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Anatomy

Tortuous Profunda Femoris Artery during Cadaveric Dissection: Anatomical Variations and Clinical Implications

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Abstract **Case Report**

Anatomical variations in blood vessels are not uncommon, and their understanding is critical for surgical and interventional procedures. During a routine cadaveric dissection at Adesh Institute of Medical Sciences, Bathinda, a tortuous profunda femoris artery was identified. This case report aims to describe the anatomical variation encountered, its clinical significance, and potential implications for medical practice. The presence of tortuous branches further enhances the complexity of this case, making it a rare and noteworthy finding. The variation in the profunda femoris artery is a rare finding and underscores the importance of thorough anatomical knowledge for medical professionals.

Keywords: Profunda Femoris Artery, Anatomical Variation, Tortuous, Cadaveric Dissection, Clinical Significance.

INTRODUCTION

The profunda femoris artery, the primary deep branch of the femoral artery, is critical for supplying the posterior and lateral thigh compartments. While its typical anatomy is well-documented, variations in origin, branching patterns, and course are increasingly recognized as clinically significant. For instance, studies report PFA origin anomalies in 3–21% of cases, including high origins near the inguinal ligament [1, 2], duplicated PFAs [3], and trifurcations with circumflex femoral arteries [1]. Such variations influence outcomes in femoral catheterization, vascular grafting, and hernia repair [1, 2]. Tortuosity, though less frequently described, adds complexity to interventional radiology and surgical procedures due to altered hemodynamics and accessibility [4]. This case highlights a rare presentation of a tortuous PFA with coiled branches, underscoring the necessity of anatomical awareness in clinical and diagnostic contexts.

CASE PRESENTATION

During a routine cadaveric dissection of the thigh region revealed a profunda femoris artery with an unusually tortuous course at Adesh Institute of Medical Sciences, Bathinda (Figure 1). The tortuosity was distinct, with multiple loops and kinks in the artery's path. No apparent signs of atherosclerosis or other pathological conditions were noted in the surrounding tissues or vasculature. Additionally, several branches originating from the profunda femoris artery exhibited similar tortuous patterns, creating an intricate vascular network within the thigh, supplying various muscles of the thigh. The specimen was carefully prepared and preserved with this abnormal arterial pattern for further study and documentation.

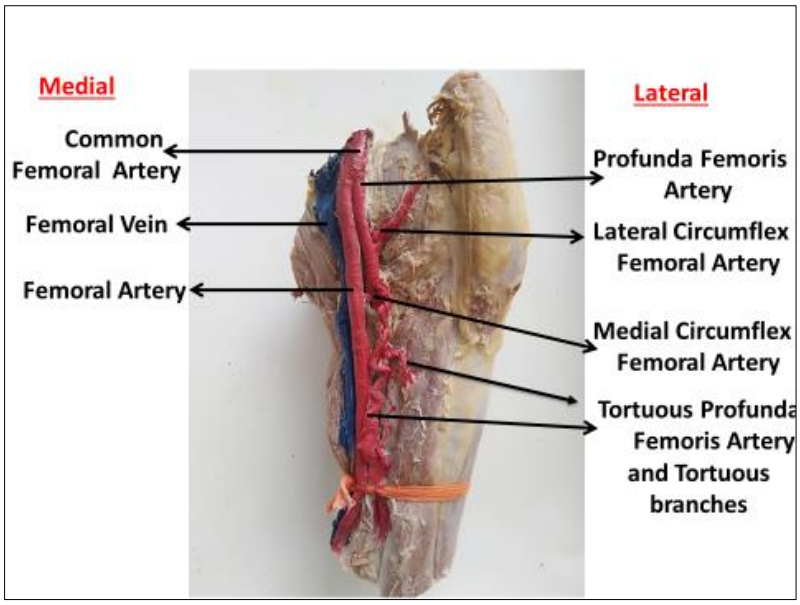

Figure 1: Tortuous Profunda Femoris Artery and Branches

DISCUSSION

The tortuous profunda femoris artery (PFA) observed in this dissection presents multifaceted clinical challenges, as supported by several lines of evidence-based analysis. From an interventional perspective, tortuosity increases procedural complexity during femoral access, as catheter navigation through coiled segments raises risks of dissection and pseudo-aneurysm formation [2-5]. This case diverges from common variations like duplicated PFAs [3], or circumflex artery trifurcations [1], emphasizing the spectrum of PFA diversity. Unlike high-origin PFAs, which are more frequent in females, this tortuous variant occurred in a male cadaver, suggesting no gender predilection. The absence of atherosclerosis contrasts with TPFAAs, which are typically linked to atherosclerotic degeneration [4].

