated findings such as varicocele and assessing venous flow dynamics [3]. However, due to its limited capacity to assess complex anatomical relationships, further evaluation using contrast-enhanced CT or MRI **is** warranted for comprehensive anatomical assessment.

Portal venous phase contrast-enhanced CT enables detailed visualization of PNCS by clearly delineating the retroaortic course of the LRV and its compression between the aorta and the vertebral body [2]. This enables a precise assessment of *key parameters* essential for accurate diagnosis and evaluation, including:

- classification of the LRV, with particular attention to Type I, which are more susceptible to impaired venous outflow and downstream venous hypertension due to compression,
- evaluation of the diameter ratio between the compressed segment and the dilated proximal portion of the LRV,
- measurement of the aorto-vertebral distance,
- assessment of the presence and extent of collateral venous pathways,
- quantification of venous dilatation, especially involving the gonadal and pelvic veins.

In contrast to ANCS, no established diagnostic cut-off values currently exist for the aorto-vertebral distance or the diameter ratio (dilated proximal portion : compressed segment of the LRV) in PNCS.

CT also plays a crucial role in identifying other potential complications, including renal parenchymal changes, ureteral compression, or thrombosis, although these are less common [3,8,18].

Additionally, CT imaging effectively excludes differential diagnoses such as retroperitoneal tumors, lymphadenopathy, and adnexal masses [3,8,18].

Importantly, radiologic findings often precede clinical symptoms, highlighting the need for radiologists to be familiar with these variants even in asymptomatic individuals.

While CT remains a cornerstone for anatomical evaluation, MRI offers a compelling alternative, particularly in younger patients or those requiring follow-up imaging. It replicates CT's ability to assess LRV compression, collateral pathways, and complications, without radiation exposure, while adding functional insights through 4D flow sequences [19].

Treatment & prognosis

Although ANCS and PNCS are well-recognized clinical entities, standardized treatment strategies remain a subject of debate due to the wide spectrum of clinical manifestations and the absence of a standardized diagnostic algorithm, leading to variability in patient evaluation and inconsistent clinical decision-making [20]. Therefore, management of ANCS and PNCS is guided by symptom severity, clinical impact, and the presence of complications.

Conservative management is favored in pediatric patients and individuals with no or mild symptoms, based on the premise that physiological growth and weight gain may reduce venous compression over time. Notably, symptom resolution has been reported in approximately 75% of mild to moderate cases following conservative treatment [13, 21].

For patients with significant or persistent symptoms, like recurrent gross hematuria or severe flank pain, *surgical treatments* may be considered. The transposition of the LRV, which involves reimplantation of the vein into the IVC to relieve compression, is considered as the standard of care [13,21]. It has demonstrated both immediate and sustained symptom relief, with multiple case series reporting clinical improvement in approximately 80% of patients [8,13]. Nevertheless, this approach is invasive and carries the potential for peri- and postoperative complications.

Coil embolization of the ovarian veins in patients with pelvic congestion syndrome can lead to symptomatic improvement in 56% to 98% of cases [10]. However, potential complications include venous rupture and coil migration to the lungs.

Endovascular stenting of the LRV has been employed as a less invasive alternative. Selection of treatment options (coiling vs. stenting) depends on the specific anatomical features, symptom burden, and risk-benefit assessment [19,22]. Nonetheless, these interventions are associated with procedural risks, long-term complications (e.g., stent migration, thrombosis), and uncertain material durability, particularly in younger individuals [23]. Novel technologies, such as patient-specific 3D-printed stents, are currently being explored as potential future solutions, although clinical data supporting their use remain limited [14].

The long-term prognosis for patients with incidental posterior nutcracker-like compression is generally favorable. Many

remain clinically stable without progression or development of symptoms. In symptomatic cases, appropriately selected interventions often lead to substantial symptom relief [14].

