

Case Report

Higher division of popliteal artery: a case report

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ABSTRACT

During the routine dissection of anatomy in an adult male cadaver at the department of anatomy, Manipal University, Manipal, higher division of popliteal artery was observed on the right side. This artery divided proximal to upper border of popliteus muscle into anterior and posterior tibial arteries. Inferomedial genicular artery which is usually a branch of popliteal artery was found to be arising from anterior tibial artery. However arterial branching pattern and point of bifurcation of popliteal artery on the left side were usual. The knowledge of these variations will be useful for angiography or various surgical approaches during knee joint surgery.

Keywords: Popliteal artery, Higher division, Anterior and Posterior tibial arteries

INTRODUCTION

The Popliteal Artery (PA) is a common site for bypass grafts above or below knee. It is also frequently affected by penetrating and blunt trauma involving the lower extremity. Exposure of this artery is, therefore, often required in both emergent and elective vascular procedures.¹ A thorough knowledge of the anatomical variations in the branching pattern of popliteal artery is important.² The PA is the continuation of the femoral artery. It extends from the opening in the adductor magnus, at the junction of the middle and lower thirds of the thigh, downward and lateralwards to the intercondylar fossa of the femur, and then vertically downward to the lower border of the popliteus muscle, where it divides into anterior and posterior tibial arteries.³ When the popliteal artery divides anywhere proximal to the lower border of the muscle, it is termed as 'high division of the popliteal artery'. The anterior tibial artery runs downwards on the posterior surface of the popliteus muscle and then it enters in to the anterior compartment of the leg through the oval space located at the superior border of the interosseous membrane of the leg. The knowledge of variations in the branching pattern of the

limb arteries are important for the success of the arthroscopic surgeries⁵

CASE REPORT

During routine cadaveric study on the popliteal artery, high division of the popliteal artery was observed on the right side of one of the embalmed male cadaver. Popliteal artery divided proximal to the upper border of popliteus muscle into anterior tibial (ATA) and Posterior Tibial Arteries (PTA). ATA descended between the popliteus muscle and posterior surface of the tibia after branching from the popliteal artery and passed through the oval space of the interosseous membrane of leg to reach the anterior surface of the leg. Inferomedial genicular artery which is usually a branch of popliteal artery was found to be arising from anterior tibial artery (Figure 1). Rest of the structures in the popliteal fossa are normal in their course and branching pattern. However, on the left side popliteal artery bifurcated at the lower border of popliteus muscle into anterior tibial and posterior tibial arteries and genicular branches followed the usual pattern.

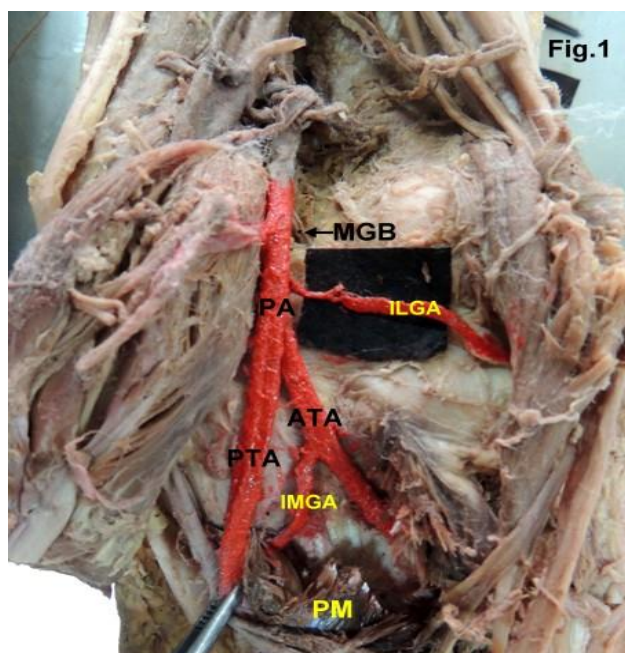


Figure 1: Photograph showing higher division of popliteal artery. (PA: Popliteal artery; ATA: Anterior tibial artery; PTA: Posterior tibial artery; ILGA: Inferolateral genicular artery; IMGA: Inferomedial genicular artery; MGB: Middle genicular artery; PM: Popliteus muscle).

