

Popliteal vein entrapment syndrome associated with an accessory slip of the lateral head of the gastrocnemius muscle

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ABSTRACT

Popliteal vein entrapment syndrome (PVES) is a rare subtype of popliteal entrapment syndrome that leads to symptoms of chronic venous stasis. We report a case of isolated PVES in a young patient associated with an accessory slip of the lateral head of the gastrocnemius muscle. The patient underwent resection of the anomalous muscle, and the symptoms were relieved postoperatively. PVES should be considered in young patients with unexplained symptoms or signs of venous stasis. Surgical resection of the causative lesion compressing the popliteal vein is indicated for selected patients. (J Vasc Surg Cases Innov Tech 2024;10:101502.)

Keywords: Gastrocnemius muscle; Popliteal entrapment syndrome; Popliteal vein

Popliteal entrapment syndrome is a condition that results from compression of the neurovascular bundle within the popliteal fossa. Arterial entrapment, which can lead to lower limb ischemia, is the most common manifestation; however, other types of entrapment syndromes are not widely recognized.¹ We report a rare case of isolated popliteal vein entrapment syndrome (PVES) associated with an accessory slip of the lateral head of the gastrocnemius muscle (GCM) in a young patient. Additionally, we highlight a notable intraoperative finding. The patient provided written informed consent to the report of his case details and imaging studies.

CASE REPORT

A 28-year-old man with an unremarkable medical history presented with a 1-year history of edema and tightness in the left calf. Edema was noted below the knee on the left limb. After a comprehensive general examinations in internal medicine, the patient remained undiagnosed. Suspecting a possible lower limb vascular disease, the patient was referred to our department. Ultrasound examination of the popliteal vessels performed with the patient in a standing position showed normal blood flow in the left popliteal artery and vein. However, examination with the patient in the prone position with the knee extended and passive dorsiflexion of the ankle showed a significant reduction in the caliber of the popliteal vein and cessation of venous flow (Fig 1). Contrast-enhanced computed

tomography (CT) conducted with the patient in the supine position, without using any provoking maneuvers, revealed an accessory slip of the lateral head of the left GCM compressing the popliteal vein (Fig 2, A and B). Other venous pathologies, such as iliac vein stenosis or deep vein thrombosis, were not observed. His symptoms were strongly suspected to be caused by the disturbed venous return. Initially, the patient was treated conservatively with compression therapy; however, the symptoms did not improve sufficiently. After a discussion, the patient decided to undergo surgical release of the popliteal vein. The operation was performed with the patient in the prone position. Surgical exploration through a transverse incision in the popliteal crease revealed the accessory slip of the lateral head of the GCM, which was attached slightly medially to the midline of the posterior aspect of the distal femur. The course of the popliteal artery and vein was normal (Fig 3, A and B). Compression of the popliteal vein by this anomalous muscle was clearly demonstrated during passive dorsiflexion of the ankle (Supplementary Video). Resection of a 4-cm segment of the anomalous muscle was performed (Fig 3, C). The patient's postoperative course was uneventful, with no complications. Anticoagulation therapy was not used during the intraoperative or perioperative period. He is completely free of symptoms at 6 months postoperatively.

DISCUSSION

PVES is a rare disease with a challenging diagnosis. It results from compression of the popliteal vein within the popliteal fossa, leading to symptoms of chronic venous stasis.² Popliteal vein entrapment can be observed, along with popliteal artery entrapment, which represents the most common form of popliteal entrapment syndrome.¹ Gerkin et al³ reported that 10% to 15% of patients with popliteal artery entrapment syndrome also demonstrate venous involvement. Less commonly, venous entrapment can also occur in isolation. Isolated PVES was first reported by Connell⁴ in 1978. Some cases of PVES are classified as functional PVES, which are mainly associated with muscle hypertrophy, and others are classified as anatomical PVES, characterized by