Differential Diagnoses

The diagnosis of PNCS compression can be challenging due to the overlap of symptoms and imaging features with several other vascular and non-vascular conditions that affect the retroperitoneum and pelvis (Table 2), including [1,10]:

1. Anterior Nutcracker Syndrome (ANCS):

Unlike the posterior variant, ANCS involves compression of the LRV between the aorta and the SMA, because of a decreased aorto-mesenteric angle of <35–39° and an aorto-mesenteric distance of < 8 mm [2]. Both variants of NCS, can present similar symptoms with hematuria, flank pain, or pelvic congestion; imaging is crucial to distinguish the anatomical course and site of compression [2].

2. May-Thurner Syndrome:

This condition involves compression of the left common iliac vein between the lower lumbar spine and the right common iliac artery [24]. While some cases are asymptomatic, it can cause severe symptoms in individuals, most commonly deep vein thrombosis and post thrombotic sequelae and sometimes pelvic varices [24].

3. Ovarian Neoplasms or Adnexal Masses:

Complex adnexal masses can occasionally mimic pelvic venous engorgement [18]. Conversely, "true" adnexal or ovarian masses may lead to secondary venous congestion due to compression of adjacent pelvic veins [18].

4. Retroperitoneal Fibrosis or Lymphadenopathy:

Fibrotic bands or enlarged lymph nodes within the retroperitoneum may exert extrinsic compression on retroperitoneal vessels, including the left renal vein, thereby mimicking nutcracker-like phenomena [25]. These conditions often present with additional imaging features such as ureteral encasement, medial deviation of the ureters, and associated hydronephrosis [25]. Clinical findings, including lower back pain, renal dysfunction, and systemic symptoms depending on the underlying etiology, may also help differentiate these entities from primary vascular compression syndromes [25].

5. Inferior Vena Cava (IVC) Anomalies:

Congenital variations of the inferior vena cava, such as duplication or left-sided IVC, can significantly alter venous drainage patterns. These anomalies may lead to pelvic varices or left-sided venous hypertension and must be recognized during interpretation of pelvic and retroperitoneal imaging to prevent misdiagnosis and guide management [26].

In all cases, a multimodal imaging approach combined with a detailed clinical history is essential to differentiate true nutcracker-like compression from mimicking entities, ensuring appropriate management and avoiding unnecessary interventions.

TEACHING POINT

The posterior nutcracker syndrome is an anatomical variant in which the retroaortic left renal vein is compressed between the aorta and vertebral body, potentially leading to pelvic venous congestion. Cross-sectional imaging, particularly contrast-enhanced CT, plays a key role in identifying the characteristic findings, including dilated left renal and pelvic veins, even in asymptomatic individuals.

QUESTIONS

Question 1: Which of the following statements about posterior nutcracker syndrome is correct?

1. It results from compression of the left renal vein between the aorta and the superior mesenteric artery.
2. It results from compression of the left renal vein between the abdominal aorta and the right common iliac artery.
3. It involves a retroaortic left renal vein compressed between the aorta and vertebral body. (**applies**)
4. It results from compression of the left renal vein by retroperitoneal lymphadenopathy or fibrosis.
5. The threshold is defined by an aorto-vertebral distance less than 8 mm.

Explanations:

1. This describes anterior nutcracker syndrome, where the left renal vein is compressed between the aorta and the superior mesenteric artery. *["The anterior nutcracker syndrome … involves compression of the left renal vein between the abdominal aorta and the superior mesenteric artery."]*
2. This describes May-Thurner syndrome, where the left common iliac vein is compressed between the right common iliac artery and the spine. *["…this condition involves compression of the left common iliac vein between the lower lumbar spine and the right common iliac artery."]*
3. The posterior nutcracker syndrome typically involves a retroaortic left renal vein that is compressed between the aorta and the vertebral column. *["…a retroaortic left renal vein … compressed between the aorta and the vertebral body."]*
4. While retroperitoneal fibrosis or lymphadenopathy can cause extrinsic venous compression, these are differential diagnoses or mimics and not the mechanism of true posterior nutcracker syndrome. *["Fibrotic bands or enlarged lymph nodes may compress retroperitoneal vessels, including the left renal vein, mimicking nutcracker-like phenomena."]*
5. Unlike anterior nutcracker syndrome, there is no standardized diagnostic threshold for posterior nutcracker syndrome. *["unlike anterior nutcracker syndrome, standardized diagnostic thresholds for posterior nutcracker syndrome are lacking."]*

