

HIGH ORIGIN OF ANTERIOR TIBIAL ARTERY - PREVALENCE AND ITS SURGICAL SIGNIFICANCE

Reena Singla^a and Usha Chhabra^b

^aDepartment of Anatomy, MMIMSR Mullana – Ambala

^bDepartment of Anatomy, GMC Patiala

ABSTRACT: This study was undertaken to find the prevalence of high origin anterior tibial artery & its surgical significance. Sixty embalmed lower limbs belonging to 30 adult human cadavers form the material for this study. The origin of anterior tibial artery was observed by exposing popliteal artery in the popliteal fossa. The prevailing pattern, its branches and variations were observed, noted and photographed. High origin anterior tibial artery was seen in 2 out of 60 specimens, prevalence being 3.3%. The mode of bifurcation of popliteal artery was into an anterior tibial and posterior tibial artery at the upper border popliteus muscle. High origin anterior tibial artery & posterior tibial artery lying superficial to popliteus muscle is the most common type in high division of popliteal artery. Knowledge of the anatomical variations in the branching of the anterior tibial artery is important because damage to its branches can be limb or life-threatening in various knee procedures that involve extension of osteotomy to the posterior tibial cortex, particularly in high tibial osteotomy & total knee replacements.

Key Words: popliteal artery, anterior tibial artery, Posterior tibial artery, Popliteus muscle

INTRODUCTION

The risk of vascular trauma during orthopaedic procedure may be increased when there is 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 margin of the popliteus muscle. Pre-operative identification of this anatomical variation may help avoid these injuries [1]. The anterior tibial artery is the terminal branch of the popliteal artery at the distal border of popliteus muscle. At first in the flexor compartment, it passes between the heads of tibialis posterior and through the oval aperture in the proximal part of the interosseous membrane to reach the extensor region, passing medial to the fibular neck. It is vulnerable here during tibial osteotomy. Descending anteriorly on the membrane it approaches the tibia and distally, lies anterior to it. At the ankle it is midway between the malleoli, and continues on the dorsum of foot as dorsalis pedis artery. The anterior tibial artery may be small but it is rarely absent. Its function may be replaced by perforating branches from the posterior tibial artery or by the perforating branch of 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 [2].

MATERIAL & METHODS

Sixty embalmed lower limbs belonging to 30 adult human cadavers from the Department of Anatomy, Government Medical College, Patiala comprised the material for this study. The cadavers were labelled from 1-30 with suffix R (right) or L (left) and M (Male) or F (Female). The popliteal artery was dissected in the popliteal fossa according to the Cunningham's manual of Practical anatomy [3]. The popliteal artery and its branches were exposed in the popliteal fossa carefully, sacrificing venae comitantes and resecting muscle which came in the way while effecting clean exposure of the popliteal artery and its terminal branches. The prevailing pattern, its branches and variations were observed, noted and photographed. The data was compiled and the observations were compared with the previous standard observations.

RESULTS

- 1) High origin of anterior tibial artery was seen in 2 specimens (Figure. 1,2) .
- 2) In both the limbs of high origin the anterior tibial and posterior tibial arteries were coursed superficial to the popliteus muscle.
- 3) The mode of termination of popliteal artery was into an anterior tibial and posterior tibial artery at the upper border popliteus muscle.



Figure. 1. Posterior view of Popliteal artery depicting (A) high origin of anterior tibial artery at the upper border of popliteus muscle; PM = Popliteus Muscle; PTA=Posterior tibial artery; PA=Popliteal artery.



Figure. 2. Posterior view of Popliteal artery depicting (A) high origin of anterior tibial artery at the upper border of popliteus muscle; PM = Popliteus Muscle; PTA=Posterior tibial artery; PA=Popliteal artery.

DISCUSSION

The description of arterial trunks of the limbs and of the arrangement of their main branches found in anatomy textbook pattern are encountered in majority of subjects and such patterns are then accepted as the normal or average arrangement. He further described that an 'abnormality' does not in any way imply an inferior or less effective blood supply of the region, but is simply a variation or departure from the "normal"[4].

In the present study, in two specimens of left side, popliteal artery bifurcated at the upper border of popliteus muscle resulting in high origin anterior tibial and posterior tibial arteries.

A comparison of the high origin anterior tibial artery and the relationship of the anterior tibial artery with the popliteus muscle observed in present study with the previous studies is shown in Table- 1 and Table-2.

