Bilateral Hypoplastic Posterior Tibial Arteries with Histological Features: Case Report

Bilateral Hipoplazik Arteria Tibialis Posterior ve Histolojik Özellikleri

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Geliş Tarihi/*Received:* 26.05.2008
Kabul Tarihi/*Accepted:* 27.06.2008

This study was presented as a poster in the 4th. Asian-Pacific International Congress of Anatomists (September 7-10, 2005, Kuşadası-Aydın, TURKEY).

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ABSTRACT During the dissection of a 56-year-old male cadaver, we encountered bilaterally hypoplastic posterior tibial arteries. While the hypoplastic posterior tibial artery was joining to the fibular artery at the distal part on the left side, it was terminating at the distal half of the leg on the right side. According to Kim's classification, this pattern was matching with type III A. In this study, we evaluated histo-morphometrical features (diameters, media and intima thicknesses) of the variant arteries. Ratios of media and intima thicknesses to the external diameter of the proximal part of the posterior tibial arteries are greater than that of their distal parts, the tibiofibular trunk and fibular arteries (proximal part, bridge and tarsal part) bilaterally. On the left side intima and media of the fibular artery, where it was coursing from lateral to the medial, was thicker than the proximal and tarsal parts of it.

Key Words: Abnormalities, tibial arteries, fibular arteries

ÖZET Bu çalışmada, disseksiyon sırasında çift taraflı olarak hipoplazik "arteria tibialis posterior"-ların belirlendiği 56 yaşında bir erkek kadavra olgusu sunulmuştur. Sol tarafta hipoplazik "arteria tibialis posterior", "arteria fibularis"e katılırken, sağ tarafta bacağın alt yarımında sonlanıyordu. Bu kalıp, Kim'in sınıflandırmasındaki tip IIIA ile uyumlu bulundu. Bu çalışmada "varyant arterlerin", çap, "tunica intima" ve media kalınlıkları gibi histomorfolojik özellikleri de değerlendirildi. Her iki tarafta "arteria tibialis posterior"ların proksimal kısımlarında "tunica intima" ve media kalınlıklarının dış çapa oranının, distal kısımlarda, "truncus tibiofibularis"de ve "arteria fibularis"dekinden (proksimal, köprü ve tarsal bölümler) daha fazla olduğu tespit edildi. Sol tarafta, lateralden mediyale yöneldiği bölümünde "arteria fibularis"in "tunica intima" ve media kalınlıklarının, proksimal ve tarsal bölümlerine oranla daha fazla olduğu belirlendi.

Anahtar Kelimeler: Arteria tibialis, arteria fibularis, anomaliler

Turkiye Klinikleri J Med Sci 2009;29(5):1330-4

In usual pattern, the popliteal artery is divided into anterior and posterior tibial arteries at the lower border of the popliteal muscle. The posterior tibial artery (PTA) extends obliquely downward and as it descends, it approaches the tibial side of the leg, lying behind the tibia, upon the posterior tibial and flexor digitorum longus muscles. In the lower third of the leg, it runs parallel with the medial border of the tendo calcaneus. Beneath the origin of the abductor hallucis, it divides into the medial and lateral plantar arteries. The fibular artery (FA) arises from the PTA at about 2.5 cm below the lower border of the popliteus muscle and descends along the medial side of the fibula.[1]

Popliteal artery and its branches show different types of variations. The first acceptable classification of these variations was made by Lippert, later modified by Kim et al. Regarding this classification, popliteal artery is composed of 3 groups with respect to branching pattern, branching levels and hypoplastic or aplastic branches.[2]

In this study, we presented a case with bilaterally hypoplasic PTA, concordant with type III-A (According to Kim's classification, type III represents hypoplastic or aplastic branching with Altered Distal Supply-A represents distal PTA replaced with FA). Furthermore, we evaluated histomorphometrical features (diameters, media and intima thicknesses) of the variant arteries.

CASE REPORT

Bilateral hypoplastic posterior tibial arteries were observed during the dissection of a 56-year-old male cadaver (Figures 1a, 2, 3). The popliteal arteries were first giving off anterior tibial arteries (ATA) and then were running as the tibioperoneal trunk (TPT) from the level of the lower border of the popliteal muscle at both sides. ATA were entering to the anterior compartment at both sides.