Question 2: Which statements about the prevalence and predisposing factors of posterior nutcracker syndrome are correct?

1. Posterior nutcracker syndrome is frequently observed.
2. Posterior nutcracker syndrome affects only female patients.
3. A retroaortic left renal vein is a necessary underlying anatomical condition for posterior nutcracker syndrome. (**applies**)
4. Most documented cases of posterior nutcracker syndrome occur in children under 10 years of age.
5. Posterior nutcracker syndrome can be observed in all ages, but most commonly observed in adults over 18 years. (**applies**)

Explanations:

1. The posterior nutcracker syndrome is a rare condition. *["Posterior nutcracker syndrome is a rare condition and its exact prevalence remains unknown, partly because of an absence of definitive diagnostic criteria and partly because of the variability in symptomatic presentation..."]*
2. Posterior nutcracker syndrome can affect both males and females. *["... equal gender distribution (male : female)."]*
3. Posterior nutcracker syndrome requires a retroaortic course of the left renal vein in order for compression to occur between the aorta and the vertebral body. *["Posterior nutcracker syndrome is defined as compression of the retroaortic left renal vein..."]*
4. While it may occur in children, it is most commonly seen in adults, not in the pediatric population. *["...affecting all ages, but most commonly >18 years."]*
5. Although it can occur at any age, the majority of reported cases are in adults. *["...affecting all ages, but most commonly >18 years."]*

Question 3: Which statements about clinical presentation of posterior nutcracker <u>are</u> correct?

1. Posterior nutcracker syndrome always causes hematuria.
2. It may be entirely asymptomatic. (**applies**)
3. Chronic pelvic pain is a common symptom. (**applies**)
4. Post-coital ache is a potential symptom. (**applies**)
5. May-Thurner syndrome is synonymous with posterior nutcracker.

Explanations:

1. Hematuria is a common symptom but <u>not always</u> present. *["The clinical presentation of posterior nutcracker syndrome is highly variable and may include hematuria, flank pain, chronic pelvic pain, and other nonspecific symptoms."]*
2. Many patients with posterior nutcracker syndrome are asymptomatic and are only diagnosed incidentally. *["posterior nutcracker syndrome may be entirely asymptomatic and discovered incidentally on imaging studies"]*
3. Chronic pelvic pain, especially in women, is a frequent symptom in posterior nutcracker syndrome due to venous congestion. *["Chronic pelvic pain and dyspareunia are frequently observed, particularly in women, and are attributable to pelvic venous congestion."]*
4. Post-coital ache is part of the symptoms of the pelvic congestion syndrome. *["... patients may experience ... post-coital ache, which can significantly affect a patient's quality of life."]*
5. These are distinct entities: May-Thurner affects the left iliac vein, while posterior nutcracker involves the left renal vein. *["It is important to distinguish posterior nutcracker syndrome from other venous compression syndromes, such as May–Thurner syndrome…"]*

Question 4: A variant of the left renal vein shows regression of the anterior (preaortic) limb and persistence of the posterior (retroaortic) limb, which drains into the inferior vena cava at the typical orthotopic position. Which RLRV subtype does this describe?

