

Case report

An unusual case of duplicated popliteal vein and its effect on the diagnosis of deep vein thrombosis.

Aithal PA¹, Kumar N², Nayak BS³, Shetty SD⁴, Patil J⁵, Ravindra SS⁶

Abstract

Background: We report in here a very unusual appearance of a duplicated popliteal vein found in a male cadaver. Popliteal vein is usually a single vein present deep in the popliteal fossa which is formed by the union of venae comitantes of the anterior and posterior tibial arteries. **Methods:** Anatomical variation in the lower extremity was identified during routine dissection of human cadaver. **Result:** We noted the presence of unilateral doublepopliteal veins which were formed at the lower end of popliteal fossa. Both the veins were found closely related to the popliteal artery and both of them received tributaries. In the adductor canal both the popliteal veins joined to form the femoral vein. **Conclusion:** It has been believed that such venous variations in lower limbs have important implications for diagnostic ultrasonography imaging in cases which are suspected with deep vein thrombosis. Thus this case reported in here is very helpful for surgeons for proper diagnosis and management of deep vein thrombosis and also to radiologists to aid in the interpretation of venograms.

Keywords Popliteal vein; duplicated; popliteal fossa; femoral vein; deep vein thrombosis.

Bangladesh Journal of Medical Science Vol. 16 No. 01 January'17. Page : 150-153

Introduction

The venous anatomy of the lower limbs is highly variable and it may be attributed to various venous malformations which occur during the late stages of development of the embryo. Due to this, several anatomical variations are encountered in the lower limbs. These variations particularly of veins of the lower limbs are very important as these are the most common sites of deep vein thrombosis. The veins of the lower limbs can be subdivided into superficial and deep veins. The superficial veins lie in the superficial fascia while the deep veins accompany the major arteries. Usually the popliteal vein is formed at the distal border of popliteus by the union of venae comitantes of the anterior and posterior tibial arteries. The relationship of popliteal vein with the popliteal artery changes as it ascends.

Distally it is medial to the artery, in the middle of popliteal fossa superficial to the artery and proximal to the knee joint it is posterolateral to the artery. The popliteal vein after its formation ascends through the popliteal fossa, passes through the adductor canal and below the sartorius muscle, in the medial side of thigh continues as femoral vein¹. Its tributaries are the short saphenous vein, veins corresponding to the branches of popliteal artery and muscular veins. There are many case reports which report the variations related to femoral vein and its tributaries. But, the literature contains relatively few reports on anatomic variations of the popliteal veins the occurrence of its variation is very rare^{2,3}. Prior knowledge regarding such variation is important for surgeons because these veins are vulnerable for deep vein thrombosis.

1. Ashwini Aithal P
2. Naveen Kumar
3. Satheesha Nayak B
4. Surekha D Shetty
5. Jyothsna Patil,
6. Swamy Ravindra S

Department of Anatomy, Melaka Manipal Medical College (Manipal Campus), Manipal University, Manipal, Karnataka, India 576104.

Correspondence to: Mr. Naveen Kumar, Department of Anatomy, Melaka Manipal Medical College (Manipal Campus), Manipal University, Manipal, Karnataka, India 576104. Email : naveentonse@gmail.com

Hence we report in here a very rare and unusual presence of duplicated popliteal veins and elaborate on its embryological and clinical aspects.

Case report

While conducting the dissection classes for medical undergraduate students, we came across this rare unilateral variation of popliteal vein in the right popliteal fossa of a male cadaver aged approximately 65 years. There was presence of two popliteal veins (upper and lower) which were formed at the lower end of popliteal fossa by the union of venae comitantes of anterior and posterior tibial arteries (Figure 1). Usually the venae comitantes which are four in number join to form a single popliteal vein. But in our case, the superficial anterior tibial vein joined with the superficial posterior tibial vein to form the upper popliteal vein while the deeper anterior and posterior tibial veins joined to form the lower popliteal vein (Figure 2). As a result of this, there was presence of a network of veins at the lower end of popliteal fossa between the two heads of the gastrocnemius muscle. The terminal branches of the popliteal artery were present in between this venous plexus. Both the popliteal veins were of same calibre. Their relationship with the popliteal artery was also peculiar. In the lower part of the fossa, the artery was present between the double popliteal veins (superficial and deep to the artery). In the upper part, the double veins were present on either side of the artery (medial and lateral side of artery). This arrangement continued till the adductor canal. In the adductor canal the two popliteal veins joined to form the femoral vein under the sartorius muscle. In their entire course we found that both the veins received tributaries and the small saphenous vein drained into the upper popliteal vein in the middle of popliteal fossa.

