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Case Series

Radiology Section

Unmasking Vascular Compression Disorders with Multi-Detector CT: A Case Series

ANUSHA PUTCHA[1], MANENDER REDDY NAINI[2], VASUDHA BATTULA[3], S SREYA CHINNAPOLLA[4], NIKHITHA MANGALAGIRI[5]

ABSTRACT

Managing vascular compression syndromes is among the most difficult challenges in vascular medicine. These conditions, a diverse group of disorders, are characterised by the external compression of otherwise healthy arteries and/or veins, as well as adjacent nerve structures, potentially leading to structural damage to the vessel walls and nerves. We have highlighted examples of vascular compression syndromes encountered in our department, including May-Thurner Syndrome (MTS), nutcracker syndrome, and anomalous origin of the Right Coronary Artery (RCA), along with their anatomical variations and distinctive features of vessel compression.

Keywords: Common iliac vein, Computed tomography, Coronary artery, Superior mesenteric artery

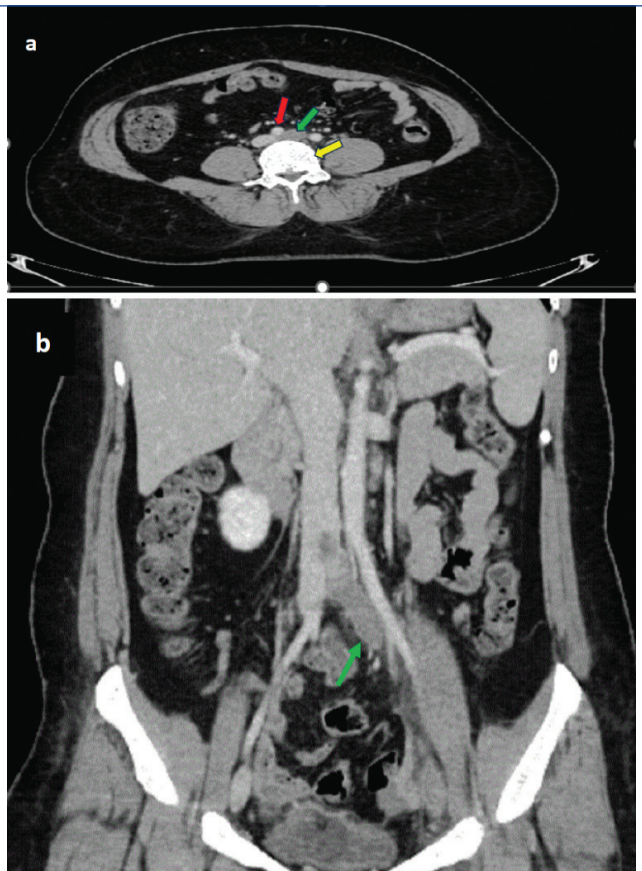
INTRODUCTION

Vascular compression syndromes are conditions in which blood vessels are constricted or compressed by surrounding structures, such as muscles, bones, or other blood vessels, resulting in limited blood flow [1]. The decreased blood flow can lead to a variety of symptoms, including pain, swelling, or other complications, depending on the location and severity of the compression. Each syndrome has distinct causes, risk factors, and symptoms, and the severity of the condition can differ significantly [1].

CASES

Case 1:

A 39-year-old female patient presented with swelling of the left lower limb for one month. The swelling was progressively increasing. The patient reported a sensation of heaviness, tightness, and mild discomfort localised primarily to the left leg, which worsened at the end of the day and after prolonged standing. There was no history of trauma, recent travel, or immobilisation. Upon examination, there was visible swelling of the entire left lower extremity, most prominent from the mid-thigh to the ankle. The limb circumference was increased by approximately 3 cm compared to the contralateral leg at the mid-calf level. The skin over the affected limb was tense but not erythematous or warm. There was mild pitting oedema, with no signs of skin discolouration, ulceration, or varicosities. Peripheral pulses were palpable and symmetric bilaterally. There was tenderness on deep palpation of the left calf, but Homan's sign was negative. The unilateral nature of the swelling, its chronicity, and the absence of acute inflammatory signs raised suspicion for an underlying venous outflow obstruction. Doppler ultrasound revealed reduced flow in the left common iliac vein, and further CT venography revealed that the osteoproximal segment of the left common iliac vein was moderately compressed between the right common iliac artery and the L4 vertebral body, causing complete occlusion and thrombosis of the left common iliac vein [Table/Fig-1a,b]. These findings were consistent with MTS.

