Nutcracker-like Phenomenon Secondary to Severe Scoliosis: A Case Report

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Abstract

Introduction:
Nutcracker syndrome refers to symptomatic compression of the left renal vein, most commonly between the aorta and the superior mesenteric artery, while the term nutcracker phenomenon is reserved for asymptomatic cases. Owing to non-specific clinical manifestations, the condition is frequently under-diagnosed and often identified incidentally on imaging. We report a novel cause of nutcracker phenomenon related to severe scoliosis.

Case Report:
A 65-year-old woman presented with transient visual disturbances and speech difficulties, prompting brain MRI for suspected stroke. While no ischemic lesions were identified, angiographic sequences revealed a small right subclavian aneurysm, leading to further thoracoabdominal CT evaluation. CT demonstrated severe scoliosis with marked displacement of abdominal vascular structures. The gastroduodenal artery and portal vein were displaced inferiorly and found to compress the left renal vein. Associated dilatation of the proximal left renal vein and left ovarian vein indicated increased venous pressure. As the patient was asymptomatic, a diagnosis of nutcracker phenomenon was made, and no specific treatment was initiated.

Discussion:
Although numerous anatomical variants causing left renal vein compression have been described, this represents the first reported case of nutcracker-like phenomenon secondary to scoliosis-induced vascular distortion involving the gastroduodenal artery and portal vein.

Conclusion:
Severe spinal deformities can result in atypical vascular compression syndromes. Awareness of such mechanisms is important when interpreting cross-sectional imaging, particularly in asymptomatic patients with incidental venous findings.

Keywords: Scoliosis, nutcracker, gastroduodenal artery, superior mesenteric artery, renal vein.

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Introduction

The term “Nutcracker syndrome”, also known as left renal vein entrapment, was first described by de Schepper in 1972. (de Schepper, 1972) This classically results from the extrinsic compression of the left renal vein between the aorta and the superior mesenteric artery, resulting in renal vein congestion. (Kolber et al., 2021) The pathology is termed the „nutcracker syndrome” when the patient is symptomatic and nutcracker ”phenomenon” if the patient is not. (Kim, 2022)

The prevalence of nutcracker syndrome is unknown, with it likely being subject to under-diagnosis. (Shin et al., 2006) It is suspected that there may be a female prevalence, though this is disputed.(Gulleroglu et

al., 2014; Penfold et al., 2025) There is, however, a discrepancy between the age of diagnosis, with men being diagnosed at 24 years old on average, versus 29 years old for women. (Penfold et al., 2025)

The CTA revealed severe lumbar scoliosis, leading to marked displacement of the abdominal vessels. As a result of this altered anatomy, the left renal vein was abnormally positioned and became entrapped in a