Ethical approval: This case report was ethically approved prior the submission

Discussion

In recent years, Deep vein thrombosis (DVT) of lower limb has become a very common medical condition with a wide range of manifestations. The signs and symptoms of it vary from person to person. In most of the anatomy textbooks, the venous system of the lower limb is described as consisting of a continuous course of veins without any duplication. Usually the venous variations have been studied through cadaveric dissections, ultrasonography or venography. It has been postulated that venous variations in lower limbs are common and have important implications for diagnostic ultrasonography imaging in cases

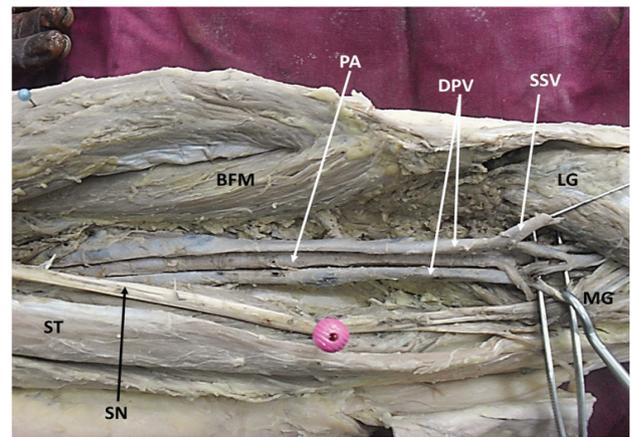


Figure 1: Dissection of the right popliteal fossa and back of the thigh showing the duplicated popliteal vein (DPV) and the popliteal artery (PA). SSV: Short saphenous vein, SN: Sciatic nerve, ST: Semitendinosus, BFM: Biceps femoris muscle, LG: lateral head of gastrocnemius, MG: Medial head of gastrocnemius.

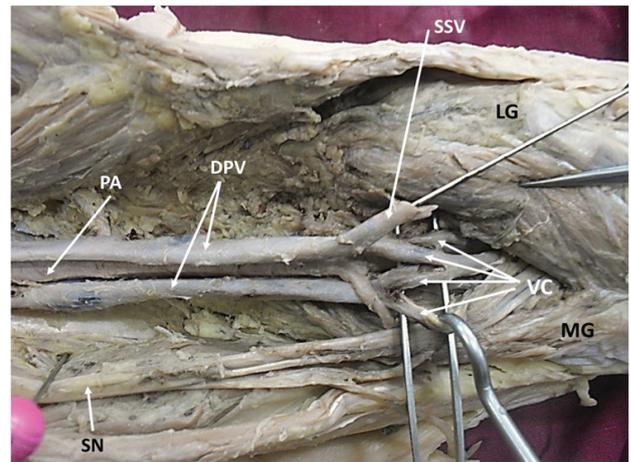


Figure 2: Closer view of the duplicated popliteal vein (DPV) showing its relation with the popliteal artery (PA) and its formation from the venae comitantes (VC) of the anterior and posterior tibial arteries. SSV: Short saphenous vein, SN: Sciatic nerve, LG: Lateral head of gastrocnemius, MG: Medial head of gastrocnemius.

suspected with DVT. Although DVT is considered to be asymptomatic, severe complications of DVT may even lead to death which makes this condition even more important. Hence thorough knowledge regarding any venous variations of the lower limb is very important for surgeons and radiologists.