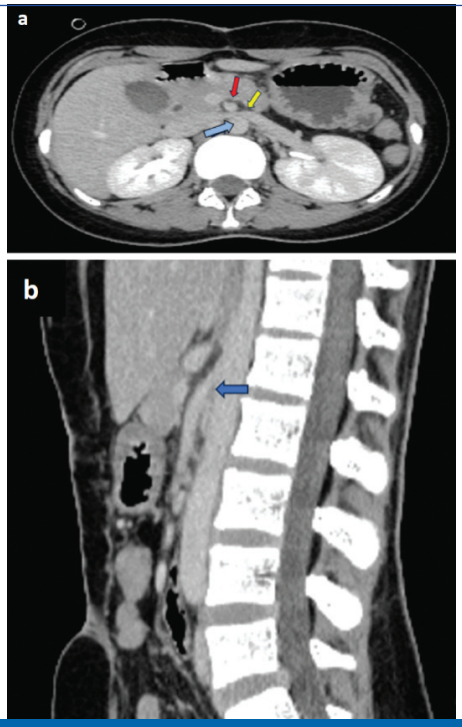


[Table/Fig-1a,b]: Axial & coronal Contrast-Enhanced Computed Tomography (CECT) abdomen images on venous phase shows: the osteoproximal segment of left common iliac vein (green arrow) is moderately compressed between the right common iliac artery (red arrow) against L4 vertebral body (yellow arrow) causing complete occlusion and thrombosis of left common iliac vein.

Case 2:

A 30-year-old female presented with dull, cramping abdominal pain localised to both iliac fossae, more prominent on the left, for four days. The pain was intermittent, non-radiating, and associated with multiple episodes of non-bloody, non-bilious vomiting. She denied fever, urinary symptoms, and menstrual irregularities. Her past medical history was unremarkable. On examination, there was mild tenderness in both iliac fossae, without guarding. Bowel sounds were present, and there were no palpable masses or organomegaly. Initial laboratory investigations, including a complete blood count, renal function tests, and inflammatory markers, were within normal limits. Urinalysis revealed microscopic haematuria without proteinuria. The pelvic ultrasound was unremarkable.

A contrast-enhanced CT of the abdomen and pelvis revealed a reduced aortomesenteric angle with entrapment of the left renal vein between the Superior Mesenteric Artery (SMA) and the aorta, causing significant luminal narrowing [Table/Fig-2a,b]. These imaging findings are consistent with anterior nutcracker syndrome.



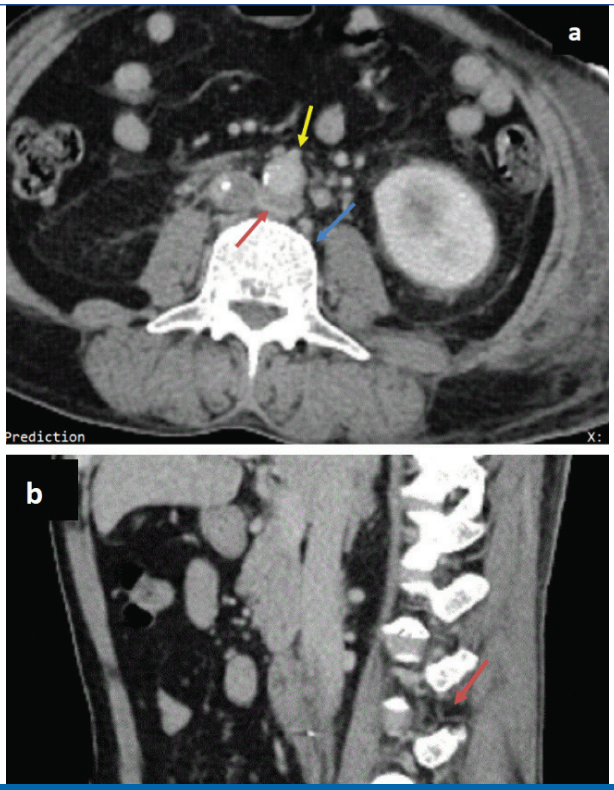
[Table/Fig-2]: a) Axial CECT shows: reduced aortomesenteric angle with entrapment of left renal vein (yellow arrow) between Superior Mesenteric Artery (SMA) (red arrow) and aorta (blue arrow) causing significant luminal narrowing. b) Sagittal section of the CECT abdomen shows: a reduced aortomesenteric angle between the abdominal aorta and the origin of the SMA (blue arrow).