1. Type I (**applies**)
2. Type II
3. Type III
4. Type IV
5. Normal venous anatomy

Explanations:

1. Type I is defined by *["...obliteration of the anterior (preaortic) limb of the left renal vein with persistence of the posterior (retroaortic) limb draining into the inferior vena cava) at its typical orthotopic position."]*. This configuration is classically associated with posterior nutcracker syndrome due to compression between the aorta and spine. *["Among these retroaortic variants, is the anatomical configurations which are the most prone to impaired venous outflow from the left kidney."]*
2. Type II also shows *["... obliteration of the preaortic limb, with the retroaortic vein coursing more caudally at the level of L4–L5, draining into the inferior vena cava after receiving collaterals such as the gonadal and ascending lumbar veins."]*
3. In Type III there is a *["... persistence of subsupracardial and intersupracardial anastomoses and the dorsal limb of the left renal vein which form a venous collar encircling the aorta."]*
4. In Type IV the *["...retroaortic vein bypasses the inferior vena cava entirely and drains into the left common iliac vein, following an oblique and caudal course."]*
5. In normal venous development, the left renal vein passes anterior to the aorta and does not have a retroaortic course.

Question 5: What are correct management strategies for asymptomatic posterior nutcracker syndrome?

1. Surgical transposition of the left renal vein
2. Endovascular stenting
3. Conservative treatment (**applies**)
4. Anticoagulation therapy
5. Nephrectomy

Explanations:

1. Surgical intervention is typically reserved for symptomatic or complicated cases (e.g., persistent hematuria, severe pain, renal function impairment). *["Conservative management is the standard of care for asymptomatic cases."]*
2. Stenting is considered in selected symptomatic patients or when conservative management fails. It is not indicated for asymptomatic individuals. *["Selection of treatment options (coiling vs. stenting) depends on the specific anatomical features, symptom burden, and risk-benefit assessment."]*
3. In the absence of symptoms, conservative treatment is the recommended approach. *["Conservative management is commonly favored in ... individuals with no or mild symptoms."]*
4. Anticoagulation is not a standard treatment for posterior nutcracker syndrome unless there's evidence of thrombosis.
5. Nephrectomy is generally not considered in the management of posterior nutcracker syndrome, especially not for asymptomatic patients.

REFERENCES

[1] Rezaei-Kalantari K, Fahrni G, Rotzinger DC, Qanadli SD. Insights into pelvic venous disorders. *Front Cardiovasc Med.* 2023; 10: 1102063. PMID: 36742076.

[2] Kolber MK, Cui Z, Chen CK, Habibollahi P, Kalva SP. Nutcracker syndrome: diagnosis and therapy. *Cardiovasc Diagn Ther.* 2021; 11(5): 1140-1149. PMID: 34815965.

[3] Gozzo C, Giambelluca D, Cannella R, et al. CT imaging findings of abdominopelvic vascular compression syndromes: what the radiologist needs to know. *Insights Imaging.* 2020; 11(1): 48. PMID: 32185572.

[4] Nam JK, Park SW, Lee SD, Chung MK. The clinical significance of a retroaortic left renal vein. *Korean J Urol.* 2010; 51(4): 276-80. PMID: 20428432.

[5] Puig S, Stühlinger HG, Domanovits H, et al. Posterior "Nutcracker" phenomenon in a patient with abdominal aortic aneurysm. *Eur Radiol.* 2002; 12 Suppl 3: S133-S135. PMID: 12522623.

[6] Rassi I, Khabbaz Z, Chelala D, Jebara VA. A new variant of the posterior nutcracker phenomenon. *J Vasc Surg.* 2010; 51(5): 1279. PMID: 19540704.

[7] Lamba R, Tanner DT, Sekhon S, McGahan JP, Corwin MT, Lall CG. Multidetector CT of vascular compression syndromes in the abdomen and pelvis. *Radiographics.* 2014; 34(1): 93-115. PMID: 24428284.

[8] Park JH, Lee GH, Lee SM, et al. Posterior nutcracker syndrome - a systematic review. *Vasa.* 2018; 47(1): 23-29. PMID: 29165061.

