



A high-origin anterior tibial artery and its current clinical importance

Published online November 23rd, 2010 © <http://www.ijav.org>Selda YILDIZ [✉]

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Received January 27th, 2010; accepted October 30th, 2010

ABSTRACT

Arthroscopic knee surgery is recently a very often performed surgical procedure. Surgical neurovascular characteristics and anatomical variations have gained importance due to such surgical interventions in that region. The aim of this study is to underline the clinical importance of a high origin anterior tibial artery from the popliteal artery with its anatomical measurements. We report a high origin anterior tibial artery from the left popliteal artery descending on the anterior surface of the popliteus muscle of a 75-year-old male cadaver.

Our opinion is that surgical complications due to anatomical variations are common. Therefore, the high origin anterior tibial artery from the popliteal artery and its relation to the popliteus muscle is an important anatomical variation which should be paid attention during knee joint surgery, total knee arthroplasty and angiographic evaluations. © IJAV. 2010; 3: 180–182.

Key words [popliteal artery] [anterior tibial artery] [anatomic variation]

Introduction

The femoral artery continues as the popliteal artery after it leaves the adductor canal. The popliteal artery divides into its terminal branches at the lower border of the popliteus muscle as the anterior tibial artery (ATA) and posterior tibial artery (PTA) [1]. In literature, the high division of the popliteal artery was defined differently. The term “high division of the popliteal artery” is used when the first branch arises at or above the articular surface of the tibial plateau [2] or if the bifurcation level is proximal to the lower border of the muscle [3]. After the bifurcation, ATA runs dorsal to the popliteus muscle, through both heads of the posterior tibial muscle and the oval space, which is located proximal to the interosseous membrane of leg, on the anterior surface of the membrane and descends with the deep fibular nerve. The artery may divide into terminal branches proximal to the popliteus muscle. ATA then may descend anterior or posterior to the muscle [1].

Distal popliteal arterial variations may influence the success of femorodistal popliteal and tibial arterial reconstructions [4]. The risk of vascular trauma during orthopedic procedures may be increased when an abnormal branching of the popliteal artery with an aberrant anterior tibial artery originating above the popliteus muscle and coursing between the posterior tibial cortex and ventral surface of the popliteus muscle. Preoperative identification of this anatomical variant may help avoid these injuries [5]. The purpose of this

study was to emphasize on the high-origin ATA from the popliteal artery and its importance in recent clinical practice.

Case Report

During routine dissections for the medical students at the Department of Anatomy, Faculty of Medicine, Gulhane Military Medical Academy, we observed a high-origin ATA running along the ventral surface of the popliteus muscle on the left side a formalin fixed 75-year-old male cadaver. The length of the popliteal artery from the adductor hiatus to the bifurcation point was 126.82 mm. The bifurcation level of the popliteal artery into a high-origin ATA and PTA was 16.02 mm proximal to the upper border of the popliteus muscle. The distance of ATA crossing the proximal part of the popliteus muscle to the origin and insertion points of the muscle were 21.59 mm and 41.96 mm respectively. The high-origin ATA descended between the popliteus muscle and posterior surface of the tibia after branching from the popliteal artery. The high origin of ATA was at the same level with the tibial plateau. It gave rise to the posterior tibial recurrent artery at the upper border of the popliteus muscle and passed through the oval space of the interosseous membrane of leg to the anterior surface of the leg (Figure 1). The diameters of the popliteal artery, high-origin ATA, PTA were 8.3 mm, 3.15 mm, 4.83 mm respectively. PTA's diameter after it gave off the fibular artery was measured 3.44 mm and the fibular artery's diameter was 4.44 mm. The length of the PTA till the