Case 3:

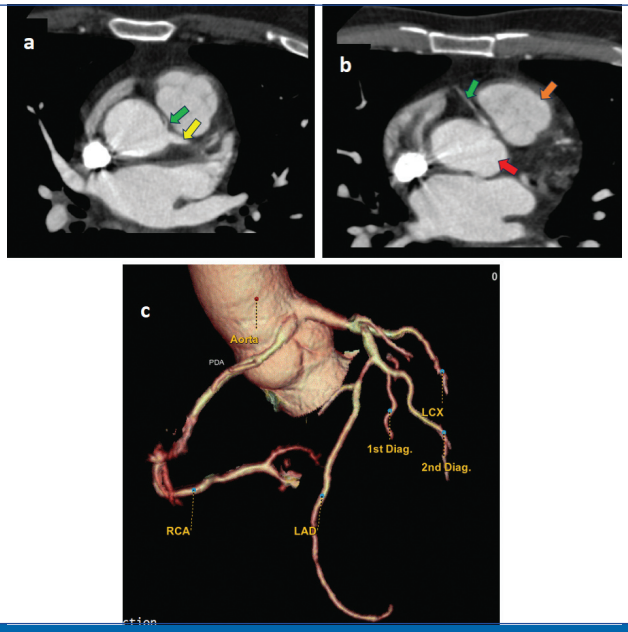
A 52-year-old male patient presented with a sudden onset of left lower limb pain and swelling for one month. The pain was described as dull and persistent, localised primarily to the thigh and calf, with associated tightness. He denied recent travel, trauma, immobility, fever, urinary complaints, or prior episodes. On examination, the left lower limb was visibly swollen from the mid-thigh to the ankle, with mild pitting oedema. Peripheral pulses were intact, and systemic examination was unremarkable. D-Dimer levels were mildly elevated (value: 0.65 mg/L). Ultrasound ruled out deep vein thrombosis but showed venous congestion of the left common iliac vein with no thrombus. Imaging findings from CT venography revealed the retro-aortic course of the left renal vein being compressed between the abdominal aorta and the vertebra, causing near-complete occlusion [Table/Fig-3a,b]. These findings were consistent with posterior nutcracker syndrome.

Case 4:

A 49-year-old male patient with a history of hypertension and type 2 diabetes mellitus for seven years, on regular medication, presented with exertional chest discomfort for the past two months, consistent with stable angina. Physical examination was unremarkable. An electrocardiogram showed nonspecific ST-T changes, and echocardiography revealed preserved left ventricular systolic function. Given the patient's intermediate-risk profile, coronary Computed Tomography Angiography (CTA) was performed as a non-invasive assessment before planned percutaneous transluminal coronary angioplasty. Imaging findings revealed an anomalous origin of the Right Coronary Artery (RCA) arising from the left coronary cusp, anterior to the left main coronary artery [Table/Fig-4a-c]. Given the high-risk anatomy of the anomalous RCA, the interventional cardiology team proceeded with diagnostic catheter angiography under careful monitoring.



[Table/Fig-3a,b: Axial and sagittal images of CECT abdomen shows: retro aortic course of the left renal vein (annotated by red arrow) getting compressed between the abdominal aorta (yellow arrow) and vertebra (blue arrow).



[Table/Fig-4]: a) Axial coronary angiogram shows: an anomalous origin of the Right Coronary Artery (RCA) (green arrow) arising from the left coronary cusp anterior to the left main coronary artery (yellow arrow). b) Axial coronary angiogram shows: that the RCA (green arrow) is coursing between the aorta (red arrow) and pulmonary trunk (orange arrow).

DISCUSSION

May-Thurner Syndrome (MTS): May-Thurner Syndrome (MTS) refers to a chronic compression of the left common iliac vein against the lumbar vertebrae by the overlying right common iliac artery [2]. The pathogenesis involved in MTS is mechanical injury to the endothelial cells of the left common iliac vein caused by pulsations from the right iliac artery [3]. Patients usually present with pain, claudication, swelling, ulcerations, and varicosities. A history of prior surgeries, immobilisation, and catheterisation are a few predisposing

factors for developing deep vein thrombosis in patients with MTS [4]. CT with intravenous contrast is the best modality of choice for confirming the diagnosis of MTS. CT venography study has the highest sensitivity and specificity in diagnosing MTS, with or without thrombosis [5].

Additionally, it enables the exclusion of other possible causes of compression and related complications, such as pulmonary and cerebral embolism. Management is performed through endovascular treatments, which include catheter-directed thrombolysis, angioplasty, and stent placement [6]. Brinegar KN et al., found that visualisation of greater than 50% stenosis in the luminal diameter of the vein is considered an adequate indicator of Left Common Iliac Vein (LCIV) compression related to MTS. In our case, there is approximately 70-80% luminal narrowing, confirming the diagnosis of MTS [4].

