

Variation of Venous System in Popliteal Fossa

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Abstract

Objective: The popliteal vein is the main vein of lower limb, generally accompanied by the popliteal artery in the popliteal fossa. It is of great importance to have the knowledge of the veins of the lower limb and their anomalies, so as to avoid any vascular injury during the surgery on lower limb and for improved assessment and treatment of deep vein thrombosis. Hence, retrospectively to review and evaluate the types of variations and their frequencies seen within the popliteal fossa, we carried out a cadaveric study in the Department of Anatomy of Dr P.D.M.M.C. Amravati. **Materials and Methods:** In the dissection hall, during routine dissection of formalin fixed cadavers of the adult donors a retrospective study of 20 bilateral (40 unilateral) lower limbs was performed. **Results:** We found one variation in lower limb vein of a 64 year male cadaver. In this case, the popliteal vein instead of continuing as femoral vein bifurcated into two veins one of which separately opened into the femoral vein in the femoral triangle. **Conclusion:** Variations in popliteal fossa venous anatomy have many important clinical implications in deep venous thrombosis as well as in lower limb surgery.

Keywords: Adductor Magnus; Popliteal Vein; Femoral Vein; Profunda Femoris Vein.

Introduction

The knowledge of popliteal vein and femoral vein variations is important for planning of some interventional procedures. The variations in the anatomy of lower extremity venous system have been studied with the use of cadavers, venography and ultrasonography. These studies have shown different results depending on the study population and the different modalities used [1]. The venous drainage of lower extremity is of great importance as the veins are prone to thrombus due to long term immobilisation or accidents. Let us consider a brief review of the veins of the lower limb.

In lower limbs, the most commonly present two venous systems of blood collection are the deep and

superficial according to the two compartments. The third system of perforating veins connect the deep with the superficial veins. Upto the knee joint the veins are generally paired and above the knee the main trunks ie popliteal, femoral and the profunda femoris are without duplication [2]. Only 17% will have this 'normal' venous anatomy. About more than 45% have duplicated multiple vessels and the popliteal vein is the common vein found with variation next to the femoral vein [2]. In very rare conditions, the popliteal vein establishes connection with the profunda femoris vein.

The deep veins of the foot and leg drain into popliteal vein which ascends to form the femoral vein. The femoral vein receives the profunda femoris vein as a tributary from deep part of the front of the thigh 8 to 9cm away from inguinal ligament [3].

The popliteal vein begins at the lower border of the popliteus muscle by joining of anterior and posterior tibial veins. Throughout its course the popliteal artery is lying deep to the popliteal vein in the same fibrous sheath.

The vein is initially posteromedial to the popliteal artery, lateral to the tibial nerve. More superiorly it is posterior to the artery and anterior to the tibial nerve. Little above, it lies lateral to the artery at the upper

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border of popliteal fossa. Superiorly the popliteal vein becomes femoral vein as it traverses the adductor hiatus. The small saphenous vein passes from posterior aspect of lateral malleolus to the popliteal fossa and it pierces the deep popliteal fascia and enters the popliteal vein.

Materials and Methods

In the dissection hall, during routine dissection of formalin fixed cadavers of the adult donors a retrospective study of 20 bilateral (40 unilateral) lower limbs was performed. Deep veins present in popliteal fossa were evaluated for the presence of any duplication and also interindividual variations in the venous anatomy.

Results

We found one variation in lower limb vein of a 64 year male cadaver. In this case, the popliteal vein instead of continuing as femoral vein bifurcated into two veins one of which separately opened into the femoral vein in the femoral triangle. In all the rest of 39 lower limbs, the popliteal vein continued till the upper end of popliteal fossa and then above as the femoral vein.

We describe a rare variation of popliteal vein which terminated into two different veins.

Case Report

The present case was observed during routine dissection of a male cadaver aged 64 years. In this case, the popliteal vein of left limb, was present at the superior angle of popliteal fossa terminated into two veins. One as the femoral vein which continued upwards and pierced the adductor magnus and other was the tributary which went vertically upwards separately and opened into the femoral vein called profunda femoris vein.