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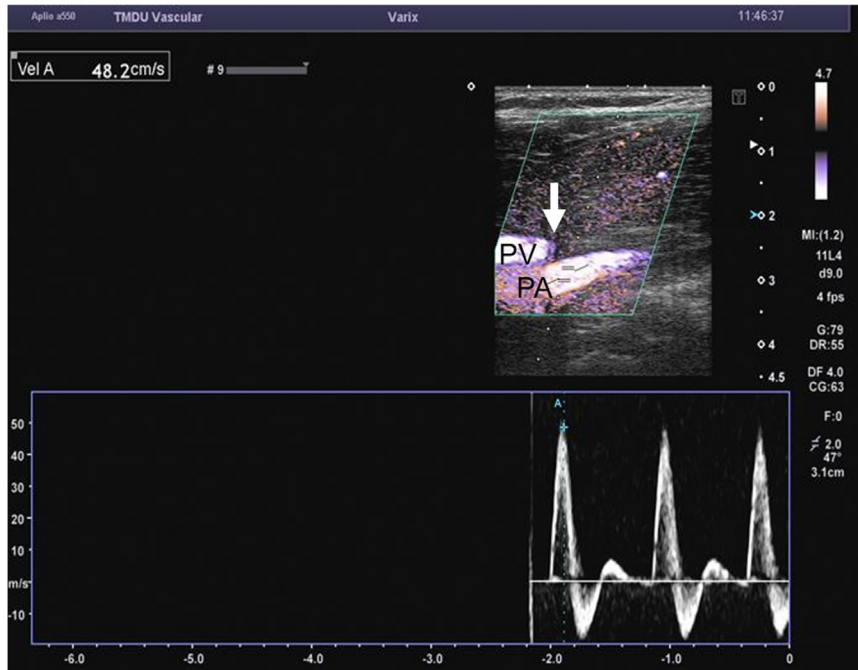


Fig 1. Color Doppler ultrasound image during knee extension with passive dorsiflexion of the ankle showing significantly reduced caliber of the popliteal vein (PV) and cessation of venous flow (arrow). Arterial flow remained unaffected. PA, Popliteal artery.

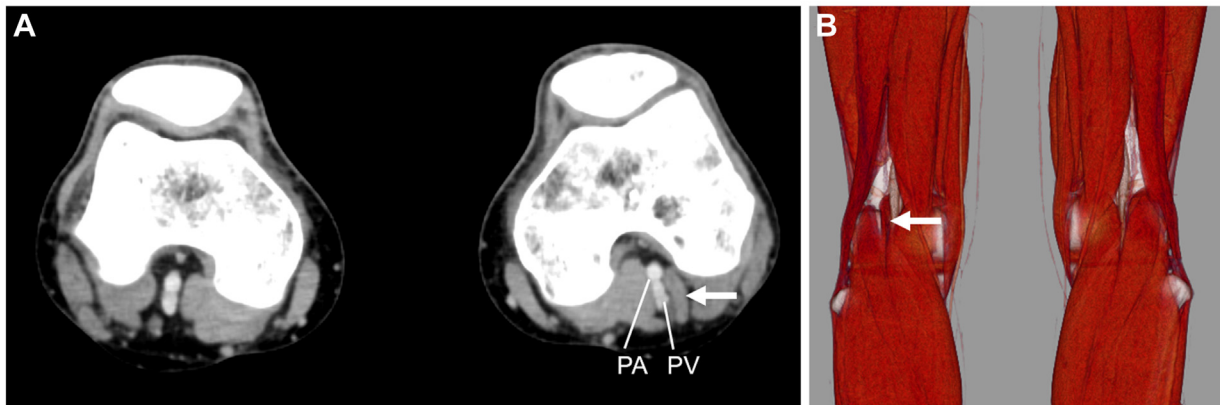


Fig 2. Axial (A) and three-dimensional volume rendering (B) computed tomography images showing the accessory slip of the lateral head of the gastrocnemius muscle (arrow) compressing the popliteal vein (PV). PA, Popliteal artery.

