

Axial transformation of the profunda femoris vein: formation, relations and course in a cadaveric specimen

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When the superficial femoral vein is obstructed by thrombosis, the profunda femoris vein provides an important collateral pathway, transforming into the axial vein of the lower limb. When operating on a transformed axial vein, a surgeon should be aware of the formation, the relations and the course of the vein. A precise description of these anatomical features is not feasible on the basis of ultrasound, venographic or surgical study but only from anatomical studies. We present a case of axial transformation of the profunda femoris vein found in a cadaver, focusing on the anatomical features of the transformed axial vein. (Folia Morphol 2008; 67: 304–306)

Key words: axial vein of the lower limb, thrombosis, variation

INTRODUCTION

Normally, the profunda femoris vein is formed by the perforating femoral veins and drains the lateral and medial circumflex femoral veins distal to the saphenofemoral junction. The popliteal vein is formed at the lower portion of the popliteal muscle by the union of the posterior and anterior tibial veins. In the popliteal fossa it runs superficially and laterally to the popliteal artery and, passing through the adductor opening, becomes the superficial femoral vein. The superficial femoral vein, accompanied by the femoral artery, travels to the anterior-medial surface of the thigh and ends at the femoral triangle [6, 7].

Sometimes the profunda femoris vein connects distally with the popliteal vein [6, 7]. In the presence of thrombosis and obstruction of the femoral vein this non-functional high-resistance anastomosis between the popliteal and profunda femoris vein enlarges to a variable extent and functions as a collateral circulation. This alternative outflow source represents the main outflow source for the limb in the foetus and is the embryonic axial vein. The enlargement of this

collateral anastomosis is therefore referred to as the axial transformation of the profunda femoris vein.

Precise description of the formation, the relations to the adjacent anatomical structures and the course of the transformed axial vein is not feasible on the basis of ultrasound, venographic or surgical study. However, when operating on a transformed axial vein, a vascular surgeon should be aware of these features. A cadaveric specimen is identical for the precise description of these features, but the few anatomical studies describing this anatomical variation failed to correlate it to the obstruction by thrombosis of the femoral vein [1, 8]. In the present study a case of axial transformation of the profunda femoris vein found in a 72-year-old male cadaver is presented, focusing on the anatomical features of the transformed axial vein.

CASE REPORT

During a routine dissection of the popliteal fossa and the posterior surface of the left thigh in a 72-year-old male cadaver we observed a large deep vein that normally does not exist. This enlarged vein

