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Short Report

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Are the Sequence and Level of the Branches of the Popliteal Artery Different in the Fetus than in the Adult?: Two Fetuses With Popliteal Arterial Variation

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The importance of the branching patterns of the popliteal artery in surgery has been evaluated by different techniques such as dissection and angiography. Lippert and Pabst have classified the branching patterns of the popliteal artery (PA) in adults according to the level and sequence of branchings of the anterior tibial (aTA), posterior tibial (pTA) and peroneal (PrA) arteries, and whether they were aplastic or hypoplastic or neither. Many other researchers have demonstrated different variations of this artery with different ratios (1-4). However, there is no study showing whether the pattern of PA in the early stages of life is different from the adult type.

According to Lippert's classification, type I-A is the type most frequently seen in adults with a percentage of 88-96% (Figure 1a) (1-5). In this type, the PA is the continuation of the femoral artery after emerging from the adductor hiatus and it extends downward to the lower border of the popliteus muscle where it ends by giving its two terminal branches, the aTA and posterior tibioperoneal trunk. Then the latter divides into the pTA and PrA. Occasionally, the PA may end by giving two terminal branches, the pTA and anterior tibioperoneal trunk. Then the latter divides into the aTA and PrA (4).

We present here two fetuses having the same unusual pattern of terminal branches of the PA in their branching levels and sequences.

Case report

It was observed that the two fetuses obtained from the Pathology Laboratory of the Medical Faculty of Mersin University had variations in their PA. The fetuses, aged 33 and 22 weeks of gestational age (female and male respectively) had been aborted spontaneously because of placental insufficiency. In the dissection of both fetuses, after reaching the popliteal fossa, the medial head of the gastrocnemius muscle and the medial border of the soleus muscle were cut and then the triceps surae muscle was displaced to the lateral side, so the PA and its branches could be observed better. The transverse line passing from the mid-point of the popliteal fossa was considered to be the reference line for measuring the distances of the branching level of the PA.

In the right lower extremity of the first fetus, the PA diverged into the pTA and anterior tibioperoneal trunk 7.3 mm below the reference line and proximal to the lower border of the popliteus muscle. The pTA had a normal course and a normal caliber. The anterior tibial trunk was terminating by giving the aTA and PrA 6.1 mm distal to its origin. Then the aTA passed through the interval superior to the interosseous membrane and reached the dorsum of the foot in the anterior compartment of the leg. The further courses of arteries were normal (Figures 1b, 2a).

In the left lower extremity of the first fetus, the PA diverged into the pTA and anterior tibioperoneal trunk

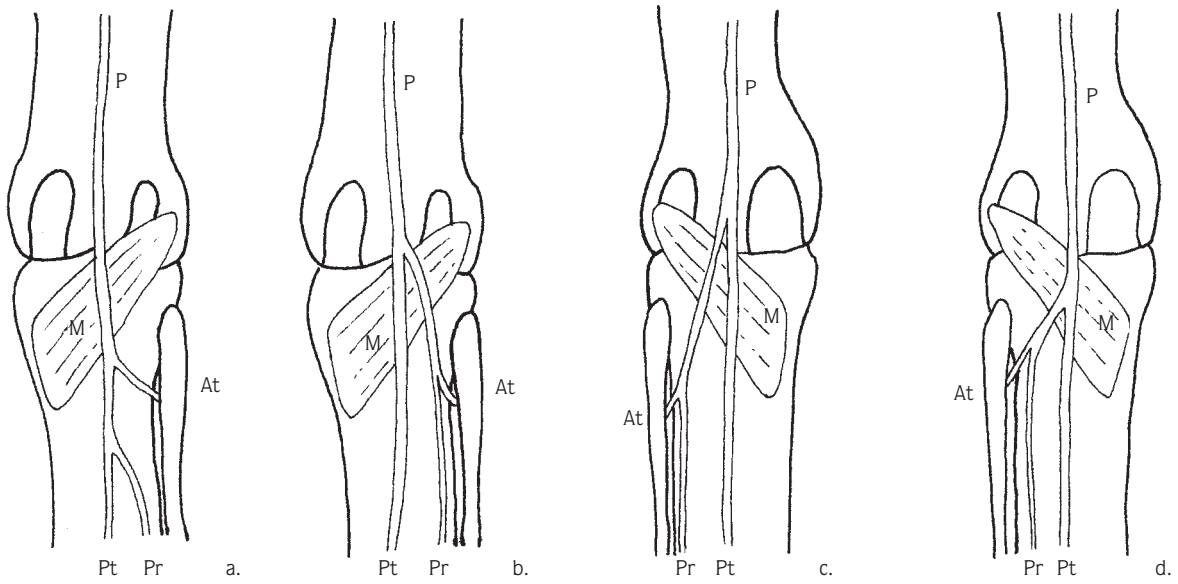

Figure 1. Schematic drawing of the normal pattern of the popliteal artery (a), the right and left sides of the first fetus (b) and (c) respectively, and the left side of the second fetus (d). (P: popliteal artery, Pt: posterior tibial artery, Pr: peroneal artery, At: anterior tibial artery, M: popliteal muscle) .