At the right side, after a course of 1.4 cm from the take off point of ATA, the TPT was dividing into two branches as FA and hypoplastic PTA. While the hypoplastic PTA was ending at the distal half of the leg, the FA was running as the dominant artery. The FA was descending behind the tibialis posterior muscle and then lying deep to the flexor hallucis longus. After giving off the calcaneal branch 3.6 cm above the midpoint of the medial malleolus, it was deviating medially and passing through the tarsal tunnel with the other structures. At the sole of the foot, it was dividing into its ter-

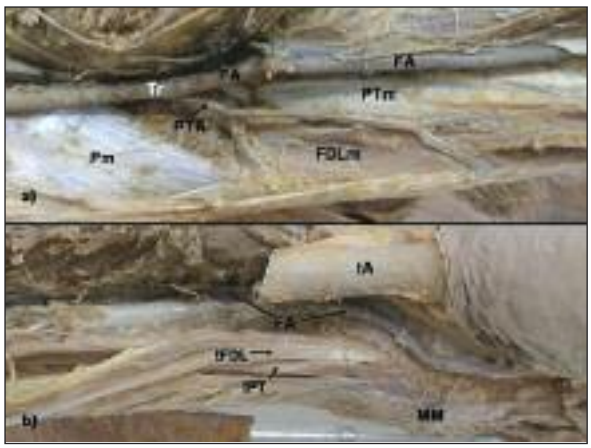

FIGURE 1: Arterial pattern of the right side a: Proximal part, b: Distal part.
a) Tr: Tibioperoneal trunk, PTA: Posterior tibial artery, FA: Fibular artery, Pm: Popliteus muscle, FDLm: Flexor digitorum longus muscle, PTm: Tbialis posterior muscle. b) FA: Fibular artery, tFDL: Tendo flexor digitorum longus muscle, tPT: Tendo tibialis posterior muscle, tA: Tendo Achilles, MM: Malleolus medialis.

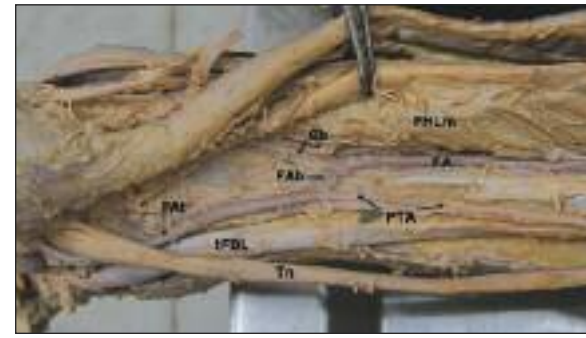

FIGURE 2: Arterial pattern of the left side, distal part of the leg.
FA: Fibular artery, FAt: Fibular artery in tarsal tunnel, FAb: Bridge part of the fibular artery, Cb: Calcaneal branch of the fibular artery, PTA: Posterior tibial artery, tFDL: Tendo flexor digitorum longus muscle, FHLm: Flexor hallucis longus muscle, Tn: Tibial nerve.

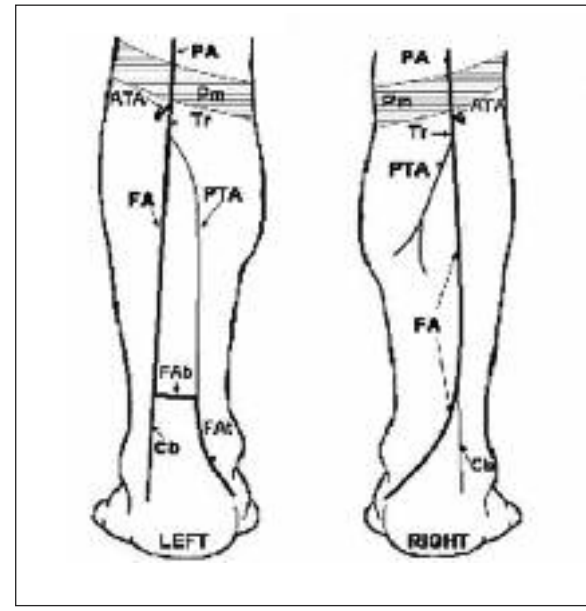

FIGURE 3: Schematic view of the variations.
PA: Popliteal artery, ATA: Anterior tibial artery, Tr: Tibioperoneal trunk, PTA: Posterior tibial artery, FA: Fibular artery, FAt: Fibular artery in tarsal tunnel, FAb: Bridge part of the fibular artery, Cb: Calcaneal branch of the fibular artery, Pm: Popliteal muscle.

minal branches, lateral and medial plantar arteries (Figures 1a, b, 3).

At the left side, the hypoplastic PTA was arising from TPT, 2.7 cm away from the take off point of the ATA and lying at the medial side of the tibialis posterior muscle. The FA was descending laterally and lying deep to the flexor hallucis longus and it was giving off the lateral calcaneal branch at 4.1 cm above the midpoint of the medial malleolus. It was curving sharply to the medial at this level and lying 7.3 mm transversely (bridging part). Then it was curving sharply again inferiorly. At this level, the hypoplastic PTA was joining to the FA. It was diverging into lateral and medial plantar branches when it reached to the plantar surface of the foot (Figures 2, 3).

