A Morphological Insight of the Femoral Vein.

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Citation

Abstract: A total of 13 cadavers (12 men and 1 woman) of different age group were used for the study with the purpose to determine the prevalence of femoral vein duplication. Lower limb regions (26 sides) were carefully dissected as per the standard dissection procedure. Femoral vein (unitruncular) was found in 96.15% of specimen. Bitruncular configurations (total bifidity) was found in a male cadaver of 75 years of age (3.85%). In the right lower limb, 6.5 cms below the inguinal ligament the femoral vein - lateral ramus received the lateral circumflex femoral vein, and the medial circumflex femoral vein, and the lateral and medial ramii formed a common venous trunk. Knowledge of the truncular venous variations is important to recognize and avoid potential errors in diagnosis of deep venous thrombosis of the femoral vein, in the case of an occluded duplicated trunk.

Key Words: Lower limb, Femoral vein, Unitruncular configuration, Bitruncular configuration, Deep vein thrombosis, Anatomical variation.

Introduction: The femoral vein accompanies the femoral artery, beginning at the opening in adductor magnus as the continuation of the popliteal vein, and ending at the level of inguinal ligament, by becoming the external iliac vein. In the lower part of the adductor canal it is posterosolateral to the femoral artery; in the upper part of the canal, and in the lower part of the femoral triangle, it is behind the artery. At the base of the femoral triangle it is medial to the artery. The femoral vein has numerous muscular tributaries. The deep femoral vein joins the femoral vein posteriorly 4–12 cm distal to the inguinal ligament, and the great saphenous vein then enters anteriorly. Lateral and medial circumflex femoral veins are usually tributaries of the femoral vein.(1) The human venous system has a complex embryology which causes frequent anatomic variations. As a result of vascular x-ray and surgery, in which the vascular tree can be observed, it has been demonstrated that only 1/6 patients are exempt of these anomalies. One of the most common is the duplicity of the superficial femoral vein.(2,3) This duplicity favours the vein thrombosis in one of its branches with special clinical features such as the absence of symptoms in the affected limb and the early triggering of a pulmonary embolism. Deep vein thrombosis (DVT) is a common medical condition with a wide range of manifestations that range from an asymptomatic state to a classic symptomatic DVT, with important sequelae of pulmonary embolism, chronic venous insufficiency, and postphlebitic syndrome. Clinical examination is insensitive, and objective tests are required for the diagnosis. Among the diagnostic tools available for patients with symptomatic DVT, duplex ultrasonography (US) has become the imaging modality of choice, increasingly replacing venography because of its simplicity and high sensitivity and specificity, especially in the femoropopliteal region.(2) The purpose of this study was to determine the prevalence of femoral vein duplication.

Materials and Methods: A total of 13 cadavers of both sexes (12 men and 1 woman) of different age group were used for the study. Lower limb regions (26 sides) of the cadavers were carefully dissected as per the standard dissection procedure in the Morphology Laboratory at the University of Pamplona. The topographic details were examined and the variations were recorded and photographed. The history of the individual and the cause of death are not known.

Results: The configurations of the femoral vein were classified into two groups: unitruncular and bitruncular. The modal anatomy of the femoral vein (unitruncular) was found in 96.15% of specimens. Bitruncular configuration (total bifidity) was found in a male cadaver of 75 years of age (3.85%) in the right lower limb.
The femoral vein on the right side was posterolateral to the femoral artery as it entered the adductor canal at the adductor hiatus. In the adductor canal it divided into two veins, one medial ramus and other lateral ramus, which ascended perpendicular until the femoral triangle. At this level 6.5 cm below the inguinal ligament, the femoral vein lateral ramus received the lateral circumflex femoral vein, and also the medial circumflex femoral vein, the lateral ramus and medial ramus forming a common venous trunk (CFV: common femoral vein) located posterior to the femoral artery. Both femoral veins extending from the adductor canal to the femoral triangle had a length of 18 cm. The caliber of the femoral vein at level of adductor canal and the caliber of common femoral vein at level of femoral triangle was 30 mm. The caliber of the femoral artery at the femoral triangle was 24 mm. The caliber of the femoral vein at the femoral triangle was much larger that the femoral artery. The caliber of the medial and lateral component veins was 20 mm. Four (4) cm below the inguinal ligament the common femoral vein received posterolaterally the deep femoral vein; three (3) cm below the inguinal ligament the common femoral vein received anteromedially the great saphenous. (Figure 1).