This other (profunda femoris) vein was as long as 19 cms. and was opening into the femoral vein near its upper end. These three were covered by hamstring muscles. The femoral vein was normal in thickness, about 20 cms in length and was accompanied by femoral artery as it ascended through the adductor magnus to the femoral triangle. So, the popliteal vein instead of directly continuing as femoral vein, terminated into two veins namely the femoral vein

and the profunda femoris vein.

When traced proximally there were two tributaries of the popliteal vein draining from the lateral border of the leg 1) The short saphenous vein and 2) Superficial Vein of the leg.

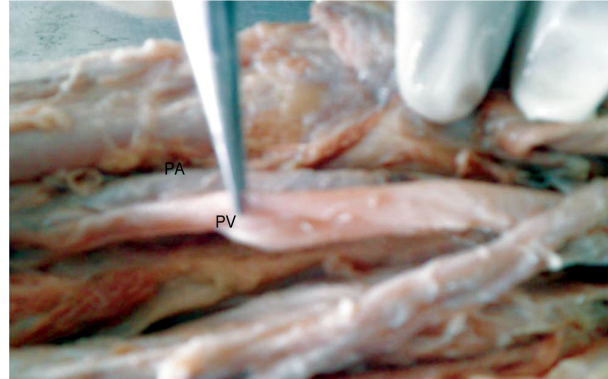


Fig. 1:

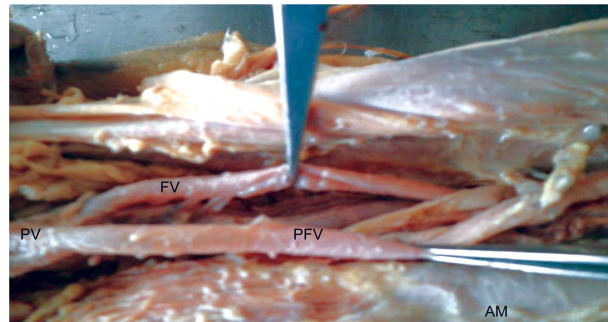


Fig. 2:

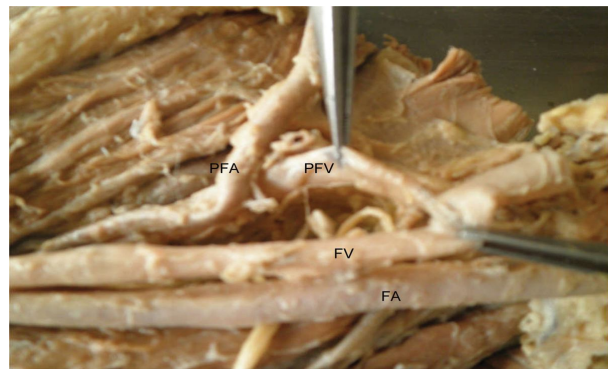


Fig. 3:

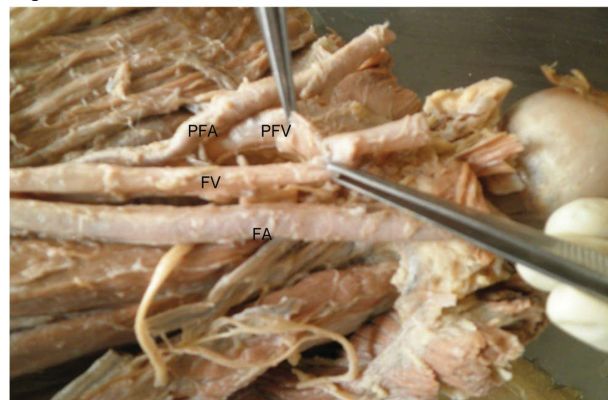


Fig. 4:

These were draining into the popliteal vein in the popliteal fossa where the posterior tibial vein joined the anterior tibial vein. In the right lower limb, the arrangement of veins was normal.