High-origin PFAs, with a prevalence of 21.21%, further exacerbate these risks by altering puncture site dynamics, potentially leading to retroperitoneal hemorrhage if misidentified [2-5]. Therefore, preprocedural imaging, such as CT angiography, becomes critical, as tortuous branches may obscure vascular landmarks, necessitating advanced visualization techniques [5, 6]. Comparative studies in carotid arteries highlight similar issues, showing that tortuosity reduces first-pass success in thrombectomy by 50% and prolongs procedural time by an average of 23 minutes, which is analogous to the challenges encountered in PFA interventions [7, 8]. Beyond procedural concerns, biomechanical and hemodynamic implications of tortuous arteries are significant. Tortuous vessels exhibit altered shear stress and axial tension, predisposing them to endothelial dysfunction and atherosclerotic degeneration [9]. Although atherosclerosis was absent in this particular case, the coiled morphology may still accelerate hemodynamic stress, mimicking mechanisms observed in carotid tortuosity associated with ischemic events [7, 9]. Furthermore, computational models suggest that tortuous vessels increase flow resistance by 15–30%, which can potentially compromise collateral perfusion in cases of superficial femoral artery (SFA) occlusion [5, 9].

Another critical concern is the risk of aneurysmal degeneration. True Profunda Femoris artery aneurysms (TPFAAs) are associated with an 18% rupture risk and frequently coexist with synchronous aneurysms in other vascular territories such as the aorta and popliteal artery [4-9]. The presence of tortuosity may mask early TPFAAs or complicate endovascular repair because of distorted vascular anatomy [4-9]. Histological studies have also linked TPFAAs with reduced elastin and smooth muscle cells, a degenerative pattern seen in aging tortuous arteries [4-9]. Notably, around 30% of TPFAAs remain asymptomatic, highlighting the necessity for vigilant surveillance in high-risk patients [4].

Surgical considerations are equally complex. Tortuosity can limit proper graft alignment during bypass grafting, thereby increasing the risk of thrombosis [2-6]. Given that the PFA serves as a critical collateral pathway in cases of SFA occlusion, preserving its patency during bypass surgery is essential [2-6]. Additionally, orthopedic procedures such as hip arthroplasty carry an elevated risk of iatrogenic injury due to the proximity of the PFA to the hip joint, especially when aberrant branches course near the lesser trochanter [6]. In symptomatic cases, surgical options like arterial shortening or stent grafting may be necessary, as has been effectively employed in managing carotid artery tortuosity [8, 9].

From an anatomical standpoint, this case deviates from common PFA variations. Although about 45.7% of PFAs exhibit lateral circumflex femoral artery origins proximal to medial branches [5], the tortuosity observed here represents a rarer morphological variant. While the PFA's collateral network typically compensates during SFA occlusion, tortuosity may impair effective flow redistribution [2-9]. Interestingly, although high-origin PFAs are more commonly seen in females, this tortuous variant was observed in a male, indicating a multifactorial etiology [2-5].

Embryological and age-related factors also contribute to the development of tortuosity. Incomplete vascular elongation during embryogenesis or age-related perivascular fibrosis may account for such anomalies, as demonstrated in studies of popliteal artery tortuosity in elderly patients, where fascial adhesions at the distal adductor canal play a role [7-10]. Additionally, connective tissue disorders such as Ehlers-Danlos syndrome are known to exacerbate vascular tortuosity and are often associated with TPFAAs and cerebral aneurysms, further highlighting the importance of systemic evaluation [4-9].

In terms of imaging and preoperative planning, Doppler ultrasound is an essential tool for identifying flow turbulence within tortuous arterial segments, aiding in the detection of hidden aneurysms (4, 9). Three-dimensional reconstructions are indispensable for mapping coiled branches before surgery, thereby reducing the risk of intraoperative surprises [6-8]. Furthermore, dynamic assessments, including knee flexion studies that have demonstrated migration of SFA and popliteal tortuosity with aging, suggest that similar positional variations could influence PFA behavior during hip joint movements [10].

CONCLUSION

This case reinforces the need for preoperative vascular mapping in procedures involving the femoral region. Surgeons and interventionalists must anticipate variations like tortuosity to mitigate complications. Future studies could explore the hemodynamic consequences of tortuous PFAs using computational flow models or longitudinal clinical data.

The finding of a tortuous profunda femoris artery in this case raises several important considerations. Anatomical variations, while not uncommon, are significant for clinical practice. In this instance, the tortuosity of the artery can have implications for procedures that require access to the profunda femoris artery, such as angiography or surgical interventions. Surgeons and interventional radiologists should be aware of these variations, as they may affect the choice of approach, technique, and equipment used during medical procedures.

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