Figure 2. Photographs of the bilaterally high divided posterior tibial arteries of the fetus, 33 weeks (a), and the same pattern on the left side of the other fetus, 22 weeks (b). (At: anterior tibial artery, Pt: posterior tibial artery, Pr: peroneal artery).

2.0 mm below the reference line. The pTA then passed below the fibrous arch of the soleus muscle. The anterior tibioperoneal trunk terminated by giving the aTA and PrA 9.0 mm below its origin. The further courses of the arteries on this side were also normal (Figures 1c, 2a).

In the left lower extremity of the second fetus, the PA diverged into the pTA and anterior tibioperoneal trunk 7.7 mm below the reference line and proximal to the lower border of the popliteus muscle. The anterior tibioperoneal trunk terminated by giving the aTA and PrA 5.8 mm distal to its origin. Their further courses and dimensions were normal (Figures 1d, 2b).

Anatomists define the division of the PA superior to the lower border of the popliteus muscle as “high division”. On the other hand, clinicians and radiologists prefer to use the medial tibial plateau as a reference point

because it is a remarkable point in angiography. Therefore they define the division of the PA superior to the upper border of the medial tibial plateau as "high division". In this study we prefer the first definition because of its practicality.

Discussion

Three branches of the PA (aTA, pTA, PrA) were evaluated and classified by Lippert according to the level and sequence of branching and hypoplastic or aplastic conditions. Kim et al. modified this classification and emphasized the importance of PA variations, which affect the success of the femorodistal popliteal and femorodistal tibial reconstructions. They also grouped the cases in which the pTA and anterior tibioperoneal trunk arising from the PA proximal to the upper border of popliteus muscle as type II-B (4). This type has been reported in different studies as a percentage of 0.8-1.7% in adult groups (1-3). It was also mentioned that it was highly possible to encounter a high division in cases with the PrA arising from the aTA (4,5).

It is reported that high division with the anterior peroneal trunk is more frequently seen in the right extremity, while high division of the PA with the usual pattern is frequent in the left side. It is also mentioned that if there is a variation on one side, one is likely to observe one on the other side (5). In our cases, one fetus had a bilateral variation while the other had a variation on the left side. The arteries in our cases were neither aplastic nor hypoplastic.

The sciatic artery, arising from the umbilical artery, is the primary artery in 10 mm stage embryos. It exits from the pelvis by passing through the greater sciatic foramen and reaches the popliteal fossa by coursing on the posterior side of the thigh and then courses between the tibia and the popliteus muscle. It terminates in the foot by forming a capillary plexus. When the embryo reaches the 14 mm stage, the femoral artery, as the continuation of the external iliac artery, passes through the adductor canal and anastomoses with the sciatic artery within the popliteal fossa (6-8). In adults, a majority of the proximal part of the sciatic artery disappears while only the inferior gluteal artery remains along the nerve. The medial and distal segments of the sciatic artery form the PA and primitive PrA. The primitive pTA is the continuation of the femoral artery. While the proximal segment of the primitive PrA gradually disappears, the permenant PrA starts to be formed due to its anastomosis with the pTA (7,8). It is generally accepted that in the third month of fetal life, the vessels of the lower extremity reach the adult form (9). In our cases it is thought that the aTA arises from the PrA instead of from the pTA, as a result of a higher anastomosis between the primitive PrA and primitive pTA (Figure 3). This may explain the anterior tibioperoneal trunk accompanying a high division.

We have not encountered any study in the literature about the branching patterns of the PA in fetuses, newborns or infants. Observing a quite rare arterial pattern in such a small group of fetuses, which is reported as relatively uncommon in adult series, may be coincidental. From our point of view, another possibility is that the connection point of the primitive PrA and pTA is more frequently found higher in fetuses, and by the development of the extremity it moves more distally. Hence the changing level and sequence of the arteries form the more common adult type. It is obvious that studies on fetuses, newborns and infants with higher numbers of subjects will explain the appropriate pattern of the PA in these groups.

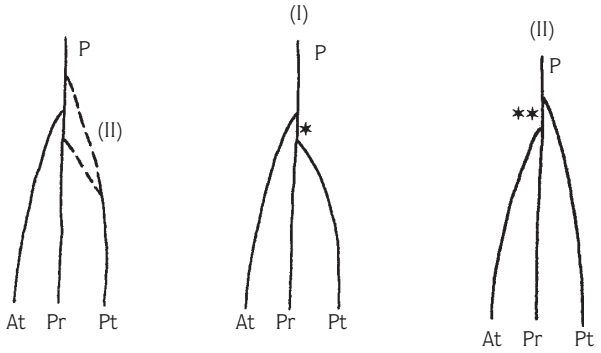

Figure 3. Schematic drawing of the formation of the normal popliteal arterial pattern (I) and the possible forming process of highly divided posterior tibial artery as the first branch of the popliteal artery (II). (P: popliteal artery, Pt: posterior tibial artery, Pr: peroneal artery, At: anterior tibial artery, *posterior tibioperoneal trunk, **anterior tibioperoneal trunk).

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