Anatomic study of the middle genicular artery

H Salaria, R Atkinson
Department of Orthopaedics, Modbury Public Hospital, Modbury, Australia

ABSTRACT

Purpose. To study the anatomy of the middle genicular artery and thus mitigate the risk of vascular injury in knee surgery.

Methods. The course, anatomic relations, and variations of the middle genicular artery in 8 cadavers (4 men and 4 women) were studied.

Results. The middle genicular artery originated from the anterolateral surface of the popliteal artery in the popliteal fossa, 3 to 5 cm proximal to the joint line either alone or having a common origin with the lateral genicular artery. Its diameter varied from 2 to 4 mm and it was 3 to 5 cm long. It was accompanied by 2 venae comitantes. This vascular bundle, including the middle genicular artery, ran distally, anterior to the popliteal artery, and posterior to the joint capsule, sandwiched between them. Distally it pierced the posterior joint capsule and became intra-articular. The relation of the middle genicular artery to the popliteal artery altered with the position of the knee joint. This alteration was secondary to the distal gliding of the popliteal artery with knee flexion. The middle geniculate artery formed an angle of 15° to 30° to the popliteal artery when the knee was extended, which became almost a right angle when the knee was flexed past 90°.

Conclusion. Care must be taken when arthroscopic or open intra-articular surgery is performed in the posterior part of the knee joint using chondrotomes and saws, particularly with limited vision. Sharp dissection and diathermy under direct vision should be safer.

Key words: arthroplasty, replacement, knee; arthroscopy; knee; popliteal artery

INTRODUCTION

The middle genicular artery is a branch of the popliteal artery in the popliteal fossa. It originates just proximal to the joint line and runs distally along its anterolateral aspect and becomes intra-articular.
where it pierces the posterior capsule of the knee joint. Intra-articularly it gives some branches to the adjacent posterior and anterior cruciate ligaments.

Catastrophic vascular complications may occur when arthroscopic or open intra-articular surgery is performed in the posterior part of the knee joint using chondrotomes, saws, or any cutting instruments. The popliteal artery is partially protected as it lies on the posterior surface of the posterior joint capsule in the popliteal fossa. The oblique popliteal ligament reinforces this portion blending with the joint capsule in this central area.

The overall incidence of vascular complications in knee ligament surgery is 0.01%, and is around 0.05% in primary total knee replacement. We performed a cadaveric study of the anatomy of the middle genicular artery, to mitigate the risk of vascular injury during knee surgeries.

**MATERIALS AND METHODS**

The course, anatomic relations, and variations of the middle genicular artery in 8 cadavers (4 men and 4 women) were studied.

**RESULTS**

The middle genicular artery originated in the anterolateral surface of the popliteal artery in the popliteal fossa, 3 to 5 cm proximal to the joint line either alone or having a common origin with the lateral genicular artery (Fig. 1). Its diameter varied...
from 2 to 4 mm and it was 3 to 5 cm long, being better developed in the male than female cadavers. It was accompanied by 2 venae comitantes. This middle geniculate vascular bundle ran distally, anterior to the popliteal artery, and posterior to the joint capsule, and was thus sandwiched between them. Distally the middle genicular artery pierced the posterior joint capsule and became intra-articular. The extra-articular part was 1.5 to 2.5 cm long and tortuous, with a coiled appearance on angiograms. Intra-articularly it ran along the distal part of posterior cruciate ligament (lying between it and the anterior cruciate ligament), and gave small branches to both the ligaments and their lining tissues (Figs. 2 and 3).

The relation of the middle genicular artery to the popliteal artery altered with the position of the knee joint. This relationship was secondary to the distal gliding of the popliteal artery with knee flexion. It formed a 15º to 30º angle to the popliteal artery when the knee was extended and was almost a right angle when the knee was flexed past 90º.

DISCUSSION

Arthroscopy and arthroplasty procedures are generally safe, with <1% resulting in vascular injuries and an overall complication rate of 5.6%. The popliteal artery was involved in 85% of vascular injuries; for which an amputation rate of 34% has been reported. Thus, though rare, vascular injury during total knee replacement or arthroscopic knee surgery can be catastrophic.

Vascular injury can occur in the form of direct or indirect vessel laceration, intimal injury, or atheromatous plaque rupture with distal embolisation into popliteal vessels. There was also a case of popliteal artery pseudoaneurysm as a result of avulsion of the middle genicular artery off the popliteal artery during anterior cruciate ligament reconstruction.

The middle genicular artery is not at risk during total knee replacement when the posterior cruciate ligament is preserved. When the posterior cruciate ligament is removed from the femur using sharp dissection or sharp bone nibblers, the risk of middle genicular artery avulsion is minimal. While under tourniquet these tributaries can often be identified as back-bleeding within the remnants of the posterior cruciate ligament and can be diathermied at the time of dissection or on release of the tourniquet at the end of the procedure. When the saw blade passes beyond the posterior cruciate ligament or when a blunt bone nibbler is used, the risk of avulsing the middle genicular artery from the popliteal artery increases, depending on the extent of dissection. The vessel itself cannot be identified unless the dissection goes beyond the posterior capsule in the popliteal fossa. Bleeding from branches of the middle genicular artery into the posterior cruciate ligament can be severe on tourniquet release, but controllable by diathermy and flexion. It is advised to routinely coagulate these vessels to minimise postoperative blood loss.

Avulsion of the middle genicular artery is possible, particularly given its shorter length and larger diameter in some knees. The torsional forces of a chondrotome or nibbler may result in its tearing off the popliteal artery. When the popliteal artery is rent asunder, the bleeding may remain posterior to the capsule and is less likely to be noticed early. Care should therefore be taken when using a chondrotome or any other sharp instrument in the posterior compartment of the knee joint. The use of diathermy under vision should be safer.

ACKNOWLEDGEMENT

We thank the Department of Anatomy of the Adelaide University for providing support for the cadaver dissections and the photography.

REFERENCES