[9] Penfold D, Leslie SW, Lotfollahzadeh S. Nutcracker Syndrome and Left Renal Vein Entrapment. 2024 May 7. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2025. PMID: 32644615.

[10] Skeik N, Gloviczki P, Macedo TA. Posterior nutcracker syndrome. *Vasc Endovascular Surg.* 2011; 45(8): 749-55. PMID: 21890560.

[11] Alharbi, Y., Jan, M.M. Anatomical Study of the Rare Left Renal Vein Anomaly. Artery Res 31, 15 (2025). [https://doi.org/10.1007/s44200-025-00082-y].

[12] Sablón González N, Lorenzo Villalba N, Parodis López Y, González Díaz P, Boada Díaz J, Kechida M. Síndrome del cascanueces [Nutcracker syndrome]. *Medicina (B Aires).* 2019; 79(2): 150-153. PMID: 31048282.

[13] Miró I, Serrano A, Pérez-Ardavín J, et al. Eighteen years of experience with pediatric nutcracker syndrome: the importance of the conservative approach. *J Pediatr Urol.* 2020; 16: 218.e1-218.e6. PMID: 32044256.

[14] Perić V, Ferenc T, Bratić T, et al. Controversies in treating nutcracker syndrome. *CVIR Endovasc.* 2025; 8(1): 26.

[15] Mazarakis A, Almpanis G, Tragotsalou N, Karnabatidis D, Fourtounas C. Is hypertension a manifestation of the nutcracker phenomenon/syndrome? Case report and brief review of the literature. *Hippokratia*. 2012; 16(2): 187-189. PMID: 23935279.

[16] Park SJ, Kim SM, Won JH, Lim HS. A case of secondary hypertension associated with the nutcracker phenomenon. *Korean Circ J.* 2014; 44(6): 434-436. PMID: 25469147.

[17] Lizama L, Bran S, Kuestermann S, García-Gallont R. RENAL VEIN THROMBOSIS DUE TO POSTERIOR NUTCRACKER SYNDROME. *Methodist Debakey Cardiovasc J.* 2020; 16(4): e5-e7. PMID: 33500769.

[18] Bookwalter CA, VanBuren WM, Neisen MJ, Bjarnason H. Imaging Appearance and Nonsurgical Management of Pelvic Venous Congestion Syndrome. *Radiographics.* 2019; 39(2): 596-608. PMID: 30844351. [19] Ananthan K, Onida S, Davies AH. Nutcracker syndrome: an update on current diagnostic criteria and management guidelines. *Eur J VascEndovascSurg.* 2017; 53(6): 886–894. PMID: 28356209.

[20] Heilijgers F, Gloviczki P, O'Sullivan G, et al. Nutcracker syndrome (a Delphi consensus). *J Vasc Surg Venous Lymphat Disord.* 2025; 13(1): 101970. PMID: 39362632.

[21] Marone EM, Psacharopulo D, Kahlberg A, Coppi G, Chiesa R. Surgical treatment of posterior nutcracker syndrome. *J Vasc Surg.* 2011; 54(3): 844-847. PMID: 21458199.

[22] Granata A, Clementi A, Floccari F, Di Lullo L, Basile A. An unusual case of posterior nutcracker syndrome. *Clin Exp Nephrol.* 2014; 18(4): 670-671. PMID: 24481951.

[23] Goldman RE, Arendt VA, Kothary N, et al. Endovascular Management of May-Thurner Syndrome in Adolescents: A Single-Center Experience. *J Vasc Interv Radiol.* 2017; 28(1): 71-77. PMID: 27818112.

[24] Poyyamoli S, Mehta P, Cherian M, et al. May-Thurner syndrome. *Cardiovasc Diagn Ther.* 2021; 11(5): 1104-1111.

[25] Vaglio A, Maritati F. Idiopathic Retroperitoneal Fibrosis. *J Am Soc Nephrol.* 2016; 27(7): 1880-1889.