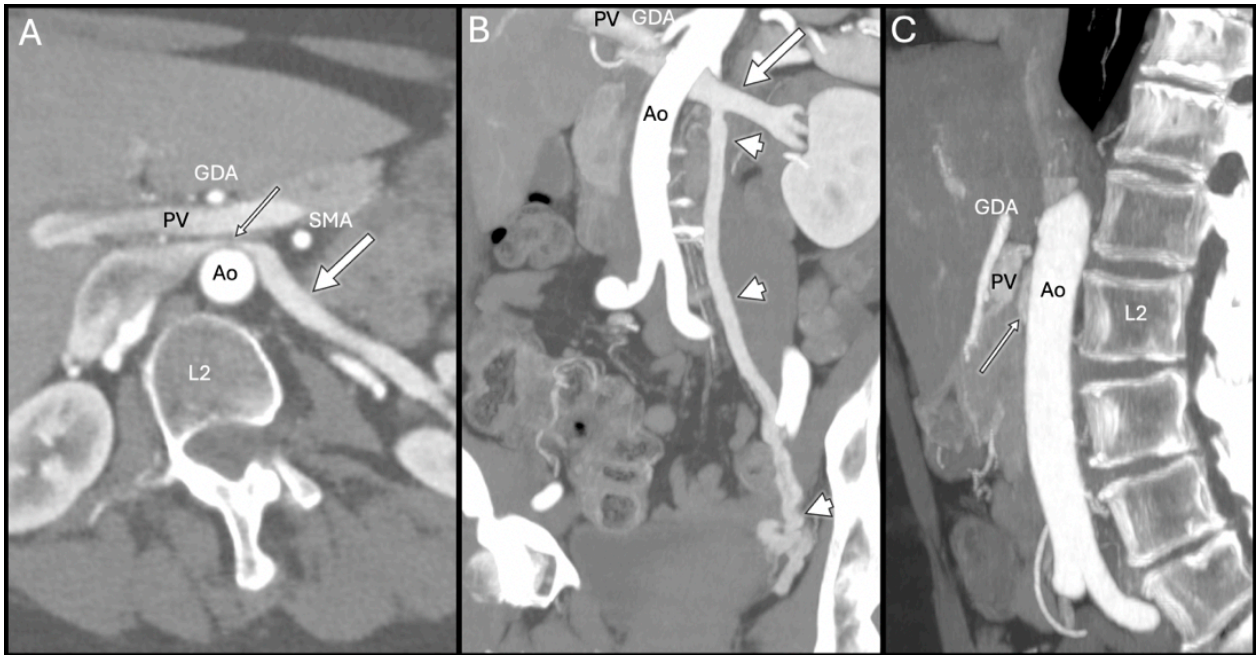

Figure 1: Abdominal computed tomography angiography (CTA) in a mediastinal window during the arterial phase. Axial oblique multiplanar reformation (MPR) (A), coronal oblique maximum intensity projection (MIP) (B), and sagittal oblique MPR (C) demonstrate a nutcracker-like compression of the left renal vein (thin white arrow) between the aorta (Ao) and the Gastroduodenal artery (GDA), with post-stenosis dilatation of the left renal vein (large white arrow). These findings are related to the combined effects of lumbar vertebral scoliosis at L2 and portal vein (PV) compression, and are associated with unilateral dilatation of the left ovarian vein and left parauterine varices (white arrowhead).

Due to the lack of specific symptoms, the phenomenon can go undiagnosed for many years and be a fortuitous discovery upon imaging. (Mniai et al., 2022) We present a case of the discovery of a nutcracker phenomenon in a patient with severe scoliosis.

Case report

A 65-year-old woman presented to the emergency department with visual disturbances and difficulty forming sentences; the rest of her neurological and physical exams were normal. The patient had ceased smoking 25 years prior and only drank alcohol occasionally. Due to these symptoms, the patient underwent an MRI for a suspected stroke.

The MRI was negative for a stroke; however, a small right subclavian aneurysm was noted on the angiographic sequences. This finding prompted a thoracoabdominal CT angiography (CTA) to assess for additional aneurysms or other vascular anomalies.

compressive “nutcracker-like” configuration. Posteriorly, it was compressed between the abdominal aorta and the L2 lumbar vertebral body, while anteriorly it was compressed by the overlying gastroduodenal artery and portal vein. This double compression resulted in significant focal narrowing of the left renal vein, with secondary dilatation of the proximal left renal vein and the left ovarian vein, consistent with increased venous pressure (Figures 1 and 2). As the patient was asymptomatic, a diagnosis of Nutcracker-like phenomenon rather than Nutcracker-like syndrome was made.

The patient did not undergo any specific treatment due to being asymptomatic.