Nutcracker syndrome: Nutcracker syndrome is the compression of the left renal vein between the SMA and the aorta, which can lead to renovascular hypertension and periureteric varices [7]. Some of the speculations leading to nutcracker syndrome are due to an abnormally high course of the left renal vein and abnormal SMA branching from the aorta [8]. Dunphy L et al., found that it is associated with the formation of the left renal vein from the aortic collar during the 6th-8th week of gestation and abnormal angulation of the SMA from the aorta [9]. The aortomesenteric space is maintained by retroperitoneal fat and the third portion of the duodenum. The normal aortomesenteric angle is approximately 45 degrees. When the aortomesenteric angle is narrowed, it results in compression of the left renal vein [10]. The clinical presentation may include haematuria, left flank pain, and proteinuria. Contrast-Enhanced Computed Tomography (CECT) of the abdomen shows the compression of the left renal vein between the SMA and aorta, with a reduced aortic-SMA angle. Prompt diagnosis and treatment are required to avoid further complications, such as renal vein thrombosis and long-term kidney disease [9].

Posterior nutcracker syndrome: In posterior nutcracker syndrome, there is a retro-aortic course of the left renal vein, which is trapped between the aorta and the vertebral column [11,12]. Other sources can lead to compression of the left renal vein, which includes compression by pancreatic cancer, retroperitoneal tumours, and abdominal aortic aneurysms [7]. CT venography demonstrates and quantifies the extent of obstruction in the compressed vein.

Anomalous origin of Right Coronary Artery (RCA): The anomalous origin of the RCA is a rare congenital anomaly. In this scenario, there are three subtypes: (a) RCA arises from the left sinus of Valsalva and courses between the two major vessels, the pulmonary artery and the aorta; (b) a low inter-arterial course between the right ventricular outflow tract and the aorta; (c) hypoplastic anomalous RCA orifice [13]. In our case, subtype (a) was observed, with the RCA arising from the left coronary cusp anterior to the left main coronary artery and coursing between the aorta and the pulmonary trunk. Patients usually present with chest pain, syncope, and Shortness of Breath (SOB). During routine activities or exercise, the RCA can become compressed between the pulmonary artery and the aorta, leading to angina pectoris, myocardial infarction, and sudden death [14]. Taylor AJ et al., found that the anomalous origin of the RCA from the left coronary sinus was the second most frequently observed anomaly associated with sudden death [14].

Other Common Vascular Compression Syndromes:

Eagle syndrome: CT imaging, especially contrast-enhanced CT Angiography (CTA), is crucial in diagnosing Eagle Syndrome by accurately visualising elongated styloid processes and ossified stylohyoid ligaments. It helps assess vascular compression, particularly of the carotid artery, and detects potential nerve or anatomical distortions. CT provides detailed, high-resolution images for both presurgical planning and assessing surrounding structures. This makes it essential for accurate diagnosis and guiding treatment decisions in Eagle Syndrome [15].

Thoracic Outlet Syndrome (TOS): TOS is a condition caused by compression of the brachial plexus or subclavian vessels in the thoracic outlet. TOS can be divided into three types: neurogenic, venous, and arterial, each involving different structures that CT can assess. Demondion X et al., noted that venous compression is very difficult to incriminate because such compression is frequently observed in asymptomatic individuals in all the compartments of the thoracic outlet after arm elevation [16]. CT helps visualise vascular structures such as the subclavian artery and vein, as well as neurological components like the brachial plexus, providing insight into compression sites caused by muscular hypertrophy, cervical ribs, or scalene abnormalities. CT allows for a detailed assessment of vascular and nerve impingement, revealing arterial narrowing, venous thrombosis, and abnormal anatomical relationships. This imaging modality is essential for accurate diagnosis, risk stratification, and presurgical planning, especially in cases where surgery or interventional procedures are being considered [16].

CONCLUSION(S)

Vascular compression disorders belong to a rare group that is often detected incidentally, where either an artery or vein is compressed by adjacent structures or vessels. This compression can result in clinical scenarios that manifest with non-specific or late-onset symptoms, leading to delayed diagnosis. CECT plays an important role in reconstructing these anatomic structures, providing accurate early diagnosis, and facilitating the treatment of these syndromes.

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PARTICULARS OF CONTRIBUTORS:
1. Assistant Professor, Department of Radiodiagnosis, Mallareddy Medical College for Women, Hyderabad, Telangana, India.
2. Associate Professor, Department of Radiodiagnosis, Mallareddy Medical College for Women, Hyderabad, Telangana, India.
3. Assistant Professor, Department of Paediatrics, Mallareddy Medical College for Women, Hyderabad, Telangana, India.
4. Senior Resident, Department of Radiodiagnosis, Mallareddy Medical College for Women, Hyderabad, Telangana, India.
5. Junior Resident, Department of Radiodiagnosis, Mallareddy Medical College for Women, Hyderabad, Telangana, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Dr. Anusha Putcha,
G-402, Beema Pride, Green Park Road, Beside Bharat Petrol Pump, Jeedimetla,
Hyderabad-500067, Telangana, India.
E-mail: anushaputcha@gmail.com

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