We observed 1. In photo1, the popliteal fossa showing popliteal artery and popliteal vein. 2. In photo 2, the popliteal vein dividing into 2 veins, the femoral and the profunda femoris vein. Femoral vein entered the adductor magnus muscle 3. In photo 3 and photo 4, the femoral vein and the profunda femoris vein in femoral triangle. The profunda femoris artery was cut for better visualization. [PA, PV -popliteal artery, vein. FA, FV- Femoral artery, vein. PFA, PFV- Profunda femoris artery and vein]

Discussion

The complex embryological development of vascular system often results in various anomalies. It is stated that the classic anatomical venous return pattern in lower extremity is found only in 16% of the patients [4]. Even though we could not provide embryological background of all the observed variations, we believe that comprehensive list of all 3D variations of femoropopliteal vein can provide an insight to formulate a hypothetical model for the development of venous system of lower extremity [1]. The duplication in popliteal vein may result in false negative deep vein thrombosis study, and consequently failure in the diagnosis of thrombotic disease and ultimately pulmonary embolism.

Variations of venous anatomy in the popliteal fossa are common and have important implications in diagnosis of deep venous thrombosis [2]. Caution should be exercised when a popliteal vein is duplicated because of high confluence of posterior tibial vein as duplication [5]. Thromboembolic disease is a process of deep vein thrombosis along with pulmonary embolism. Most of the pulmonary embolisms are thought to originate in the deep veins of the lower extremity [4]. Kambal et al studied variations and the role of ablation in the management of symptoms and skin changes [6].

Much of the literature on lower extremity venous duplication is based on venography studies. The prevalence in these studies varies widely from 4-5% for popliteal vein and upto 46% in femoral vein [5,6,7]. It is of great importance during the surgery on lower limb, to avoid any vascular injury and related complications intraoperatively as well as postoperatively.

The duplication of lower extremity venous system is the anatomical variation which is the most common reason for a false negative deep vein thrombosis study that consequently results in failure to diagnose venous thrombotic disease and ultimately the pulmonary embolism [5].

Hence, the knowledge of the veins of the lower limb and the knowledge concerning the incidence and distribution of venous anomalies is utmost required for detecting the underlying anatomical variation for improved assessment and treatment of venous disease [4].

In the obstruction or thrombosis of profunda femoris vein, phlebology gives a great deal of information about collateral blood flow [9].

The variations in the anatomy of lower extremity venous system have been studied with the use of cadavers, venography and ultrasonography. However venography has not been considered as an appropriate procedure it needs that all the vessels to be filled by the contrast which is often not possible. Nowadays, multidetector CT is an upcoming recent technique for the presence of any variant vein or accompanying small artery [8,10,11,12].

A substantial number of studies had been published when follow up of patients with the negative above-knee ultrasound results [13,14,15,16,17] or negative single full-leg ultrasound results were done [18,19,20,21]. These studies reported that there was low rate of thromboembolic event over the subsequent 3 months. The analysis also suggested that the follow ups were cost-effective.

However, the concerns about costs, complications, contraindications and radiation dose have led a decrease in the use of venography, such that it is limited to only a selected group of patients [22].

Further anatomical and functional studies using new imaging modalities available should target the areas within 5 cm of the inguinal ligament, within 3 cm of the profunda femoris vein and in the popliteal vein near the adductor hiatus to identify whether certain valves play a more important role in venous disease. This may guide us in the development of new treatment options for patients with deep venous disease [23].

Conclusion

In our study, the variation in popliteal vein of the left lower limb was found. The duplication of lower extremity venous system is the anatomical variation which is the most common reason for a false negative

result. In deep vein thrombosis study consequently there are chances of failure to diagnose venous thrombotic disease and ultimately the pulmonary embolism. The use of venography, now a days is limited as new imaging modalities like 3D sonography and Doppler sonography, multi detector CT scan, magnetic resonance imaging etc. are available.

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