CASE REPORT

Unexpected popliteal artery variation in a patient with leg injury: a valuable lesson - a case report

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Introduction

The popliteal artery (PA) begins at the adductor hiatus as a continuation of the superficial femoral artery. In the popliteal fossa it runs immediately posterior to the lower femur, the capsule of the knee joint and the upper tibia. Therefore the artery is frequently injured with knee joint dislocation and the fractures around the knee joint (supracondylar fracture of the femur and the tibial plateau fracture). Variations of the PA occur at the rate of 9.3% -15%. [1, 2, 3] This report discusses a case of popliteal artery variation identified in a patient who presented after a leg injury with suspected arterial trauma. An open exploration and dilatation of the artery was done successfully. This case report illustrates the importance of being aware of such variations in order to recognize and prevent complications.

Case

A 17 year old male presented to the accident and emergency department of the national hospital of Sri Lanka (NHSL), following road traffic accident and leg injury. He sustained an open lower tibia and fibula fracture. He was haemodynamically stable at the time of admission. The femoral pulse was palpable. However the popliteal and the distal pulses were absent. An urgent computerised tomographic (CT) angiogram of the lower limb was done.

The CT angiogram revealed early division of the popliteal artery superior to the knee joint line on the injured limb (Figure 1). The contralateral artery was dividing normally in the infra genicular region. Multiple filling defects were demonstrated, probably due to artefacts. The distal arteries were not visualised properly. Since there were features of ischemia on the foot and there were filling defects on the CT angiogram, an urgent exploration of the popliteal and the distal arteries was planned.

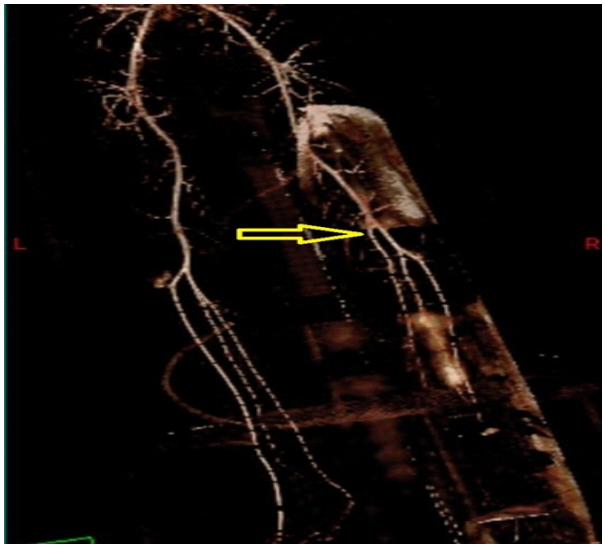

Figure 1: CT angiogram showing early branching of the popliteal artery (Arrow)

The popliteal artery was approached through a medial incision. On exploration, the popliteal artery was found to be dividing above the knee joint level as seen on the CT angiogram. After the division, the branches were running inferiorly on either side of the popliteal vein. The medial branch entered the posterior compartment of the leg through the soleal arch and continued as the posterior tibial artery. The lateral branch was larger in diameter and was running inferiorly on the lateral side of the popliteal vein. At the lower border of the popliteus muscle, the lateral branch divided into the anterior tibial artery and the peroneal artery (Figure 2). There was no arterial wall injuries found on exploration. The popliteal artery and the branches were considered to be in spasm. A mechanical dilatation of the artery was planned with a balloon tipped embolectomy (fogarty) catheter. Control of the popliteal artery, posterior tibial artery (medial branch), and the anterior tibial and the peroneal artery was achieved with silicone tapes. A transverse arteriotomy of about 5mm was made on the popliteal artery about a centimeter proximal to the division. The fogarty catheter was directed into the posterior tibial, anterior tibial and the peroneal arteries selectively beyond the site of leg injury. There were no clots

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retrieved from the arteries indicating that there were no tibial or peroneal arterial injuries distally. Following mechanical dilatation of the popliteal artery and its main branches, the distal pulses appeared and the foot was perfused well thus confirming the arterial spasm.

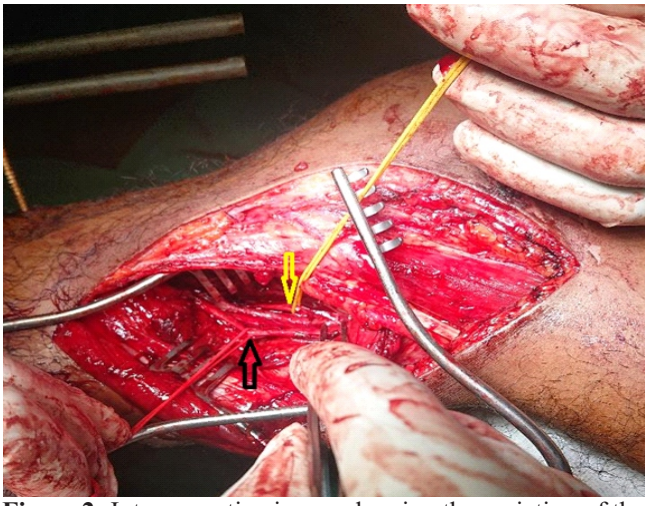

Figure 2: Intra operative image showing the variation of the popliteal artery (medial division - black arrow, lateral division - yellow arrow)

Discussion

For surgical and interventional purposes, the popliteal artery is divided into 3 segments. The segment extending from the adductor hiatus to the upper border of the patella is called part 1 (P1) or the supra genicular PA. The segment extending from the upper border of the patella to the knee joint line is called part 2 (P2) or the infra genicular PA. The segment extending from the knee joint line to the division at the lower border of the popliteus muscle is called part 3 (P3) or the infra genicular PA.

