

Anomalous Origin of Dorsalis Pedis Artery and its Clinical Correlations- A Case Report

Raviprasanna KH^{1*}, Aditya Krishna Das² and Anand L Kulkarni³

¹Associate Professor, Department of Anatomy, Mamata Medical College, Khammam, Telangana, India

²Associate Professor, Department of Anatomy, Sree Narayana Institute of Medical Sciences, Ernakulam, Kerala, India

³Professor and HOD, Department of Anatomy, Sree Narayana Institute of Medical Sciences, Ernakulam, Kerala, India

***Corresponding Author:** Raviprasanna KH, Associate Professor, Department of Anatomy, Mamata Medical College, Khammam, Telangana, India.

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Abstract

Peripheral arteriosclerotic diseases are evaluated even by palpation of dorsalis pedis artery in lower limb. Main source of blood supply to talus and dorsum of foot is by dorsalis pedis artery and its branches. A thorough knowledge about the origin, course and branching pattern of dorsalis pedis artery helps surgeons for conducting surgeries without any complications and also for arterial reconstruction. The anomalous origin and course of dorsalis pedis artery was observed in 5 out of 16 different lower limb specimens during routine dissection to educate the 1st MBBS students in the Department of Anatomy, Sree Narayana Institute of Medical Sciences, Ernakulam, Kerala, India. 5 specimens showed hypoplastic anterior tibial artery and anomalous origin of dorsalis pedis artery from peroneal artery. The normal pattern of arcuate artery was absent in all the 5 specimens and dorsalis pedis artery divided directly into dorsal metatarsal branches. The awareness and knowledge about these variants helps both vascular and orthopaedic surgeons for smooth surgeries.

Keywords: Anterior Tibial Artery; Posterior Tibial Artery; Peroneal Artery; Variations; Dorsalis Pedis Artery

Abbreviations

PA: Peroneal Artery; TA: Tibialis Anterior; DPA: Dorsalis Pedis Artery

Introduction

During locomotion and standing, the human foot acts as main anchor which can adapt to both even and uneven surfaces. The arteries which supply foot include branches of dorsalis pedis artery from dorsal aspect and by branches of medial and lateral plantar arteries in the plantar surface. The lower limb arterial network has wide range of variations which can be explained on the embryological basis [1]. The recent changes in life style and stress cause most common diseases like diabetes and hypertension. The risk of amputation is common with infections of foot due to diabetic neuropathy. The Dorsalis pedis artery is most common artery used for assessing peripheral pulsations in the dorsum of foot. Popliteal artery divides into anterior and posterior tibial arteries in the popliteal fossa. Anterior tibial artery distal to ankle joint continues as dorsalis pedis artery which courses along the tibial side of foot till proximal end of 1st inter-metatarsal space. Later it passes between two heads of first dorsal interosseous muscle and completes the plantar arch by anastomosing with branch of lateral plantar artery. The branches of dorsalis pedis artery include medial and lateral malleolar arteries, artery to sinus tarsi, lateral tarsal artery, first dorsal metatarsal artery and arcuate artery. The arcuate artery runs laterally across the bases of the metatarsals deep

to the extensor tendons and gives a dorsal metatarsal artery to each of the other intermetatarsal spaces. Each of these communicates through the proximal end of the intermetatarsal space with the perforating branches of plantar arch. Each dorsal metatarsal artery runs forwards on the corresponding dorsal interosseous muscle and forms the dorsal digital artery in each of adjacent toes. The posterior tibial artery supplies posterior compartment of leg and divides into medial and lateral plantar arteries to supply sole. The peroneal artery arising from the posterior tibial artery about 2.5 cm distal to the popliteus muscle supplies lateral compartment muscles and divides into calcaneal branches at the inferior tibiofibular syndesmosis [2]. The knowledge regarding variations in the origin, course and branching pattern of the limb arteries are essential for the success of the surgeries of ankle region.

Materials and Methods

The 16 human cadaver lower limb specimens were obtained from the Department of Anatomy, Sree Narayana Institute of Medical Sciences, Chalakka, Ernakulam, Kerala, India over a span of two years which were used to educate undergraduate MBBS students. These specimens were fixed in 10% neutral buffered formalin. The gross dissection of the ankle region and dorsum of foot was done by avoiding damage to underlying structures. The dorsalis pedis artery was exposed and traced from ankle to first dorsal interdigital space by cleaning the connective tissue around it. The course, branches and variants of the dorsalis pedis artery were observed.

Case Report

The anomalous origin and course of dorsalis pedis artery was observed in 5 lower limb specimens (R-3, L-2) out of 16 specimens over a span of two years. The 5 specimens in which we observed hypoplastic anterior tibial artery had dorsalis pedis artery arising from peroneal artery. The peroneal artery which had origin from posterior tibial artery supplied peroneal compartment and pierced lower part of interosseous membrane between tibia and fibula to continue as dorsalis pedis artery. Figure 1 shows the origin of peroneal artery which was larger than usual and how it pierces interosseous membrane to enter anterior compartment of leg. Figure 2 depicts the hypoplastic anterior tibial artery near the ankle joint and the terminal part of peroneal artery crosses ankle joint from lateral to medial side and continues as dorsalis pedis artery in between the tendons of extensor digitorum longus and extensor hallucis longus in left foot. Figure 3 shows the absence of dorsalis pedis artery in the first webspace and terminal part of peroneal artery after piercing interosseous membrane passes deep to extensor digitorum brevis and supplies dorsum of right foot as dorsalis pedis artery. The normal pattern of arcuate artery was absent in all the 5 specimens which had anomalous origin of dorsalis pedis artery and the dorsalis pedis artery divided directly into metatarsal branches to supply the dorsum of the foot.