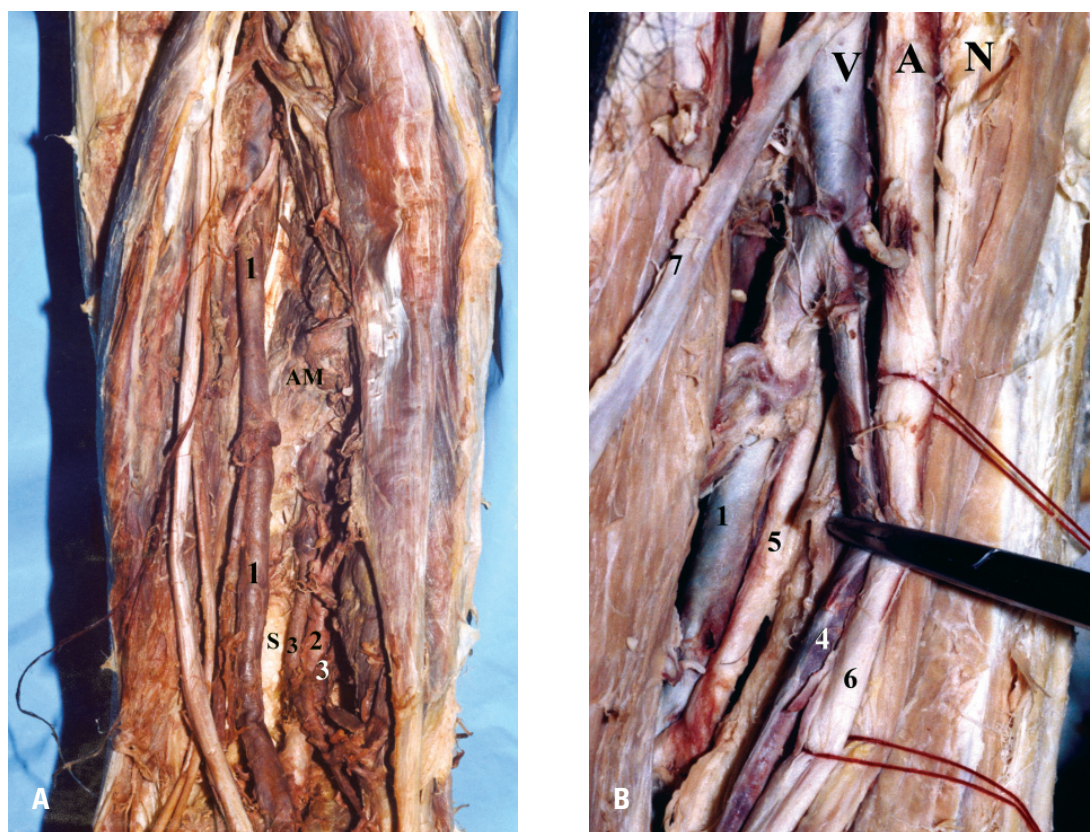


Figure 1. Cadaveric specimen: axial transformation of the profunda femoris vein. **A.** Posterior aspect; **B.** Anterior aspect; 1 — transformed axial vein, 2 — popliteal artery, 3 — satellite veins of the popliteal artery, 4 — superficial femoral vein, 5 — profunda femoris artery, 6 — femoral artery, 7 — great saphenous vein, S — femoral shaft, AM — adductor magnus muscle, V — femoral vein, A — femoral artery, N — femoral nerve.

represented the embryonic axial vein and was formed by the union of the posterior tibial and the sural muscular veins. It was located deep to the hamstring muscles, on the posterior surface of the femoral shaft, and travelled toward the anterior surface of the thigh between the femoral shaft and the adductor magnus muscle. It ran over the adductor brevis and the pectineal muscles, accompanying the deep femoral artery and draining the medial circumflex femoral vein. It emptied into the superficial femoral vein at the same height as the lateral circumflex femoral vein, just distal to the saphenofemoral junction. The superficial femoral vein in the femoral triangle had a calibre reduced by a third in comparison with that of the profunda femoris vein. The superficial femoral vein was formed by the anastomosis of the two satellite veins of the popliteal artery. The medial satellite vein formed by the muscular veins of the semitendinosus and semimembranosus muscles and the lateral satellite vein, which anastomosed with the transformed axial vein, was formed by the two satellite veins of the anterior tibial artery. The lateral satellite vein of the popliteal

artery was fully obstructed by a thrombus (Fig. 1). The medical record of the cadaver was not available and therefore there was no information about the clinical condition of the venous system. Furthermore, there were no obvious signs of incision to the venous system of the lower limb. During the dissection of the right thigh we observed no anatomical variation.

DISCUSSION

The embryonic axial vein represents the main outflow source of the lower limb [5]. The profunda femoris vein represents the cephalic remnant of the embryonic axial vein of the lower limb, and the popliteal vein represents the caudal remnant of the axial vein. The intervening portion largely disappears, and the popliteal vein anastomoses with the superficial femoral vein pertaining to the preaxial vessels (Fig. 2). However, the intervening portion may persist in some individuals as a non-functional high-resistance anastomosis between the popliteal and profunda femoris veins. In the presence of thrombosis and obstruction of the superficial femoral vein this potential

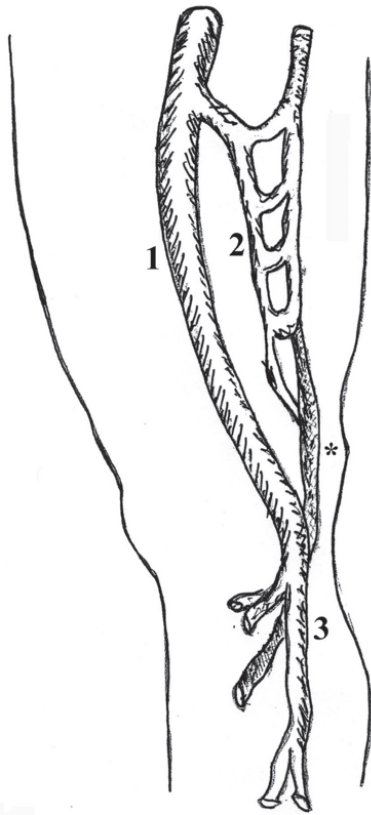


Figure 2. Illustration of the adult femoral veins; 1 — femoral vein, 2 — profunda femoris vein, 3 — popliteal vein. The popliteal-profunda anastomosis (*) constitutes the intervening portion of the embryonic axial vein.