During the embryological development, the axial artery bud of the lower limb arises from the umbilical artery in the fetus. External iliac artery bud also arises from the umbilical artery separately (proximal to the axial artery bud). The axial artery extends distally into the developing limb as the sciatic artery and ends in a capillary network in the foot. Below the knee joint the sciatic artery gives off an anterior branch (future anterior tibial artery). In the leg the axial artery runs as peroneal artery. The peroneal artery gives off an anterior branch above the ankle joint (future distal anterior tibial artery). The external iliac bud elongates into the limb as the femoral artery and communicates with the sciatic artery just above knee joint. Below this communication the femoral artery continues inferiorly as the saphenous artery into the leg. The saphenous artery forms the digital arteries in the foot. During further development the sciatic artery regresses proximally above the communication with the femoral artery and remains as the inferior gluteal artery and the artery to the sciatic nerve in the adult. The part of the sciatic artery below the communication with the femoral artery develops as the popliteal artery and the peroneal artery. The anterior branches of the axial artery in the leg forms communications and develop into anterior tibial artery. The main axial artery below the popliteal artery remains as peroneal artery. This gives off a posterior branch which runs distally and communicates with the distal part of the saphenous artery to form the posterior tibial artery. (Figure 3)

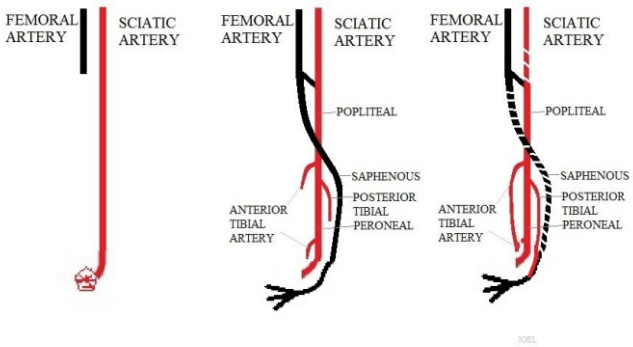

Figure 3: Lower limb arterial development

In the above case described, the saphenous artery probably persisted as early origin of the posterior tibial artery above the knee joint level. The popliteal artery (lateral branch in this case) divided into anterior tibial artery and the peroneal artery. The variations in the popliteal artery are classified in various ways. One classification is described below [4];

1. Type 1 - Normal level of popliteal arterial branching
   A - Usual pattern
   B - Trifurcation
   C - Anterior tibio peroneal trunk
2. Type 2 - High division of the popliteal artery
   A - Anterior tibial arises at or above the knee joint
      1. Normal course of proximal anterior tibial
      2. Medial initial curve in anterior tibial
   B - Posterior tibial arises at or above the knee joint. Common trunk for peroneal artery and anterior tibial
   C - Peroneal artery arises at or above the knee joint. Common trunk for anterior tibial and posterior tibial
3. Type 3 - Hypo plastic or aplastic branching with altered distal supply
   A - Hypo plastic-aplastic posterior tibial. Distal posterior tibial replaced by peroneal artery
   B - Hypo plastic-aplastic posterior tibial and

anterior tibial. Dorsalis pedis replaced by peroneal artery

C - Hypo plastic-aplastic posterior tibial and anterior tibial. Posterior tibial and dorsalis paedis replaced by peroneal artery.

According to the above classification, the current case is type 2 B i.e. high division of the popliteal artery with the posterior tibial artery arising at or above the knee joint level. Common trunk for peroneal artery and anterior tibial artery. This variation was reported in 0.8% of subjects [4].

Awareness of such variations is important to avoid serious complications and to perform successful procedures. For example in this patient if the variation was not detected before surgery, the fogarty catheter dilatation of the posterior tibial artery would not be done because it had a higher origin than the usual expected site. In addition repeated futile attempts to insert the fogarty catheter into usual site would have resulted in iatrogenic injuries. Furthermore in endovascular interventions, it is essential to know the variations to perform successful endovascular interventions. Also in case of popliteal artery reconstruction or bypass, problems can be encountered due to non-identification of the variations. In case of bypasses, failing to recognise a variant vessel not perfusing the intended distal site results in by pass failure [4]. Therefore awareness of the variations of the popliteal artery is essential to prevent unwanted outcomes.

References

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Learning Points:

- It is important to be aware of the variations when assessing a patient with arterial injuries. Meticulous interpretation of the imaging if available is important.
- Surgical or endovascular interventions must be planned according to the variant anatomy. Variations may affect exposure.
- Failure to recognize the variations can increase technical difficulty or the risk of iatrogenic injury