Figure 1: Dissection of the posterior compartment of leg to expose Posterior tibial and peroneal arteries and peroneal artery piercing the interosseous space between tibia and fibula to enter anterior compartment.

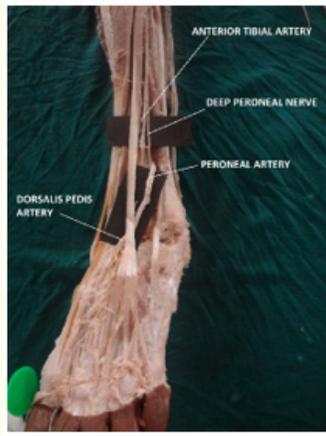


Figure 2: Dissection of the anterior compartment of left leg and dorsum of foot to expose the continuation of peroneal artery as dorsalis pedis artery after piercing interosseous membrane between tibia and fibula.

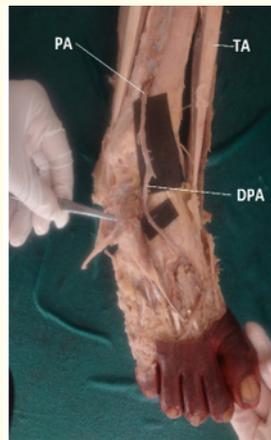


Figure 3: Dissection of the dorsum of right foot to expose the continuation of peroneal artery as dorsalis pedis artery after piercing interosseous membrane between tibia and fibula (PA: Peroneal Artery; TA: Tibialis Anterior; DPA: Dorsalis Pedis Artery).

Discussion

Surgeons who plan for percutaneous vascular reconstruction surgeries in the lower limb should be aware about the variations in the arterial pattern of lower limb. In 1989, Kim., *et al.* described distal popliteal arterial variations may influence the success of femorodistal popliteal and tibial arterial reconstructions [3]. Atanasova., *et al.* reported anomalous course and branching pattern of the tibial arteries and their clinical complications [4]. Senior (1919) explained the abnormal branching patterns of the popliteal artery is a result of arrest of normal development of limb vessels. The lower limb vessels arise from two important sources: first is the primary limb bud artery (axial or sciatic artery, a branch of the umbilical artery) and the second being femoral artery. The popliteal and fibular (peroneal) arteries will be arising from the axial artery, whereas the anterior tibial and posterior tibial arteries are derived from the femoral system [5]. Being

the derivative of the axial artery, the fibular (peroneal) artery is constant and true absence of it has never been reported [6]. The fibular (peroneal) artery which is a branch of posterior tibial artery normally terminates into small branches that communicate with anterior and posterior tibial arteries at the level of the ankle joint. When the proximal segments of the anterior and posterior tibial arteries are congenitally absent or hypoplastic, the fibular (peroneal) artery directly supplies their distal distribution areas. In the present case study, the posterior tibial artery in all the 5 specimens were of normal size, but anterior tibial artery became hypoplastic and fibular (peroneal) artery was larger than the usual size and it pierced through lowest portion of the interosseous membrane between tibia and fibula to continue as dorsalis pedis artery and supplied dorsum of foot and completed the arterial arch between first dorsal metatarsal artery and branch of lateral plantar artery. Absence of anterior tibial artery in patients with severe bony malformations of leg such as clubfoot, deficiency of the calf bone, tibial aplasia and metatarsal absence was reported by [7,8]. Yamada, *et al.* in their study reported absence of dorsalis pedis artery in 6.7% of cases and the dorsal metatarsal arteries were supplied by the plantar arteries. In 16.67% of cases dorsalis pedis artery failed to provide the arcuate branch [9]. Dorsalis pedis artery and its branches act as major vessel to supply talus at the junction of neck and body of talus in the tarsal area. The artery to tarsal sinus arises from an anastomotic loop between lateral tarsal branch of dorsalis pedis artery and perforating branch of peroneal artery. Lateral tarsal artery may also give direct branches to the head of the talus and to the anterolateral part of the body of talus. The knowledge of vascular course of dorsalis pedis artery is thus essential to understand avascular necrosis and triple arthrodesis of talus [10]. 70% of diabetic patients presenting with intermittent claudication and rest pain fall under signs of ischemia. Other signs of advanced ischemia include loss of hair growth over dorsum of toes and foot, thickening of toe nails, atrophy of skin and its appendages, delayed return of capillary blush and end stage is ulceration and gangrene. These arterial variations make palpation of the pedal pulse difficult and absence of dorsalis pedis artery pulsations indicate one of the causes like peripheral vascular disease/vasculitis, collagen vascular disease, thrombotic disorders, congenital hypoplasia of dorsalis pedis artery, popliteal entrapment, Buerger's disease or Pseudo-occlusion of dorsalis pedis artery [11]. The precise knowledge of vascular anatomy of ankle is necessary for surgical techniques such as ankle arthroscopy or surgical release of club foot. Arterial abnormalities are likely to increase the risk of postsurgical trauma [12]. These arterial variations can be visualized via doppler ultrasound or arteriography [13].

Conclusion

Palpation of dorsalis pedis artery pulsation over the dorsum of foot is one of the common sites of peripheral arterial pulsations. The dorsalis pedis pulse is felt over the navicular and cuneiform bones or at the proximal end of first dorsal interosseous space. Absence of pulsations is a sign of peripheral arterial disorders. Awareness of this variation will help the surgeon to decide the absence of pulse is either due to abnormal course or hypoplastic anterior tibial artery. Prior confirmation by doppler ultrasound or arteriography for any variations will avoid unnecessary complications during surgery.

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Conflict of Interest

Nil.

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