[26] Li SJ, Lee J, Hall J, Sutherland TR. The inferior vena cava: anatomical variants and acquired pathologies. *Insights Imaging.* 2021; 12(1): 123. PMID: 34460015.

FIGURES

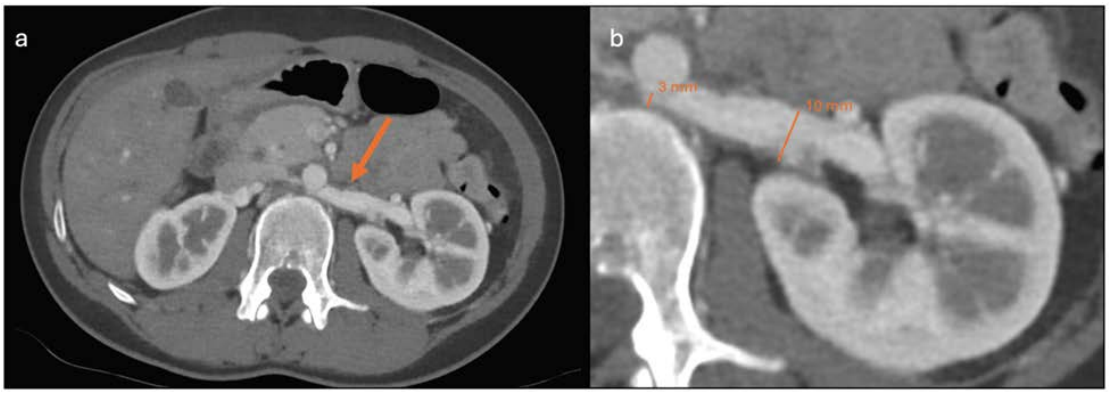

Figure 1: Retro-aortic left renal vein: 31-year-old female with a retroaortic course of the left renal vein joining the inferior vena cava in the normal position (Type I). *Findings:* Axial contrast-enhanced CT in the portal venous phase shows a retroaortic left renal vein (orange arrows, *image a*, magnified in *image b*) compressed between the aorta and the vertebral body (anteroposterior diameter: 10 vs 3 mm, compression ratio of 1 : 3.3), consistent with posterior nutcracker syndrome. *Technique:* Axial CT, 150 mAs, 80 kV, 1.25 mm slice thickness, portal venous phase after intravenous injection of 80 ml of iodinated contrast agent (Iohexol 300 mg I/mL).

