

Anatomical Variations in Formation and Branching Pattern of the Femoral Nerve in Iliac Fossa

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Abstract

Case Report

The femoral nerve is the largest branch of the lumbar plexus. It arises from the dorsal branches of second to fourth ventral rami. Conventionally the femoral nerve passes behind the inguinal ligament and divides into anterior and posterior divisions in the thigh. Aberrant slip of iliacus or psoas major muscle sometimes splits the femoral nerve. The detailed knowledge of the possible variations of these muscles and femoral nerve may have immense importance in various pelvic and pelvi-femoral surgeries. The femoral nerve was studied during routine undergraduate cadaveric dissection performed in the department of Anatomy, KCGMC, Karnal. We observed a rare variation in the course of femoral nerve on the left side. The femoral nerve was found to split into two divisions above the inguinal ligament after its origin from the lumbar plexus by two slips of iliacus muscle. The lower division of the nerve passed deep to the slips of iliacus muscle fibres and the upper division ran superficial to iliacus muscle deep to fascia iliaca. Both the divisions joined after entrapping the slips of iliacus muscle just above the inguinal ligament to form the trunk of the femoral nerve. Another variation noted in the present case was that lateral cutaneous nerve of thigh arose directly from the femoral nerve. In the cases of femoral nerve paralysis, neuropathy caused by iliac hematoma after anticoagulant treatment or vessel catheterization, the existence of some variant muscles or variations in formation and branching pattern of the femoral nerve may increase the chances of nerve compression. Origin of lateral cutaneous nerve of thigh from the femoral nerve may have impact on the clinical efficacy of lumbar plexus blockade, since femoral nerve blockade is likely to produce blockade in the area of distribution of lateral cutaneous nerve of thigh in these plexuses. These variations are of significant practical importance for the surgeons to prevent further surgical complications during routine surgery.

Keywords: Anatomical Formation Branching Pattern Nerve Fossa.

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INTRODUCTION

The femoral nerve is the largest branch of the lumbar plexus. It arises from the dorsal branches of second to fourth ventral rami. The femoral nerve descends through psoas major and emerges on or under its lateral border, about 4 cm above the inguinal ligament. It passes between psoas major and iliacus deep to the iliac fascia and runs posterior to the inguinal ligament into the thigh. It gives off branches that supply iliacus and pectineus, and sends sensory fibres to the femoral artery. Posterior to the inguinal ligament, it lies lateral to the femoral artery and sheath.

Conventionally the femoral nerve passes behind the inguinal ligament and divides into anterior and posterior divisions in the thigh [1.]The femoral nerve block is performed on the main trunk of the

femoral nerve just below the inguinal ligament [2]. The higher division of the femoral nerve in iliac fossa results in incomplete femoral nerve block.

Aberrant slip of iliacus or psoas major muscle sometimes splits the femoral nerve [3-5]. The detailed knowledge of the possible variations of these muscles and femoral nerve may have immense importance in various pelvic and pelvi-femoral surgeries.

The lateral femoral cutaneous nerve (lateral cutaneous nerve of the thigh) is usually derived from the ventral rami of L2 and 3, but variable contributions from L1 to L3 are described. It emerges from the posterolateral border of psoas major and crosses iliacus obliquely towards the anterior superior iliac spine. It supplies sensory fibres to the parietal peritoneum in the

iliac fossa. Both nerves usually pass behind the inguinal ligament about 1–2 cm medial to the anterior superior iliac spine; occasionally, they pass through or, rarely, anterior to the ligament [6]. Occasionally, the nerve lies anterior or superior to the anterior superior iliac spine as it enters the thigh.

CASE REPORT

During routine dissection for medical undergraduates in the Department of Anatomy, KCGMC, Karnal, a rare variation in the course of femoral nerve was found on the left side in 50-60 year old female cadaver. The skin, superficial fascia, muscles of anterior abdominal wall and all abdominal viscera were removed to expose the posterior abdominal wall. The exposure of origin of femoral nerve was done by removing psoas major muscle piece by piece. Posterior abdominal wall was dissected minutely to find out different branches of lumbar plexus and the lumbosacral trunk; the psoas major muscle was cut for that purpose. The femoral nerve was found to split into two divisions above the inguinal ligament after its origin from the lumbar plexus by two slips of Iliacus muscle. The lower division of the nerve passed deep to the slips of iliacus muscle fibres and the upper division ran superficial to iliacus muscle deep to fascia iliaca. Both the divisions joined after entrapping the two slips of iliacus muscle just above the inguinal ligament to form the trunk of the femoral nerve. Since the hip joints were disarticulated before the dissection of lumbar plexuses, so we did not study the further course and branching pattern of the femoral nerve in the thigh.