Table-1: High origin of anterior tibial artery - present study compared to previous studies

Authors	No. of specimens studied	High origin of anterior tibial artery
Adachi[5]	770	2.8%
Trotter[6]	264 (American whites)	4.9%
	368 (Negroes)	6.2%
Keen[4]	280	5%(14)
Somayaji et al [7]	250	10%(25)
Present study	60	3.3%(2)

Table-2:Relation of anterior tibial artery to popliteus muscle - present study compared to previous studies

Authors	High origin of anterior tibial artery coursed superficial to popliteus muscle (%)	High origin of anterior tibial artery coursed deep to popliteus muscle (%)
Adachi[5]	1.9	1.0
Trotter[6]	3.9	2.4
Keen[4]	4	0.4
Somayaji et al[7]	6.4	3.6
Present study	3.3	-

According to Broman [8] in case of arteries of lower limb, the adult pattern is completed somewhat later, during the third month. Therefore the factors that produce departures from the so called “normal” patterns must be active at the embryonic stage. In view of the early developmental establishment of the adult patterns, it is probable that all arterial variations are of genetic origin, and it has been shown that these genetic factors act more often in an independent manner in the right and left limbs, and less often bilaterally [4]. An embryological study by Senior [9] described in the embryo before the 14 mm stage the axis artery of the lower limb is the arteria ischiadica. At the knee joint level the axis artery becomes the popliteal which at this stage runs in front of the popliteus (deep popliteal artery) and then continues as the anterior tibial. At the 14 mm stage the arteria ischiadica is being supplemented by the femoral artery. Two longitudinal arteries which traverse the leg in the embryo, the future posterior tibial and peroneal arteries arise from the axial vessel at the upper border of the popliteus muscles. A gradual proximo-distal union of the posterior tibial and peroneal arteries occurs and is well advanced in embryos of 20mm. This union forms the part of the definitive popliteal artery that lies behind the popliteus muscle. A communicating branch from either at the lower border of the popliteus enlarges to become the definitive anterior tibial, while the deep popliteal artery gradually disappears.

High origin anterior tibial artery lying superficial to the popliteus muscle is the most common type during cadaveric studies. High origin of anterior tibial artery is surgically important as it is in direct contact with the posterior tibial cortex. It is thus vulnerable during knee arthroplasty, high tibial osteotomy and total knee replacement, when a transverse tibial cut through the tibial cortex is performed using an oscillating saw, a drill or even an osteotome. Arterial complications including transection, fistula formation, pseudo aneurysm and thrombosis can be life or limb threatening [10].

CONCLUSION

Prevalence of high origin anterior tibial artery was observed in 3.3% cases. This information may help to reduce risk of injury to the anterior tibial artery during high tibial osteotomy, external fixation and pin placement or insertion of locking screws.

REFERENCES

- [1] Klecker ,R.J., Carl, S.W., Piran, A., Tom ,M. 2008. The aberrant anterior tibial artery. Magnetic Resonance Appearance, Prevalence and Surgical implications. The American Journal of Sports Medicine, 36: pp:720-7.
- [2] Williams, A., Newell, R.2005. Leg. Gray's Anatomy, 39th Ed. Elsevier Churchill Livingstone, U.K., pp: 1501-2.
- [3] Romanes, G.J.2003. Cunningham's Manual of Practical Anatomy. 15th Ed. Vol.1,pp: 164-5.
- [4] Keen, J.A.1961. A study of the arterial variations in the limbs with special reference to symmetry of vascular patterns. Am J Anat, 108,pp:245-61.
- [5] Adachi, B. 1928.Das arteriensystem der Japaner, Vol. II.Maruzen,Kyoto,pp: 137-269.
- [6] Trotter, M.1940. The level of termination of the popliteal artery in the White and the Negro. Am J Anthropol, 27,pp:109-18.
- [7] Somayaji, S.N, Nayak, S., Bairy, K.L. 1996. Variations in the branching pattern of the popliteal artery. J. Anat. Soc. India , 45 (1), pp :23-6.
- [8] Broman, I.1921.Grundriss der Entwicklungsgeschichte des Menschen.J.F.Bergman, Munchen,pp : 237.
- [9] Senior, H.D. 1929. Abnormal branching of popliteal artery. American Journal of Anatomy, 44 : pp:111-20.
- [10] Tindall, A.J, Shetty, A.A, James ,K.D, Middleton, A., Fernando, K.W.K.2006. Prevalence and surgical significance of a high-origin anterior tibial artery. Journal of Orthopaedic Surgery,14 (1),pp:13-6.