In our literature review we found that reports of variations associated with the popliteal vein are very rare. Most of the studies done involve either

ultrasonography or venography study of the popliteal vein. Hence we report in here a very important cadaveric observation where we found the presence of double popliteal vein in the popliteal fossa and back of the thigh and discuss its anatomical and clinical importance. There are many reports related to the duplication of femoral vein and also variations of its tributaries. Its incidence is considered to be high and also variable. Kerr et al. in their study by duplex scanning on venous and arterial variations of the lower limbs diagnosed that duplication of the femoral vein was the most common variation of the venous system of lower extremities⁴. Gordon et al has reported the incidence of duplication of the femoral vein in 25% of the cases investigated by them⁵. It has been noted that a number of medical specialists, especially radiologists, have described a relationship between the presence of duplicated veins of lower limb and the occurrence of DVT. Sreaton et al.⁶ in their retrospective review of 381 venograms have found that the number of false-negative ultrasound findings of thrombosis was larger in the presence of a duplicated femoro-popliteal venous system. Nayak et al. have reported a case wherein there was an unusual communication between the profunda femoris vein with the popliteal vein in the popliteal fossa⁷. Saha Susmita et al have reported a case of anomalous deep femoral vein in popliteal fossa⁸. In their case the deep femoral vein arose as a branch of popliteal vein and then continued as profunda femoris vein which later terminated into femoral vein.

It has been observed that most often DVT remain asymptomatic, as anatomic variations of deep veins form a collateral circulation. Hence it is very important to note any variations related to the deep veins of lower limbs. Regarding the embryological basis of venous malformations, it has been opined that truncular venous malformations represents an embryologically defective vein where developmental arrest has occurred during the vascular trunk formation period in the later stage of the embryonic development. This does not possess the evolutionary capacity to proliferate. Whereas the extratruncular venous malformations represents a defective vein where developmental arrest has occurred during an earlier stage of embryonic development and therefore it possess the evolutionary ability to proliferate⁹. Variation noted by us is of truncular venous malformation which has resulted in the duplicated popliteal vein.

There are very few reports on variations of popliteal

vein anatomy. Few of these are true duplications while others represent a high confluence of the tibial veins. In a study done by Sadowska et al, have found that the variation of the deep veins in the popliteal fossa are present in more than 30% of lower limbs as studied by them¹⁰. In approximately 19% of the lower limbs there was a high origin of the popliteal vein formed by two or three tributaries. In almost 8% of the studied cases they found true duplicated popliteal veins. They opine that true duplicated popliteal veins are not a very common finding and their presence is considered as a risk factor for deep-vein thrombosis¹⁰. Retrospective review of bilateral venograms done by Quinlan et al reported that the incidence of true duplicated popliteal veins is 5.1%¹¹. In another retrospective study which was performed to determine the prevalence of lower extremity venous duplication using duplex ultrasound, duplication of the popliteal vein was observed in 3.6% of cases¹², while in a more recent study performed with the same technique it was shown to be even more rare¹³. In conventional venography it is impossible to demonstrate the anatomical course and the relationship of the veins with the accompanying artery. Thus cadaveric observations are very important to note venous variations.

The presence of variations among deep veins within the popliteal fossa raises the risk of the potential formation of thrombosis and also results in changes in flow velocities. This duplicated popliteal vein may also compress the popliteal artery which may result in decreased blood flow to the leg and foot. The presence of duplicated popliteal vein may remain unknown which may amplify the possibility of a negative result in cases of a missed thrombus during ultrasonography image analysis, if only a single vein is visible. Williams has studied the veins of popliteal region and has classified into 3 groups³. Group 1 consisted of specimens with a single large vein crossing the knee joint. Group 2 has two popliteal veins crossing the knee joint. Group 3 specimens had three popliteal veins that crossed the knee joint. But he has reported that such incidences are very rare. Duplicated popliteal vein that we report in here falls into group 2 category. Cross et al have reported that they found 84.6% of the 52 specimens studied by them exhibited more than a single vein crossing knee joint¹⁴. They opine that lower extremity trauma involving the knee joint or popliteal fossa is frequently associated with vascular injury. This information should be of great value to the surgeon operating for traumatic injury in the popliteal fossa as the

standard operative approach is from a medialskin incision. If only one vein is identified and the other vein remains unnoticed, it may lead to injury of that vein. If the venous injury involves a single popliteal vein without extensive collateral veins, ligation may lead to extremity oedema and/or ischemia¹⁴. Thus this case reported in here is very helpful for surgeons operating on this region and also to radiologists to aid in the interpretation of venograms.