specific anatomical anomalies. The most common anatomical cause of entrapment is an anomaly in the medial head of the GCM.^{5,6}

In the present case, the left popliteal vein was compressed by an accessory slip of the lateral head of the GCM. Based on the early classification of popliteal entrapment syndrome described by Rich et al,⁷ the etiology of our patient does not conform to any type. However, in the new classification system proposed by Jayaraj et al,⁸ the etiology of our patient is classified as type III, vein (V), lateral (L). According to the study by Koplak

et al,⁹ the anomaly of the GCM observed in the present case is not uncommon, present in 1.9% of patients who underwent knee magnetic resonance imaging. However, only a few cases of PVES caused by anomalies of the lateral head of the GCM, such as an accessory slip or anomalous attachment, have been reported.¹⁰⁻¹²

Patients with PVES can present with various degrees of venous stasis, and the possibility exists that many cases could have been overlooked.

Color Doppler ultrasound is an initial diagnostic test when entrapment is suspected. Scanning with

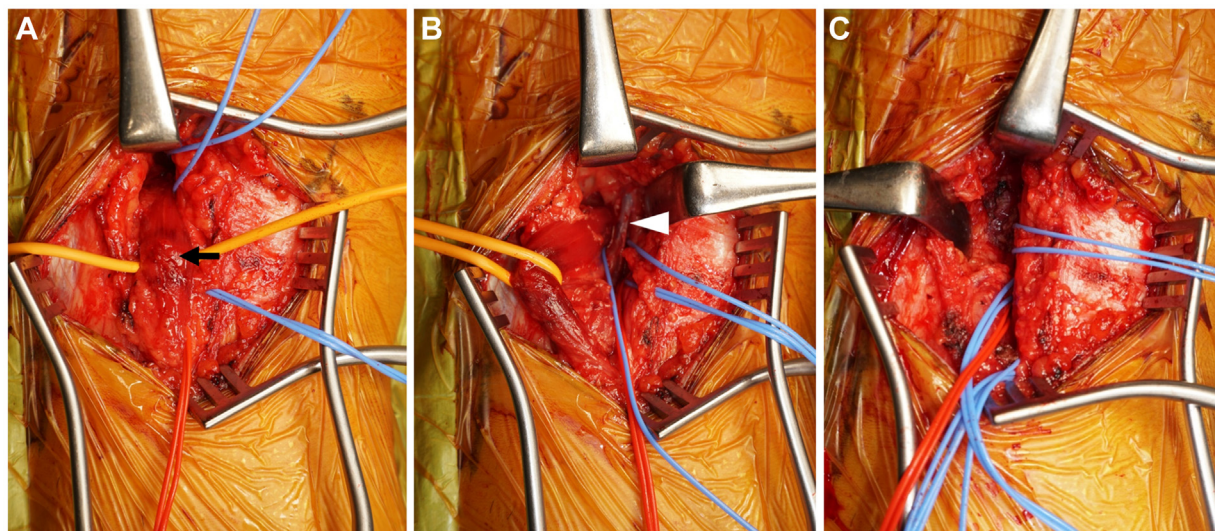


Fig 3. **A**, Intraoperative photograph showing the accessory slip of the lateral head of the gastrocnemius muscle (arrow). **B**, The popliteal vein (arrowhead) was exposed by lateral traction of the accessory slip. **C**, Intraoperative photograph after muscle resection.

provocation maneuvers, such as knee extension with plantar flexion or passive dorsiflexion of the ankle, can be beneficial in visualizing the functional result of compression.⁶ However, it should be noted that compression of the popliteal vein on provocation can be observed in asymptomatic individuals.¹³ CT and magnetic resonance imaging are used to assess anatomical information within the popliteal fossa. Conventional venography or magnetic resonance venography using a blood pool contrast agent can demonstrate venous stasis.¹⁴ Even with the combination of these methods, the diagnosis of PVES can be difficult because it is a functional disorder.