DISCUSSION

Several cadaveric studies showed that the pattern and the level of termination of the popliteal artery at the lower border of popliteus muscle occurs in the majority of subjects.³ However, the artery may occasionally (5% of cases) show a high bifurcation and divide into its terminal branches proximal to popliteus or it may trifurcate into anterior and posterior tibial and fibular arteries; in that case the ATA sometimes descends in front of popliteus. There may be a true 'trifurcation' of popliteal artery into anterior and posterior tibial and peroneal branches. Either the anterior tibial or the posterior tibial artery may be reduced or increased in size. The anterior tibial artery may be small but is rarely absent. Its function may be replaced by perforating branches from the posterior tibial artery or by the perforating branch of the peroneal artery. It occasionally deviates laterally, regaining its usual position at the ankle. It may also be larger than normal, in which case its territory of supply in the foot may be increased to include the plantar surface.³ Keen JA reported high division of popliteal artery in 14 out of 280 limbs.⁶ Kim D et al. assessed popliteal artery anatomy in 605 extremities and the tibial arterial anatomy in 495 extremities. Seventy five variant cases were identified. Normal branching of the popliteal artery was present in 92.2%. Among the 7.8% incidence of variants, the majority 72% were either high-origin of ATA or a trifurcation pattern.⁷ Colborn et al. reported popliteal bifurcation above the lower border of popliteus muscle in 3 out of 42 cadavers. In each case, the point of

bifurcation was symmetrical in both limbs, and the peroneal artery arose from the anterior tibial artery. In one case, the popliteal artery coursed deep to the popliteus muscle.¹ Thane (1892) cited a case in which popliteal artery extended to the middle of back of leg before dividing. He also reported an instance in which the popliteal artery divided into two branches which reunited after a course of 5 cm.⁸ Parson and Robinson recorded the results of 106 observations made on the variation in the branching pattern of the popliteal artery. According to them a high division of the artery was present in 8.5% instances and only in two dissections (1.9%), the anterior tibial artery passed in front of the popliteus.⁹

Somayaji et al. dissected 250 limbs. In 25 specimens, high division of popliteal artery was seen. In 19 out of 25 specimens, popliteal artery divided at the upper border of popliteus muscle into anterior tibial and posterior tibial arteries. In 6 specimens, popliteal artery divided at upper border of popliteus muscle into anterior tibial artery and peroneal artery, where the posterior tibial artery was absent.¹⁰

These variants can be explained due to the combination of persistent primitive arterial segments, abnormal fusions or segmental hypoplasia or absence, as embryonic vascular development determines the anatomic variability. Thus embryonic vessels may either persist or degenerate (degeneration of these vessels is normal), or abnormal fusions may occur. Understanding the embryology and variant anatomy has significant clinical implications regarding transluminal angioplasty, embolectomy, vascular grafting, direct surgical repair or the diagnosis of the arterial injury.¹¹

Ertugrul M, et al. analyzed the PA branching patterns in 535 extremities (270 right, 265 left). The branching patterns were classified according to the level of branching and the presence of hypoplasia or aplasia of the distal branches. 470 (88.1%) limbs had a normal level of popliteal artery branching. High division of the popliteal artery was seen in 30 (5.6%) limbs. 33 limbs (6.1%) exhibited hypoplasia/aplasia of the distal branches.¹²

The lower extremity arteries arise from two sources: sciatic artery and the femoral artery. Variability in the crural arteries depends on both the regression of the sciatic artery and also on the persistence of its junction with the primary femoral artery in the popliteal region.¹³ The popliteal artery arises as a sprouts from the axis artery at the proximal border of popliteus muscle, passes along the dorsal surface of the popliteus muscle and subdivides in the posterior tibial and primitive peroneal arteries which lie superficial to the tibialis posterior muscle. At the distal border of the popliteus muscle the axis artery provides a branch which passes ventrally above the interosseous membrane and is continued as the anterior tibial and dorsalis pedis artery. The embryonic vascular development determines the anatomic

variability. Understanding the embryology and variant anatomy may have significant clinical implications. Vascular grafting and repair is indicated in a variety of disease processes, including atherosclerosis, emboli and trauma.

Anatomic variants will influence the surgical approach and dissection and the choice of suitable arterial graft sites.² It is interesting for any anatomist to explore the possible embryological reasons behind the existence of anomalies. Anatomist have described that the branching patterns of the popliteal artery are related to the combinations of the sciatic artery and primary femoral arteries.¹⁴ The popliteal vein may lie between artery and femur or it is sometimes doubled in part or throughout popliteal fossa.¹⁵

CONCLUSION

Variations of the branches of popliteal artery are of paramount importance not only in clinical practice but also in theoretical considerations. Knowledge of variation of popliteal artery bifurcation point and branching pattern is mandatory for vascular surgeons to avoid complications during various surgical approaches and the choice of suitable graft sites in lower extremity. Awareness of these variations will also be beneficial to angiographers for evaluation of arteriograms.

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