Discussion:
The reported incidence of multiple femoral veins has varied between 6% and 38% depending on the study population and the employed modalities. (2,4-9) The duplex ultrasonography (US) studies have consistently demonstrated lower rates (6-25%) of multiple femoral veins compared to that of the venographic studies, which have reported rates of 31% and 33%. (2,6)
The complex embryologic development of the vascular system often results in a myriad of clinically relevant variants. It has been stated that the classic anatomic venous pattern in the lower extremity is found in only 16% of patients. (10) Primitive vascular channels in the limb first appear in the third week of gestation. During stage 1 of its development (undifferentiated stage), only a capillary network is present. Stage 2 is the retiform stage when large plexiform structures can be seen, while in stage 3, by the third week of gestation, the maturation stage includes development of larger channels, and maturation of the arteries, veins, and lymphatics. (11) One important fact is that the arrangement of the vessels parallels the layout of the neuronal network. The nerves appear first. From the axons and Schwann cells that coat them, they secrete a vascular endothelial growth factor, or VEGF. This factor appears to have a two-fold role: to attract the primitive blood vessels to the vicinity of the nerves, and then to induce their arterial, venous, or lymphatic specialization. (12,13) The ephrin family (B2-B4) play an important role in the venous or arterial differentiation. (14) In addition, the arterial-venous differentiation and patterning are controlled by the blood flow. (15,16)

Coming to the embryological basis of venous malformations (VM), the ‘truncular’ VM is one of two different types of the VMs, classified based on the stage where the developmental arrest/defect occurred. The truncular VM represents an
embryologically defective vein where developmental arrest has occurred during the vascular trunk formation period in the 'late stage' of the embryonic development. This lesion no longer possesses the evolutionary capacity to proliferate. The 'extratruinous' VM represents a defective vein where developmental arrest has occurred during an 'earlier stage' of embryonic development and therefore maintains the mesenchymal cell properties and its evolutionary ability to proliferate when stimulated.(1,17)

The venous malformations (truncular forms) occurring during the late development of the embryo produce several anatomical variations in the number and caliber of the main venous femoral trunks at the thigh level. The modal anatomy of the femoral vein was found in 308 of 336 limbs (88%). Truncular malformations were found in 28 of 336 limbs (12%); unitruncular configurations in 3% (axo femoral trunk (1%); bifurcated configurations in 9% (bifidity of the femoral vein (2%), femoral vein with axio-femoral trunk (5%), and femoral vein with deep femoral trunk (2%). Though truncular venous malformations of the femoral vein are not rare (12%), their knowledge is important for the investigation of the venous network, particularly the venous mapping of patients with congenital vascular disease. (16) It is also important to recognize a bifurcatruin configuration to avoid potential errors for the diagnosis of deep venous thrombosis of the femoral vein, in the case of an occluded duplicated trunk. Scraton et al. (1998), conducted a retrospective review of 381 venograms obtained after initial ultrasound findings were considered negative for thigh or popliteal thrombosis in patients in whom deep vein thrombosis was suspected. False-negative ultrasound findings occurred in four (2%) of 204 patients with single femoral veins and in 10 (6%) of 177 patients with duplicated femoral veins. They made an important inference that the frequency of missed proximal thrombosis at ultrasound appears to be increased when duplicated superficial femoral veins are present, and imaging studies are insufficient to support the adoption of a totally noninvasive imaging strategy. (3) Liuet et al. (1986), conducted an ascending positive contrast venography on 337 lower extremities to determine whether there were any anatomic variations that might predispose to deep vein thrombosis (DVT) and to explain why some patients with DVT are asymptomatic. They concluded that one factor associated with 'silent' DVT was multiple femoral veins. In these patients, complete occlusion by the thrombus is less likely because multiplicity may offer internal collaterals, preventing epifascial edema. Multiple FVs were found in 31% of the total limbs. Of the limbs with multiple FVs, 40% had DVT. This was a statistically higher incidence (p<0.001) than that seen in the 19% of those limbs with a single FV. Only 41% of the DVT limbs with multiple FVs were symptomatic, whereas 72% of DVT limbs with a single FV were symptomatic (p<0.001). While no difference was found relative to symptomatology and incidence of DVT between single and multiple popliteal veins. (6)

The femoral region of the thigh is utilized for various clinical procedures, both open and closed, particularly with respect to arterial and venous cannulation. Femoral vein catheterization is the easiest and safest method for obtaining temporary vascular access in hemodialysis patients, deep vein transposition reconstruction surgery of the opposite limb. (1,2) Femoral veins have been widely used as vascular substitutes, especially in delicate situations. Since initial reports, Femoral vein (FV) has been the first, if not the only, choice of substitute for in situ reconstruction of the aortoiliac tree when prosthetic infection is present. Casella et al. (2010), observed 99.0% of the main FVs and 25.4% of the accessory veins presented diameters superior to 6 mm, a suitable value for iliac substitution. (18)

Infringuinal bypass surgery is another possible application for FVs as substitutes when the contralateral options are depleted or infection is present. Diameters between 3 mm and 7 mm were observed in 17.2% of the main FVs and 79.1% of the accessory veins. Since these vessels are usually short for complete substitution in infrainguinal bypass procedures, they could be used in combination with saphenous or arm veins to cover the necessary extension. Theoretically, main FV harvesting for use as a substitute would be more tolerated in patients with duplicated systems, as venous flow originating from leg veins would naturally be redirected to accessary femoral veins. (18,19)

Conclusion:
Completely extending duplicated veins with similar diameters is an uncommon condition, noticed in fewer than 10% of limbs, and in this study being 3.85%. These findings should be considered when duplex examination is performed for femoral DVT diagnosis, or when venous substitutes are required for arterial reconstruction.

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References:


