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A CADAVERIC STUDY OF MORPHOLOGY AND LOCALIZATION OF HIATUS ADDUCTORIA

Anatomy

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ABSTRACT

BACKGROUND: Adductor hiatus is an opening in the distal aponeurotic part of adductor magnus. Femoro-popliteal occlusions are quite common around the hiatus. Multiple imaging studies emphasized the cause as multifactorial.Very few cadaveric studies are found in extant literature, evoking interest in the clinical implications of adductor hiatal morphology.

OBJECTIVE: To determine the shape, structure and localization of adductor hiatus (AH) .

MATERIALS & METHODS: 30 embalmed lower extremities were dissected to expose the adductor hiatus ,the shape and morphology of hiatus was noted. Femoral length and hiatal length were measured. Localization of hiatus was done relative to femoral length.

RESULTS: 14 limbs showed musculotendinous, 9 limbs muscular and 7 limbs tendinous boundaries around hiatus. The average femoral length and hiatal length were 41.25cm and 11.55cm respectively.20limbs had hiatal apex located in distal third ,6 in middle and 4 at midpoint of middle and distal third of femur.

CONCLUSIONS: Sound knowledge of the morphology and localization of adductor hiatus is a pre-requisite for endovascular surgeons and orthopaedicians to perform concerned surgeries. An attempt to study adductor hiatus in cadavers would be of clinical relevance and can be correlated with imaging techniques in volunteers.

KEYWORDS

INTRODUCTION

The femoral vessels are transmitted from the adductor canal through the aponeurotic opening in the adductor magnus described as adductor hiatus or hiatus adductoria into the popliteal fossa as popliteal vessels. Perforating arteries and the profunda femoris artery itself passes through minor openings along the attachment of the adductor magnus to the linea aspera. A comprehensive review of literature has provided multiple imaging (CT & MRI angiographic) studies on femoro-popliteal arteries along adductor canal and hiatus.

The distal part of femoral artery is a well known predilection site for atherosclerosis. Scholten et.al found 72% of femoro-popliteal occlusions at the level of the adductor canal hiatus[1]. Involvement of the femoro-popliteal arteries in patients suffering from peripheral arterial diseases is very common. Patients with obstructive disease of femoro-popliteal arteries typically present with symptoms of either intermittent claudication or critical limb ischemia depending on the degree and the extent of circulatory compromise. Patients with severe claudication and critical limb ischemia typically exhibit femoro-popliteal occlusive disease, often in combination with more proximal (aorto-iliac) and /or more distal (infra popliteal) lesions[2]. Lindblom identified 2 principal sites for femoro-politeal occlusions, the main one being in the region of adductor hiatus and the other in the popliteal area[3]. Watt suggested that unfavorable haemodynamic circumstances such as the S-shaped configuration of the femoral and popliteal arteries or frequent branching in this area contribute to the origin of atherosclerosis. Since the adductor hiatus and vessels are close to knee joint, flexion of knee will certainly influence the local morphology[4]. Both Lindbom and Watt speculated on the influence of knee flexion on atherogenesis in the adductor and popliteal region[3,4]. Wensing et al emphasized the importance of location of arterial region dorsal to axis of movement of knee implicating a relation and influence of local morphology for occlusion[5]. Local anatomical factors such as the morphology of boundaries around the hiatus, accessory fibrous bands and sometimes hypertrophied muscles can lead to compression of femoral vessels.in a young man two different pathophysiological mechanisms, first being a sort of fibrous band compressing the neurovascular bundle and the second is a "scissor-like compression mechanism" during exercise over femoral artery at the adductor hiatus by the hypertrophied vastus medialis and the adductor magnus[6].

Distal femoral approach, to expose medial distal femoral fractures, usually a Hoffa type (supracondylar) fracture, localization of osteochondroma or other neoplastic conditions of bone might cause damage to arterial supply and compromise the blood flow[7]. The exact cause and the tendency of occlusive disease of femoro-popliteal region is not yet specified in detail as it is proposed to be multifactorial. There is a paucity of cadaveric studies in extant literature on adductor hiatus morphology and localization, which led to the initiation of study with surgical significance and clinical relevance.