Discussion

The most common form of nutcracker syndrome results from extrinsic compression of the left renal vein between the abdominal aorta posteriorly and the superior mesenteric artery anteriorly. (Kolber et al., 2021) Other

variants, such as compression due to a retro-aortic left renal vein, termed a posterior Nut-cracker, or extrinsic compression by neo-plasms, lymphadenopathy, aortic aneurysms, strangulation by fibrous tissue, renal vein duplication, ectopic renal arteries and over-pressure, to back pain which can radiate into the abdomen, thigh and buttocks. (Kurk-linsky & Rooke, 2010)

When specifically searched for, nutcracker syndrome is often found to be responsible

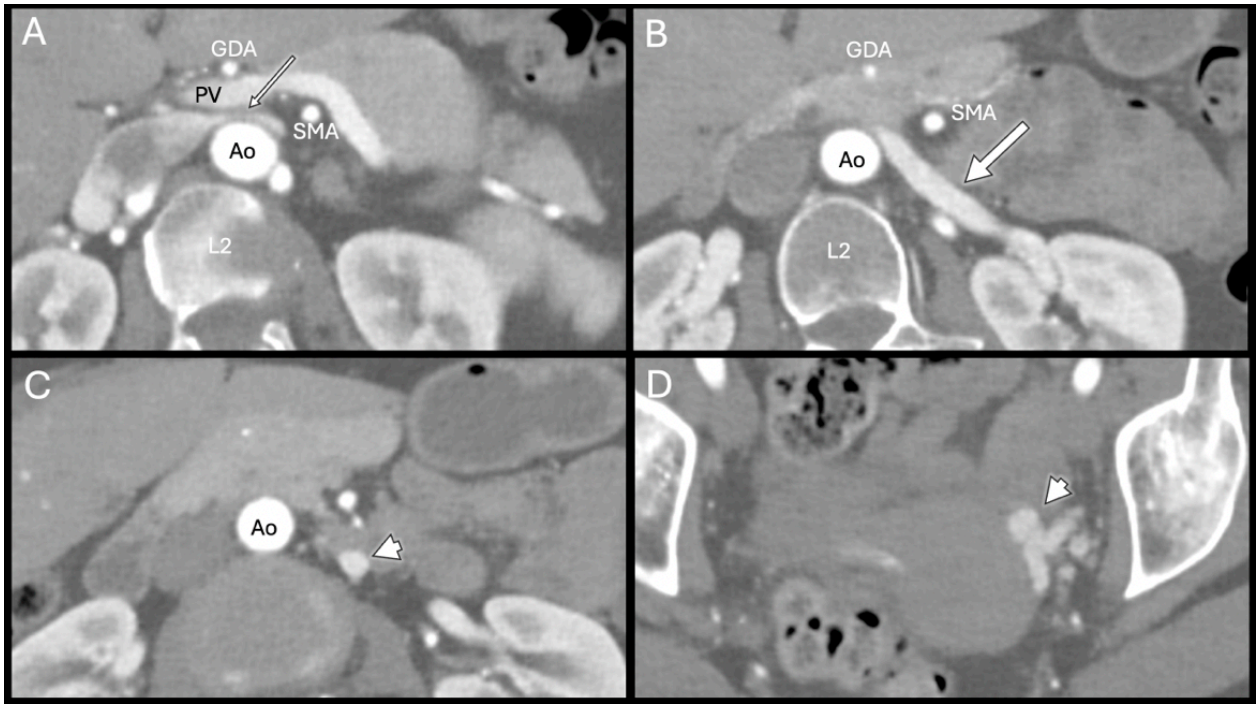

Figure 2: Abdominal CT angiography (CTA) in a mediastinal window during the arterial phase. Consecutive strictly axial images from cranial to caudal (A–D) demonstrate nutcracker-like compression of the left renal vein (thin and large white arrows) between the aorta (Ao) and Gastroduodenal artery (GDA), related to lumbar vertebral scoliosis (L2) and portal vein (PV) compression. This is associated with unilateral dilatation of the left ovarian vein and left parauterine varices (white arrowheads).

arching gonadal arteries, amongst others, also exist. (Berz et al., 2025; Gulleroglu et al., 2014) This is the first description of a nutcracker-like compression of the left renal vein by the combined pressure of the gastroduodenal artery and portal vein due to an anatomical distortion because of scoliosis. In the case of our patient, scoliosis resulted in the downwards traction of the gastroduodenal artery and the portal vein, bringing them out of their normal anatomical position above the left renal vein and into direct contact with it. This subsequently caused compression of the renal vein, with the development of varices of the gonadal vein, proving that there was indeed an increase in the pressure within the upstream venous system.