HISTOLOGICAL EVALUATION

For histological evaluation, tissues in 1 cm length were removed from the tibiofibular trunk, the proximal parts of the posterior tibial and fibular arteries at their origins, from the end of the distal part of the PTA before distributing to the muscle on the right and before contributing to the fibular artery on the left, the FA coursing in the tarsal tunnel on both sides and at the site of the bridge on the left.

The tissues were fixed with 10% formaline. The transverse sections were routinely processed for light microscopy and were embedded in paraffin. Sections (4 μm) were cut by microtome and were stained with Verhoeff and Van Giesson methods to identify media and intima clearly.[3] Slides were examined with regard to elastic fibers and smooth muscles with the light microscope. The thickness of the intima and media, and internal and external diameters of the arteries were measured at four random sites per section with ocular micrometer and mean values were calculated.[4]

All the arteries evaluated were muscular type arteries (Figures 4a, b). The diameters and wall thicknesses of the arteries were decreasing towards the distal end. Ratios of media and intima thicknesses to the external diameter of the proximal part of the posterior tibial arteries were greater than

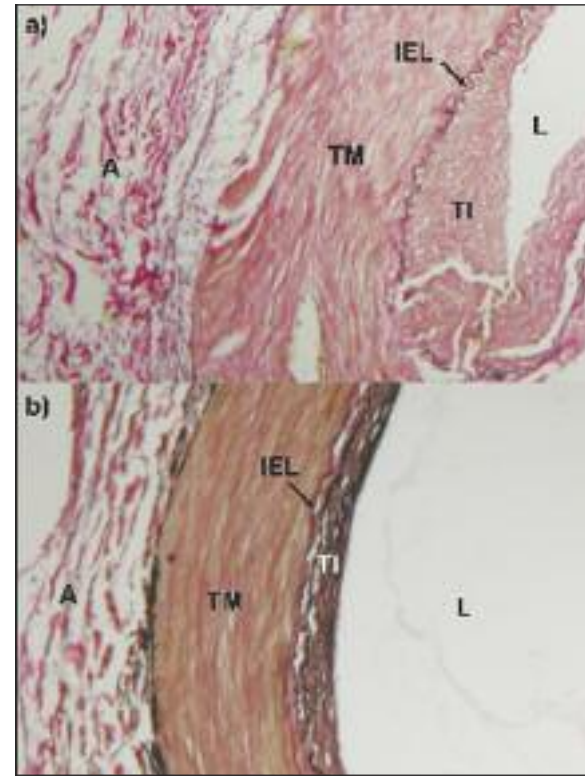

FIGURE 4: Transverse histological sections of the arteries (stained by Van Gieson-Verhoeff's, x120).
a) PTA-P, b) FA-P
TI: Tunica intima, TM: Tunica media, IEL: İnternal elastic lamina,
L: Lumen, A: Tunica adventitia

that of their distal parts, the tibiofibular trunk and fibular arteries (proximal part, bridge and tarsal part) bilaterally (Table 1). However, the intimal and medial thickness of the FA, where it was lying transversely after the sharp curving (tunica intima and media: 121.25 μm and 331.25 μm) was greater than its proximal part (tunica intima and media: 56.25 μm and 307.5 μm) and the part at the tarsal tunnel (tunica intima and media: 66.5 μm and 287.5 μm) on the left side (Figures 4b, 5a, b).

DISCUSSION

In a 10 mm embryo, the primary artery of the lower extremity, the axial artery, passes through the greater sciatic foramen, elongates in the posterior part of the thigh, reaches the popliteal fossa and ends in a capillary plexus in the leg. In a 14 mm embryo, the femoral artery, arising from the

TABLE 1: Histo-morphometrical data of the arteries.

		Tr	PTA-P	PTA-D	FA-P	FA bridge	FA-in tarsal
Ratio of TM to external diameter	L	0.092	**0.127**	0.121	0.080	0.105	0.104
	R	0.054	**0.104**	0.073	0.046	-	0.128
Ratio of TI to external diameter	L	0.008	**0.045**	0.025	0.015	0.038	0.024
	R	0.005	**0.029**	0.016	0.007	-	0.012

TM: Tunica media, TI: Tunica intima, L: Left, R: Right Tr: Tibioperoneal trunk, PTA-P: Proximal part of the posterior tibial artery, PTA-D: Distal part of the posterior tibial artery, FA: Fibular artery, FA-P: Proximal part of the fibular artery.