OBJECTIVE:

To determine the shape, structure and localization of adductor hiatus.

MATERIAL & METHODS:

An observational study was conducted on 30 embalmed lower extremities in the Department of Anatomy at Dr.Pinnamaneni SIMS & RF. Regular dissection was performed on limbs and the medial distal ends of the thighs were exposed. The adductor magnus muscle and the hiatus were identified. The shape and structures forming the boundaries of the hiatus were noted. Bony landmarks were identified to take measurements on femur and the hiatus. Femoral length(FL) was measured from the highest point of greater trochanter up till the prominent point on lateral epicondyle with a non-elastic measuring tape.Hiatal length(HL) was measured from adductor tubercle upto the apical point of adductor hiatus. The measurements were calibrated in centimeters and the localization of adductor hiatus was done relative to the length of femur.

RESULTS

Out of 30 limbs 15 were right and 15 were left limbs. Shape of adductor hiatus was oval in all the dissected limbs. Musculotendinous boundaries were seen in 14 limbs, 9 limbs showed muscular and 7 limbs showed tendinous boundaries around the hiatus respectively. The measurements of femoral length ranged from 38cm to 44.5 cm with an average of 41.25cm.The range of hiatal length varied from 8.2 cm to 14.9 cm with an average of 11.5cm.For vertical localization of apex of adductor hiatus relative to the length of femur, 20 limbs had apex located in the distal third of femur,6 limbs it was located in the middle third and in 4 limbs the apex of hiatus was located at midpoint of distal and middle third of femur. The course of the femoral vessels was normal. No accessory muscular bands were identified. The results are tabulated below.

TABLE-1 Showing the femoral and hiatus length with the location of apex and boundaries around the adductor hiatus

S.no	Side	Femur Length(fl) (cm)	Hiatal Length(hl) (cm)	Apex Location Relative To Fl	Boundaries Of Hiatus
1.	R	39.5	10.3	Distal	musculotendinous
2	L	39.5	13.3	Middle	Muscular
3.	R	38.5	8.5	Distal	musculotendinous
4	L	38.4	8.62	Distal	Musculotendinous

5	R	38.5	8.2	Distal	Tendinous
6.	L	38.5	8.3	Distal	Musculotendinous
7	R	44.5	14.9	Middle	Musculotendinous
8	L	44.4	12.9	Distal	Musculotendinous
9	R	38	13	Middle	Tendinous
10	L	38	12.6	Midpoint	Muscular
11	R	41.2	10.4	Distal	Musculotendinous
12	L	41.1	10.3	Distal	Musculotendinous
13	R	38.5	11.5	Distal	Tendinous
14	L	38.7	11.4	Distal	Musculotendinous
15	R	39	13.3	Middle	Muscular
16	L	39.2	12.6	Distal	Muscular
17	R	40	12	Distal	Muscular
18	L	40.2	13.8	Middle	Tendinous
19	R	39.6	13.6	Middle	Musculotendinous
20	L	39.5	13.1	Distal	Muscular
21	R	40.9	13.6	Midpoint	Muscular
22	L	40.7	13.5	Midpoint	Muscular
23	R	38.5	10.4	Distal	Tendinous
24	L	38.3	12.7	Midpoint	Musculotendinous
25	R	40.3	8.7	Distal	Musculotendinous
26	L	40.1	8.7	Distal	Muscular
27	R	41.3	8.9	Distal	Tendinous
28	L	41.3	9.3	Distal	Tendinous
29	R	39.4	8.2	Distal	Musculotendinous
30	L	39.4	8.3	Distal	Musculotendinous

DISCUSSION

Most of the peripheral arterial diseases are common in the femoro-popliteal arterial region with multiple anatomic factors affecting the vessels. Numerous imaging studies and case reports of femoral artery occlusion at the level of adductor hiatus have been reported. Vernon et al investigated 6 lower limbs post-mortem in knee flexion with angiography and identified that morphological changes take place between two fixed points in the arteries, one at the adductor hiatus proximally and the other at the origin of anterior tibial artey distally [8].A similar study of effect of knee flexion in 25 patients conducted by Zocholl et al with digital subtraction angiography shared Vernon's view for the existence of two fixed points[8]. Balaji et al reported 3 cases of adductor canal outlet syndrome , in which the study confirmed that the trauma occurred at the point where femoral artery crossed the adductor magnus at the hiatus[9].