Another variation noted in the present case was that Lateral cutaneous nerve of thigh arose directly from the splitted femoral nerve from its upper division on the left side.

The formation of femoral nerve & other branches of lumbar plexus were found to be normal on the right side.

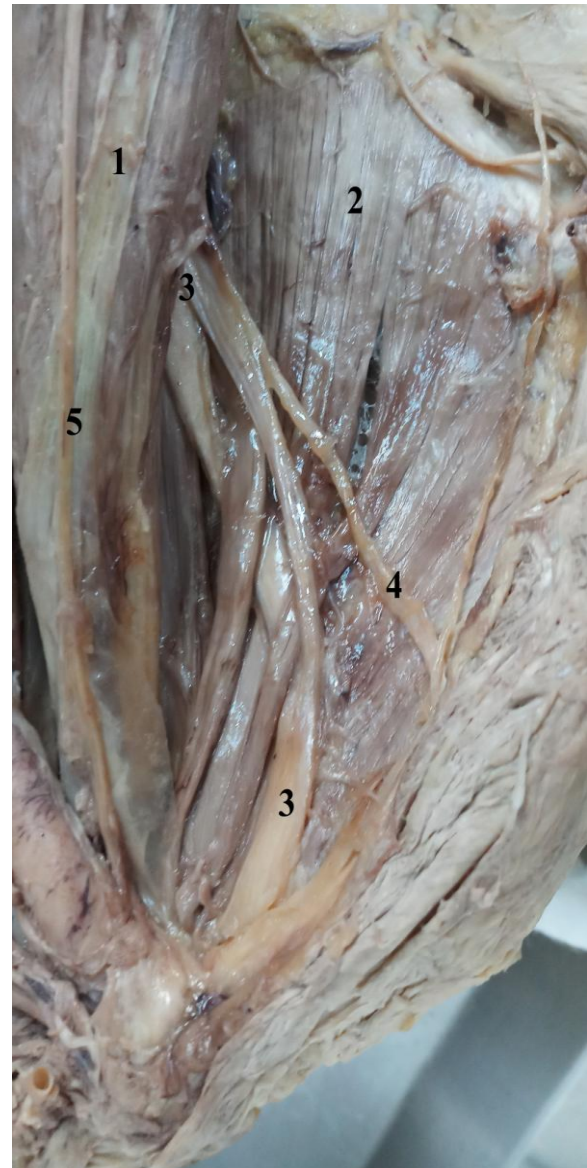


Fig-1: Variant slips of iliacus muscle causing splitting of Femoral nerve. 1=psoas major, 2=Iliacus, 3=Femoral nerve, 4=Lateral cutaneous nerve of thigh, 5= genitofemoral nerve

DISCUSSION

A tight fascial compartment is formed by the femoral nerve, the psoas major and iliacus muscles roofed over by the iliacus fascia, which accounts for femoral nerve lesions due to space-occupying processes in this area. Neuropathy caused by iliac hematoma after anticoagulant treatment [7] or vessel catheterization [8] may lead to femoral nerve paralysis. The existence of some variant muscles or variations in branching pattern of the femoral nerve may increase the chances of nerve compression.

Variant slips of the iliacus and psoas major muscles split the femoral nerve into two or three separate slips in 35.3% [5], 7% [4] and 2.2% [3]. Jakubowicz reported splitting of the femoral nerve by lateral fibers of psoas major muscle in 2.5% and by muscle fibers of iliacus in 2.5% in fetal lumbar plexus [9]. Jeleu *et al.* reported accessory iliopsoas muscle splitting the left femoral nerve in a female cadaver [10]. Astik & Dave found splitting of the femoral nerve into two slips by muscular slip of psoas major in three plexuses and by accessory iliacus slip in two plexuses. The femoral nerve slips fused with each other at variable distance above the inguinal ligament [11].

Variant muscular slip of psoas major or accessory slips from iliacus which cause tension of the femoral nerve and therefore, should be suspected in patients with referred pain to the hip and knee joints [3]. The accessory muscles may be seen as interesting findings in patients during retroperitoneal surgery in the lower lumbar region and should be kept in mind in the differential diagnosis on CT imaging of the iliopsoas compartment [12].