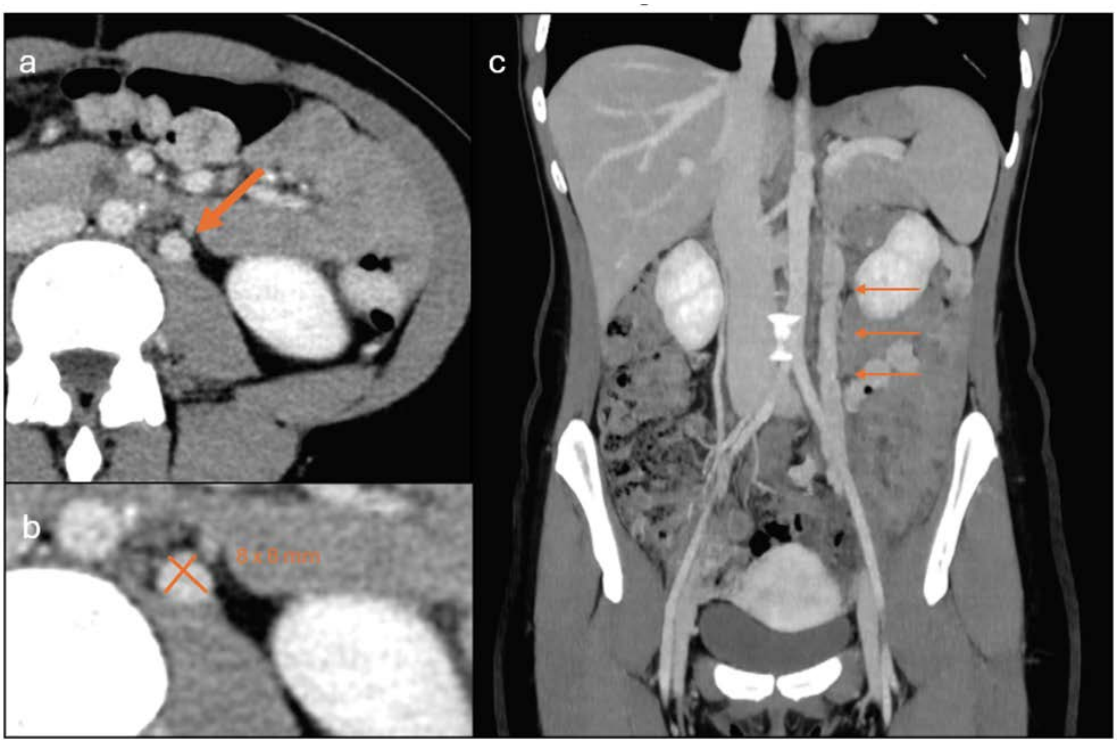

Figure 2: Dilatation of the left ovarian vein : 31-year-old female with pelvic venous congestion secondary to posterior nutcracker syndrome. *Findings:* Axial (*image a,* magnified in *image b*) and coronal (*image c*) portal venous phase contrast-enhanced CT images demonstrate marked dilatation of the left ovarian vein (*arrow*), measuring up to 8 × 8 mm. This reflects upstream venous stasis as part of pelvic congestion syndrome, due to impaired venous drainage via the retroaortic left renal vein. *Technique:* Axial and coronal CT, 218 mAs, 80 kV, 1.25 mm slice thickness, portal venous phase after intravenous injection of 80 ml of iodinated contrast agent (Iohexol 300 mg I/mL).

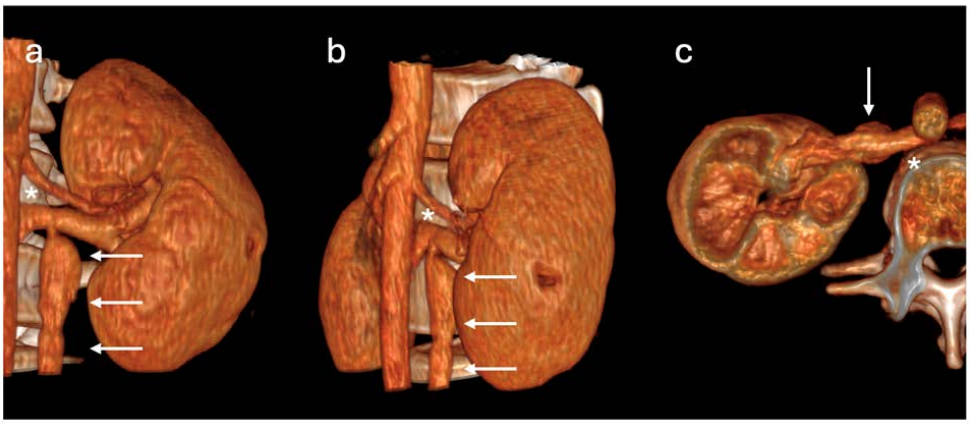

Figure 3: 3D reconstructions: Retroaortic left renal vein (*asterisk*) and the dilated ovarian vein (*white arrow*) in coronal (*a*), sagittal (*b*), and axial (*c*) 3D reconstructions of the CT scan (218 mAs, 80 kV, 1.25 mm slice thickness, portal venous phase after intravenous injection of 80 mL of iodinated contrast agent (Iohexol 300 mg I/mL).

Table 1: Summary table of compression of a retroaortic left renal vein (RLRV) and posterior nutcracker syndrome (PNCS).