In the present case, a significant reduction in the caliber of the popliteal vein was observed by color Doppler ultrasound during passive dorsiflexion of the ankle. CT confirmed the presence of the accessory slip of the GCM that compressed the popliteal vein.

For patients with mild symptoms, conservative treatment with compression therapy could be enough to relieve the symptoms; however, if this approach proves ineffective, surgical treatment is indicated. Surgical treatment is performed to release the popliteal vein from the causative structure.^{5,6,11} One worthwhile finding in the present case was the intraoperative demonstration of the stretch of the anomalous muscle provoked by passive dorsiflexion of the ankle. The finding was useful for intraoperative confirmation of entrapment and determining the extent of muscle resection. Surgical resection of the part of the anomalous muscle that compressed the popliteal vein was sufficient to relieve the patient's symptoms.

CONCLUSIONS

We report a rare case of PVES associated with an accessory slip of the lateral head of the GCM. PVES should be considered in young patients with unexplained symptoms or signs of venous stasis. Surgical resection of the causative lesion compressing the popliteal vein is indicated for selected patients.

DISCLOSURES

None.

REFERENCES

1. Sinha S, Houghton J, Holt PJ, Thompson MM, Loftus IM, Hinchliffe RJ. Popliteal entrapment syndrome. *J Vasc Surg*. 2012;55:252–262.e30.
2. Chen CK, Kolber M. Venous popliteal entrapment syndrome. *Cardiovasc Diagn Ther*. 2021;11:1168–1171.
3. Gerkin TM, Beebe HC, Williams DM, Bloom JR, Wakefield TW. Popliteal vein entrapment presenting as deep venous thrombosis and chronic venous insufficiency. *J Vasc Surg*. 1993;18:760–766.
4. Connell J. Popliteal vein entrapment. *Br J Surg*. 1978;65:351.
5. Iwai T, Sato S, Yamada T, et al. Popliteal vein entrapment caused by the third head of the gastrocnemius muscle. *Br J Surg*. 1987;74:1006–1008.
6. Hirokawa M, Iwai T, Inoue Y, Sato S. Surgical treatment of popliteal vein entrapment causing symptoms. *Phlebology*. 2002;17:103–107.
7. Rich NM, Collins GJ Jr, McDonald PT, Kozloff L, Clagett GP, Collins JT. Popliteal vascular entrapment. Its increasing interest. *Arch Surg*. 1979;114:1377–1384.
8. Jayaraj A, Gloviczki P, Duncan AA, et al. Popliteal entrapment syndrome-The case for a new classification. *Vascular*. 2022;30:285–291.
9. Koplak MC, Grooff P, Piraino D, Recht M. Third head of the gastrocnemius: an MR imaging study based on 1,039 consecutive knee examinations. *Skeletal Radiol*. 2009;38:349–354.
10. Nelson MC, Teitelbaum GP, Matsumoto AH, Stull MA. Isolated popliteal vein entrapment. *Cardiovasc Intervent Radiol*. 1989;12:301–303.
11. Raju S, Neglen P. Popliteal vein entrapment: a benign venographic feature or a pathologic entity? *J Vasc Surg*. 2000;31:631–641.

12. Liu PT, Moyer AC, Huettl EA, Fowl RJ, Stone WM. Popliteal vascular entrapment syndrome caused by a rare anomalous slip of the lateral head of the gastrocnemius muscle. *Skeletal Radiol.* 2005;34:359–363.
13. Leon M, Volteas N, Labropoulos N, et al. Popliteal vein entrapment in the normal population. *Eur J Vasc Surg.* 1992;6:623–627.
14. Beitzke D, Wolf F, Juelg G, Lammer J, Loewe C. Diagnosis of popliteal venous entrapment syndrome by magnetic resonance imaging using blood-pool contrast agents. *Cardiovasc Intervent Radiol.* 2011;34:S12–S16.

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