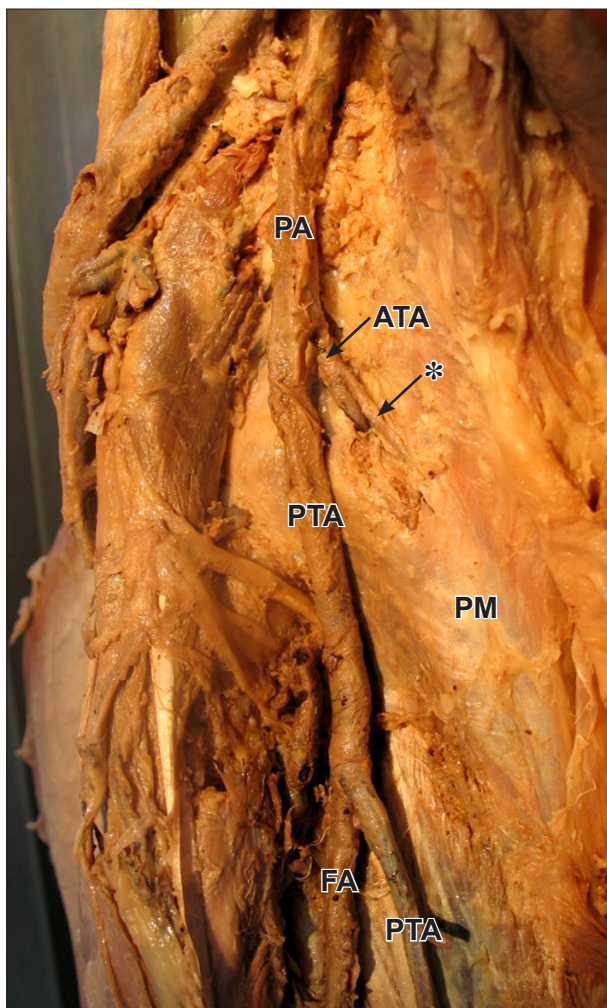


Figure 1. High origin of the anterior tibial artery. (PA: popliteal artery; ATA: anterior tibial artery; PTA: posterior tibial artery; PM: popliteus muscle; FA: fibular artery; *: posterior tibial recurrent artery)

branching point of the fibular artery was 77.74 mm and the distance between the lower border of the popliteus muscle and the branching point of the PTA was 10.02 mm.

Discussion

The variations of the popliteal artery's terminal branching and its relation to the popliteus muscle were studied in 3 groups by Adachi. Group 1: The popliteal artery descended at the posterior surface of the popliteus muscle. At the medial portion of the artery the posterior peroneotibial trunk was formed, which branched into the fibular artery and PTA, and at the lateral portion the ATA. The diameter of the lateral branch was equal to the popliteal artery or smaller than the medial branch, rarely the opposite. Group 2: The popliteal artery descended at the posterior surface of the popliteus muscle. It was divided medially into the PTA and laterally into the anterior peroneotibial trunk. The diameter of the lateral branch was observed to be larger. The anterior peroneotibial trunk bifurcated into the fibular artery and

ATA at the distal border of the popliteus muscle. Group 3: The popliteal artery bifurcated at the proximal border of the popliteus muscle. The anterior branch descended at the ventral surface of the popliteus muscle and continued as ATA between the muscle and posterior surface of tibia, whereas the posterior branch continued as the posterior peroneotibial trunk at the dorsal surface of the popliteus muscle (%1). The branching point ATA was 1-3 cm proximal to the upper border of the muscle. It descended to the interosseous membrane and gave the inferior medial and lateral genicular arteries before it descended further between the popliteus muscle and tibia. After 7-9 cm the posterior branch divided into the fibular artery and PTA 1-2 cm distal to the tendinous arch of soleus muscle [2]. Both the course and relation to the popliteus muscle of our case was comparable with group 3.

It has been reported that high-origin ATA branched at or above the level of the articular surface of the tibial plateau [6,7] at a ratio of 1.2-6% [6-9]. Another radiological study of femoral angiograms on 495 lower extremities was performed to view the tibial artery anatomy, and found that 7.8% of the cases revealed variations. The majority of those variations were components of high-origin ATA and trifurcation patterns [4].

In generally, the diameter of the PTA is bigger than the fibular artery, but in our case its diameter was smaller. Ozgur et al.'s findings on high division popliteal arteries revealed that PTA diameters were smaller than the fibular artery in a significantly high ratio (%42.5) [8]. Our findings were compatible with this study.

It was reported in previous studies that the course of ATA could either be from the ventral or dorsal surface of the popliteus muscle [6,7,10]. A ventral course was observed in 1-2.1% of the cases [2,3,5,7,9,10]. Other high-origin ATA studies reported a ventral course in 42% of cases [10] and a close relation with the tibial cortex [5,9], which also was observed in our case. This close relation with the tibial cortex gets it vulnerable during knee arthroplasty or high tibial osteotomy when a transverse tibial cut through the posterior tibial cortex is performed using an oscillating saw, a drill, or an osteotome [9].

Clinicians and radiologists have defined a different terminology of the popliteal artery and its main branches in popliteal surgery. ATA was defined as the tibial-fibular trunk as soon as it branched from the popliteal artery [6]. The tibial arteries were referred to as anterior or posterior peroneotibial trunk according from which tibial artery the fibular artery originated [2]. Our opinion is that this terminology has been defined incorrectly as the fibular artery is actually a branch of the PTA and as this terminology does not included in the Nomina Anatomica.

In conclusion, high-origin ATA from the popliteal artery and its relation to the popliteus muscle may play an important role in knee joint surgery, angiographic evaluations, femoral distal end or proximal tibial/fibular fracture surgery, total knee arthroplasty and especially in surgical interventions performed for popliteal artery aneurysms, which are the most common peripheral artery aneurysms due to atherosclerosis.

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