collateral branch is already in place to enlarge rapidly and become functional [2, 4]. In the present study one of the two satellite veins of the popliteal artery was fully obstructed by a thrombus and therefore the dilated popliteal-profunda anastomotic branch functioned as a collateral circulation.

Raju et al. [3] described four grades of axial transformation of the profunda femoris vein: Grade 0 — normal presentation of the venous anatomy; Grade 1 — existence of the profunda-popliteal connection with normal profunda calibre; Grade 2 — the profunda enlarged but smaller than or equal in size to the superficial femoral vein; Grade 3 — enlargement of the profunda femoris vein more than the superficial femoral vein and marked stenosis of the superficial femoral vein; Grade 4 — axial transformation of the profunda femoris vein with total occlusion of the superficial femoral vein. The distribution of patients among the various grades of axial transformation was as follows: Grade 1 — 15%; Grade 2 — 40%; Grade 3 — 36%; Grade 4 — 9%. In our case the superficial femoral vein in the femoral triangle had a calibre

a third smaller than that of the profunda femoris vein and was classified as Grade 3.

In their study Raju et al. [3] discovered that 57 out of 500 (11.4%) consecutively treated patients with severe venous stasis had axial transformation of the profunda femoris vein. The anatomical variation that we present constitutes the sole case out of the 70 cadavers (1.4%) which have been dissected in our Department over the last few years.

Reflux is invariably present when the profunda femoris vein dilates in order to compensate for loss of superficial femoral vein outflow due to obstruction and is partially or completely transformed into the axial vein of the lower limb [3]. The compensatory dilation of the profunda femoris vein disrupts the normal function of the vein valve found in the proximal portion of the vein [5, 7]. Reconstruction of the dilated leaky valve is considered in some cases to be a therapeutic approach to putting an end to reflux.

The superficial femoral vein, when fully obstructed, is not visualised on a venogram and therefore the transformed axial vein may easily be mistaken for the superficial femoral vein. The identification of the transformed axial vein is based on its course; the transformed axial vein has a more lateral course in the thigh than the superficial femoral vein, overlaying the femoral shaft (Fig. 1A) [3].

The present anatomical study enabled us to describe fully the formation, the relations to the adjacent anatomical structures and, in particular, the course of the transformed axial vein. We believe that these observations may be helpful to surgeons who have to cope with a transformed axial vein.

REFERENCES

1. Jiji PJ, D'Costa S, Prabhu LV, Nayak SR, Skariah S (2007) A rare variation of the profunda femoris vein in the popliteal fossa. *Singapore Med J*, 48: 948–989.
2. O'Rahilly, Muller F (1996) Systemic human embryology and teratology. In: *Human Embryology and Teratology*. 2nd ed. John Wiley & Sons, New York, pp. 402–403.
3. Raju S, Fountain T, Neglen P, Devidas M (1998) Axial transformation of the profunda femoris vein. *J Vasc Surg*, 27: 651–659.
4. Raju S, Fredericks R (1991) Venous obstruction: an analysis of one-hundred thirty-seven cases with hemodynamic, venographic, and clinical correlations. *J Vasc Surg*, 14: 305–313.
5. Raju S, Hardy JD (1997) Technical options in venous valve reconstruction. *Am J Surg*, 173: 301–307.
6. Rosse C, Gaddum-Rosse P (1997) Lower limb. In: *Hollinshead's Textbook of Anatomy*. 5th ed. Lippincott-Raven Publishers, Philadelphia, p. 369.
7. Standring S (2005) Pelvic girdle and lower limb. In: *Gray's Anatomy: the Anatomical Basis of Clinical Practice*. Elsevier Churchill Livingstone, Spain, p. 1452.
8. Sujatha K, Arvind CH, Naveen T (1997) A rare variation of deep femoral vein. *Indian J Med Sci*, 51: 82–84.