Lateral cutaneous nerve of thigh arose directly from the femoral nerve in 6 (10%) plexuses [13]. Dias Filho *et al.* reported origin of lateral cutaneous nerve of thigh from the femoral nerve inferior to the inguinal ligament in one case in their study [14]. Uzumansel *et al.* reported origin of accessory lateral cutaneous nerve of thigh from the femoral nerve above the inguinal ligament in their case report [15]. Astik & Dave found origin of lateral cutaneous nerve of thigh from the femoral nerve above the inguinal ligament in 4 plexuses (out of 32 cadavers) [11]. Origin of lateral cutaneous nerve of thigh from the femoral nerve may have impact on the clinical efficacy of lumbar plexus blockade, since femoral nerve blockade is likely to produce blockade in the area of distribution of lateral cutaneous nerve of thigh in these plexuses. Similarly, lateral cutaneous nerve of thigh blocks would produce femoral nerve blockade as described by Sharrock [16]. The impact of the presence of this variation on femoral and lateral cutaneous nerve of thigh blockade is yet to be investigated.

Compression of the femoral nerve in the iliac fossa has been reported as a consequence of several pathologies, but never as a result of muscular compression. Aberrant slips of iliacus muscle, however, have occasionally been reported to cover or split the femoral nerve. Each disposition may be a potential risk for nerve entrapment [17].

The cause for the variations of the iliopsoas muscle, described in the text, might be an unknown disturbance in the embryonic muscular blastema and its interaction with the aggressive ingrowths of the femoral nerve through the developing iliopsoas muscle complex. The muscular variations, such as those

mentioned above, most probably do not cause any considerable disturbance in the lower limb movements.

The accessory muscles may be seen as interesting findings in patients during laparotomy and enrich the possibilities in the differential diagnosis on CT imaging of the iliopsoas compartment. Mainly because of the frequent co-existence with an unusual course and formation (splitting) of the femoral nerve, these muscular variations are of a great importance to clinical practice. A variant muscular slip, belonging to the psoas major. Muscle or iliacus muscle, or even an accessory muscle may cause tension of the femoral nerve and therefore should be suspected in patients with referred pain to the hip and knee joints and to the lumbar dermatomes. In case of femoral nerve neuropathy caused by iliac hematoma after anticoagulant treatment or trauma or vessel catheterization the existence of some variant muscles, which may increase the nerve compression, must be born in mind. The detailed knowledge of the possible variations of the iliopsoas muscle complex and the femoral nerve variations, connected with them, may also give surgeons confidence during iliacus compartment fasciotomy in the treatment of iliacus hematoma [10].

Spratt *et al.* found four examples of unilateral variant slips of iliacus muscle and psoas major muscle in 68 cadavers they dissected. In three of them the femoral nerve was pierced by the variant slip. Such anomalies might cause tension on the femoral nerve resulting in referred pain to the hip and knee joints and to the lumbar dermatomes L2, 3 and 4 [3].

The anatomical variations of the femoral nerve can be explained on the embryological basis. Limbs develop in the form of buds of cellular undifferentiated mesoblast before the spinal nerves have any connection with them. Somatic branches of the nerves then stream out into the limb bud, passing into it below the ends of the myotomes and spreading out into a bundle of fibers at the proximal attachment of the limb. Later on, the nerves separate each into a pair of definite trunks, which are named dorsal and ventral, dividing round a central core of mesoblast and proceed to the dorsal and ventral surfaces of the limb bud respectively. While this process is going on, a secondary union takes place between parts of adjacent dorsal and ventral trunks. Dorsal trunks unite with other dorsal trunks, whereas the ventral trunks unite with ventral trunks, to form the nerves distributed ultimately to the surfaces and periphery of the limb (Cunningham, 1905). Variations in formation and branching pattern of the femoral nerve may occur due to abnormal union of dorsal and ventral trunks of the nerve during the fourth week of intrauterine development. These anatomical variations are usually concomitant with compensatory variations in adjacent nerves, and are due to the fibers of a given spinal nerve taking an abnormal course in the trunk of

another nerve of distribution and effecting a communication with the proper nerve peripherally. In this way variations in the origin of lateral cutaneous nerve of thigh from the femoral nerve, and splitting of the femoral nerve by psoas major or accessory iliac muscle may be explained [18].

CONCLUSION

The knowledge of anatomical variations of the femoral nerve is essential for the surgeons to avoid iatrogenic injury to the femoral nerve, for the radiologists to prevent diagnostic errors, for the clinicians who are treating patients with meralgia paresthetica as lateral cutaneous nerve of thigh may arise from the femoral nerve, for the anesthetists to give successful block in femoral or lateral cutaneous nerve of thigh. The detailed knowledge of the possible variations of the iliopsoas muscle complex and the femoral nerve variations connected with them, may also give surgeons confidence during iliacus compartment fasciotomy in the treatment of iliacus hematoma and during drainage of intramuscular abscess.

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