Conclusion

Lack of experience and knowledge regarding such anatomical variations could lead to fatal errors in the diagnosis as well as different surgical interventions

related to deep veins of lower limbs. Adequate descriptions regarding the presence of duplicated popliteal vein in literatures are lacking. Most of the studies done to examine the popliteal venous anatomy is through ultrasonography or venography. We believe that there is a need for an extensive review of the venous anatomy of the lower limb before performing any interventions in this region and hence we report this cadaveric variation of the duplicated popliteal vein. Such uncommon variation is noteworthy for surgeons and radiologists for proper management of deep vein thrombosis.

Conflict of interest: None

References:

1. Susan Standring. Gray's Anatomy. 40th edition. Churchill Livingstone. 2008. p 1409.
2. Picque R, Pigache R. Contribution a l'etude des veines profondes du membre inferieur. J Anatet Physiol. 1909. 45:537-564.
3. Williams AF. The formation of the popliteal vein. Surg-Gynecol Obstet. 1953. 97:769-772.
4. Kerr TM, Smith JM, McKenna P, Lutter KS, Sampson MG, Helmchen RH, Roedersheimer LR. Venous and arterial anomalies of the lower extremities diagnosed by duplex scanning. SurgGynecol Obstet. 1992. 175:309-314
5. Gordon AC, Wright I, Pugh ND. Duplication of the superficial femoral vein: recognition with duplex ultrasonography. ClinRadiol. 1996. 51: 622-624. [https://doi.org/10.1016/S0009-9260\(96\)80055-9](https://doi.org/10.1016/S0009-9260(96)80055-9)
6. Sreaton NJ, Gillard JH, Berman LH, Kemp PM. Duplicated superficial femoral veins: a source of error in the sonographic investigation of deep vein thrombosis. Radiology. 1998. 206: 397-401. <https://doi.org/10.1148/radiology.206.2.9457192>
7. SatheshaBadagabettuNayak, Srinivasa Rao Sivasanagandla, SudarshanSurentran, Vasanthakumar, VenuMadhavNelluri. Unusual communication of profundafemoris vein with the popliteal vein in the middle of the popliteal fossa. Forensic Medicine and Anatomy Research.2013. 1(4), 80-82. <https://doi.org/10.4236/fmar.2013.14017>
8. SahaSusmita, Aggarwal Shilpi. An anomalous deep femoral vein in the popliteal fossa and its clinical implications. IntJclinsurg adv.2013; 1(2):64-68.
9. Lee BB, Laredo J, Neville R. Embryological background of truncular venous malformation in the extracranial venous pathways as the cause of chronic cerebrospinal venous insufficiency. IntAngiol. 2010; 29: 95-108.
10. SadowskaA, SpodnikJ.H, WójcikS. Variations in popliteal fossa venous anatomy: implications for diagnosis of deep-vein thrombosis. Folia Morphol. 2013, 72(1). 51-56 <https://doi.org/10.5603/FM.2013.0008>
11. Quinlan DJ, Alikhan R, Gishen P, Sidhu PS. Variations in lower limb venous anatomy: implications for US diagnosis of deep vein thrombosis. Radiology. 2003. 228: 443-448. <https://doi.org/10.1148/radiol.2282020411>
12. Dona E, Fletcher JP, Hughes TM, Saker K, Batiste P, Ramanathan I (2000) Duplicated popliteal and superficial femoral veins: incidence and potential significance. Aust N Z J Surg. 2000. 70: 438-440. <https://doi.org/10.1046/j.1440-1622.2000.01855.x>
13. Simpson WL, Krakowski DM. Prevalence of lower extremity venous duplication. IndianJ Radiol Imaging. 2010. 20: 230-234. <https://doi.org/10.4103/0971-3026.69367>
14. Leanne Cross, John Hall, Thomas R Howdieshell, Gene L. Colborn and Thomas F Gale. Clinical Anatomy of the Popliteal Blood Vessels. ClinicalAnatomy. 2000. 13:347-353. [https://doi.org/10.1002/1098-2353\(2000\)13:5<347::AID-CA4>3.0.CO;2-9](https://doi.org/10.1002/1098-2353(2000)13:5<347::AID-CA4>3.0.CO;2-9)