Patients with nutcracker syndrome have non-specific symptoms, ranging from hema-turia, attributed to the rupture of veins in the collecting system due to increased venous

for both hematuria, with one ultrasound-based study in children finding that most patients with macrohematuria and a third of patients with microhematuria presented with the phenomenon. (M. et al., 1998)

Clinically Nutcracker syndrome is a diagnosis of exclusion due to its non-specific symp-toms. (Penfold et al., 2025) However, imaging can be used to confirm the diagnosis. When using ultrasound, anatomical parameters are the primary feature, showing compression of the left renal vein with subsequent increased diameter of the proximal part of the vein. (Kim, 2022) A second criterion that can be used in the measurement of the angle between the abdominal aorta and superior mesenteric artery, which is normally around 90° but, in cases of nutcracker syndrome, can be reduced with an angle of less than 35° being considered definitive. (Kim, 2022) Doppler ultrasound is traditionally the best non-invasive technique, which can be used

to measure blood flow velocity. Velocity within the left renal vein of 80-100 cm/s is considered diagnostic for nutcracker syndrome. (Kim, 2022) Contrast-enhanced CT can also be used, with the nutcracker syndrome often being a chance discovery during the workup of hematuria. (Kim, 2022) Although the velocity of the blood cannot be directly measured, a jetting phenomenon after the compressed segment of the vein during the early cortical phase can be suggestive. (Kim, 2022; Penfold et al., 2025) Furthermore the ratio of the diameter of the uncompressed proximal segment compared to the compressed segment of more than 2.25 is considered a criterion. (Penfold et al., 2025) In pediatric patients MRI is preferred to CT due to the lack of radiation, having the additional advantage of being able to overcome problems linked to non-standard measurements due to lack of patient cooperation. (Er et al., 2019)

The treatment of nutcracker syndrome is controversial however in cases of patients with mild hematuria and well-tolerated symptoms conservative management is recommended. (Ananthan et al., 2017) Surgery may be considered in patients with recurrent gross hematuria and pain when conservative management has failed after more than 2 years in children or 6 months in adults. (Ananthan et al., 2017) Surgery can entail either the freeing of the vein from its fibrous channel between the aorta and superior mesenteric artery or transposition of the vein note some cases require autotransplantation in which the kidney is moved to either the left or right iliac fossa. (Ananthan et al., 2017)
The prognosis of nutcracker syndrome is unclear due to its under diagnosis, though spontaneous resolution in children is possible as they age. (Kalantar et al., 2023) However, morbidity is possible in untreated symptomatic patients with the possibility of left renal vein thrombosis and subsequent renal damage as well as in patient presenting with haematuria should also be treated due to the possibility of anaemia. (Ananthan et al., 2017)

Conclusion

Compression of the left renal vein resulting in nutcracker phenomenon can occur due to various causes, ranging from the classic compression by the superior mesenteric artery, to aortic aneurysms and tumors. We presented the first documented case of a nutcracker-like phenomenon by the combined pressure of an overlying gastroduodenal artery and portal vein due to anatomical distortions linked to severe scoliosis. This case highlights the anatomical distortion that can occur in patients with scoliosis and the subsequent need to search for unusual compression syndromes.

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Declarations

Consent for publication: The author clarifies that written informed consent was obtained and the anonymity of the patient was ensured. This study submitted to Swiss J. Rad. Nucl. Med. has been conducted in accordance with the Declaration of Helsinki and according to requirements of all applicable local and international standards. All authors contributed to the conception and design of the manuscript, participated in drafting and revising the content critically for important intellectual input, and approved the final version for publication. Each author agrees to be accountable for all aspects of the work, ensuring its accuracy and integrity.

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Conflict of interest:

The authors declare that there were no conflicts of interest within the meaning of the recommendations of the International Committee of Medical

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