Etiology	Retroaortic course of the LRV between the aorta and the vertebral column, leading to congenital or acquired compression.
Incidence	· **RLRV:** 0.5 - 6.8% (general population) · **PNCS:** Rare; exact prevalence unknown; only 27 reported cases.
Gender ratio	Unknown; suggested 1:1 (male : female)
Age predilection	All ages, most commonly > 18 years.
Risk factors	· Underlying anatomic condition: Retroaortic left renal vein · Rapid growth during puberty · Pregnancy · Abdominal aorta aneurysm · Pancreatic neoplasm · Para-aortic lymphadenopathy · Retroperitoneal tumors · Strangulating fibrolymphatic tissue between the aorta and vertebrae
Treatment	· **Asymptomatic/mild cases:** Conservative treatment. · **Symptomatic patients:** Surgical decompression, ovarian vein embolization, endovascular stenting.
Prognosis	· **Asymptomatic patients:** Favorable prognosis. · **Surgical treatment:** immediate and sustained symptom relief in 80% of patients. · **Ovarian vein embolization:** symptomatic improvement in 56% to 98% of patients. · **Endovascular stenting:** less invasive but associated with procedural risks and long-term complications.
Findings on Imaging	· Dilated retroaortic LRV compressed between aorta and vertebrae (no cutoff ratio to the moment). · Pelvic varices with enlarged +/- tortuous left ovarian vein

PNCS: Posterior Nutcracker Syndrome; LRV: Left Renal Vein; RLRV: Retroaortic Left Renal Vein.

Table 2: Imaging-based differential diagnosis of posterior nutcracker syndrome (PNCS).

Diagnosis	**CT findings**
Posterior Nutcracker Syndrome (PNCS)	Retroaortic compression of the RLRV between the aorta and vertebral body □ secondary pelvic varices.
Anterior Nutcracker Syndrome (ANCS)	Compression of the LRV between the aorta and SMA with reduced aorto-mesenteric angle (<35–39°) and distance (<8 mm) □ secondary pelvic varices.
May-Thurner Syndrome	Compression of the left common iliac vein by the right common iliac artery □ secondary pelvic varices.
Ovarian or Adnexal Masses	Adnexal/ovarian tumors · can mimic pelvic congestion vs. · secondary venous congestion due to compression.
Retroperitoneal Fibrosis/Lymphadenopathy	External compression of LRV or IVC by fibrotic tissue or enlarged lymph nodes □ secondary pelvic varices +/- hydronephrosis when ureteral involvement.
Inferior Vena Cava (IVC) Anomalies	Congenital variants (e.g. duplicated or left-sided IVC) □ altered venous drainage; enlarged collateral pathways (azygos, gonadal veins).

PNCS: Posterior Nutcracker Syndrome; ANCS: Anterior Nutcracker Syndrome; LRV: Left Renal Vein; RLRV: Retroaortic Left Renal Vein; SMA: Superior Mesenteric Artery; IVC: Inferior Vena Cava.

KEYWORDS

posterior nutcracker syndrome; pelvic congestion syndrome; retroaortic renal vein; pelvic venous disorder; pelvic varices; venous compression syndrome; incidental Finding.

ABBREVIATIONS

ANCS = Anterior Nutcracker Syndrome
CT = Computed Tomography
IVC = Inferior Vena Cava
LRV = Left Renal Vein
NCS = Nutcracker Syndrome
PNCS = Posterior Nutcracker Syndrome
RLRV = Retroaortic Left Renal Vein
SMA = Superior Mesenteric Artery

Online access

This publication is online available at:
www.radiologycases.com/index.php/radiologycases/article/view/5888

Peer discussion

Discuss this manuscript in our protected discussion forum at:
www.radiolopolis.com/forums/JRCR

Interactivity

This publication is available as an interactive article with scroll, window/level, magnify and more features.
Available online at www.RadiologyCases.com

Published by EduRad

www.EduRad.org