There are very few studies conducted on cadavers in relation to adductor hiatus morphology and location relative the length of femur. Kale et al have done a comprehensive study, where they classified and localized the adductor hiatus in 20 embalmed cadavers. They have identified and classified four types which include oval fibrous, oval muscular ,bridging fibrous and bridging muscular hiatus. Localization of the hiatus was done vertically and horizontally by taking certain measurements over the hiatus .In relation to vertical localization the mean measurements were 119.6mm ranging from 72 to 170.4 mm. The femur length was found as a mean of 369.2 mm with a range from 334 to 445mm.The horizontal measurement ranges between 2.2 to 17.7 mm with a mean of 7.94mm.The apex of the adductor hiatus was located in the middle third of femur in 14 thighs ,and in the remaining 26 the apex was located in the distal third [10].In the present study all oval shaped hiatus were noted with classification of boundaries surrounding the hiatus as muscular, musculotendinous and tendinous. The femur length ranged from 38 to 44.5 cm with an average of 41.25 cm(412.5mm). Horizontal localization was not done in the present study. Vertical location was estimated by measuring the hiatal length which measured from 8.2 cm to 14.9 cm with an average of 11.55cm(115.5 mm) which is close to Kale's study though the landmarks determining the hiatal length were differently utilised. Majority of limbs (20) ,the apex of hiatus was located in distal third,6 limbs in middle third ,but another entity identified in present study was in 4 limbs

up to the apex of the in lower limbs of 24 skeletally mature cadavers which ranged from 8 to 13.5 cm with a mean of 10 cm. They have also postulated that an area up to 8 cm proximal adductor tubercle and anterior to medial intermuscular septum appears safe interval for avoiding vascular structures [11]. Checroun et al measured the distance from the adductor tubercle to the proximal most point of the adductor hiatus and found that it ranged from 132 to 180 mm. In present study the hiatal length was measured from adductor tubercle to apex of the hiatus and the mean measured 11.55cm with a range of 8.2 to 14.9cm[12].

Scholten and Mali (1989) have localized adductor hiatus using external sonography and defined hiatus location as the site where the cross-section of the femoral artery was at the level of the two echogenic lines that represented the continuation of the adductor fascia on either side of the defect. Location of hiatus varied from 80-130 mm (mean 100mm) in 16 legs of 8 healthy volunteers [13]. Scholten et al in 1993 used Duplex ultrasonography to locate level of femoro-popliteal occlusions in 50 patients. The location of hiatus varied from 70-150 mm (105mm mean)[1].

Fractures of distal end of femur especially supracondylar will most likely cause damage to the femoral artery and may cause impairment of blood supply to the leg. First femoro-popliteal bypass was conducted 1949 by Dr. Kunlin with great saphenous vein as conduit[14]. Technical advances have broadened the application of technique to a variety of clinical and anatomic scenarios. The adductor canal compression syndrome was first described by Palma in 1950 which involves compression of neurovascular structures in adductor canal [15]. The popliteal entrapment syndrome is another entity described in relation to adductor region .A sound and must know objectives have to be derived for young aspiring endovascular surgeons and the clinicians dealing with angiopathies and neuropathiesin in the adductor region.

CONCLUSIONS

Present study has identified the shape and structures forming the boundaries of adductor hiatus keeping in view the paucity of studies conducted on cadavers. The localization of hiatus was defined in relation to the length of femur which is of utmost clinical importance for endovascular surgeons for various techniques to perform in femoro-popliteal diseases and orthopaedicians who deal with fixation of distal femur fractures.

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