external iliac artery, reaches the popliteal fossa and makes an anastomosis with the axial artery. At the proximal margin of the popliteus, axial artery provides a primitive posterior tibial and a primitive fibular branch. At the distal border of the popliteus, the axial artery gives off a perforating branch, forming the anterior tibial artery. The proximal parts of the primitive posterior tibial and fibular arteries fuse, but distally remain separate. Eventually much of the primitive FA disappears, although a part of the axial artery is incorporated in the permanent FA.[1]

Anomalies of the limb arterial tree are related with their multiple and plexiform sources, the temporal succession of the emergence of principal arteries and anastomoses and functional dominance followed by regression of some paths.[1]

Bradsley and Staple showed by arteriogram that if an arterial anomaly occurred on one side, there was a 50% probability that the contralateral limb would have a variant.[5] Our case had bilateral PTA variation. Although the distal patterns showed differences, it bilaterally matched type IIIA according to Kim's classification. This type of variation was reported to be between 0.9% and 5%.[2,6]

If one of the tibial arteries were lacking or hypoplastic, the FA supplied that part of the foot and harvest of a FA supplying collateral circulation to the territory of a deficient tibial artery has potential to cause foot ischemia.[2,5] Reports indicate that it is difficult to discriminate a true anatomical variation and occlusion of a vessel with collateral circulation. Especially distal branching patterns are often difficult to assess particularly in the setting of peripheral vascular disease.[7]

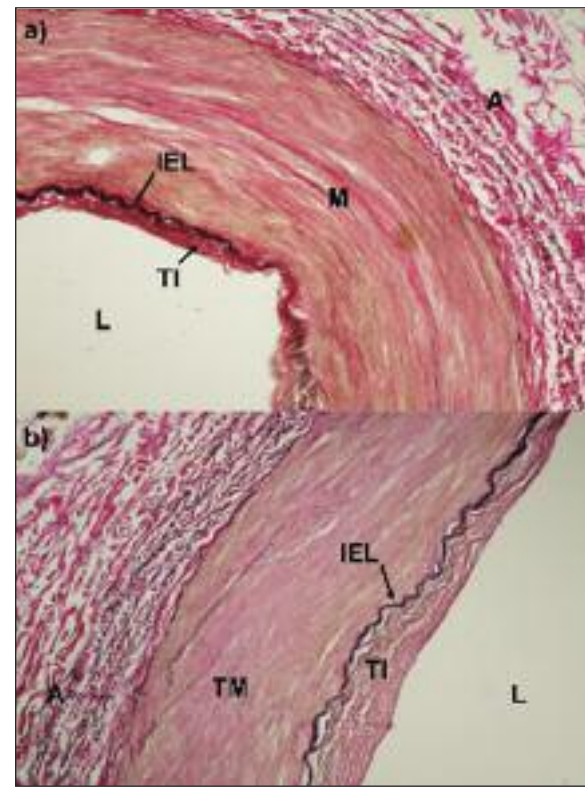

FIGURE 5: Transverse histological sections of the arteries (stained by Van Gieson-Verhoeff's x 120)
a) FA-bridge, b) FA-tarsal
TI: Tunica intima, TM: Tunica media, IEL: İnternal elastic lamina, L: Lumen, A: Tunica adventitia.

In this case, it appeared that the distal part of the PTA regressed partially on the left side and completely on the right. Instead, the FA, distal part of which was anticipated to regress, maintained its existence and replaced the PTA as dominant vascular source of the foot. The connecting vessel between the distal part of the primitive posterior tibial and fibular arteries, which was expected to regress, enlarged and perpetuated blood flow of the

distal fibular artery from lateral to medial. The posterior tibial and fibular arteries were observed to be steadily narrowing to the distal as normal and the arteries did not show any extraordinary features like any local distinct narrowing throughout the artery. Nonetheless, at the proximal part of the posterior tibial arteries, ratios of media and intima thicknesses to the external diameter were greater than that of their distal parts, the tibiofibular trunk and fibular arteries (proximal part, bridge and tarsal part) bilaterally (Figure 4a, b). On the left side, marked thickening of the intima and media of the FA at the site where it coursed from lateral to the medial, in comparison to the proximal and tarsal parts of the same artery was another interesting issue (Figure 5a, b). Turbulence effect of the blood flow at the site of sharp curve of the FA might explain the thickening of the intima-media. Findings both for the distal part of the FA and for the proximal part of the PTA may be the result of a started but not completed disappearance process of the anastomotic channel.

To our knowledge, there are no articles related to those suggestions, and more cases are needed to achieve definite conclusions. Any evidence verifying that any part of a variant fibular artery really inclined to obstruction would be very important for angiographers and vascular surgeons.

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