

Anatomical variations of the lumbar plexus in fetus

Fetuslarda plexus lumbalis'in anatomik varyasyonları

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Abstract

The lumbar plexus is formed within the psoas major muscle and is one of the main nervous pathways supplying the lower limb. Although we came across literature concerning the variations in lumbar plexus in adults, there is dearth of the same in fetuses. Aim of the study was to study the variations in lumbar plexus in fetus. The study was done bilaterally in 25 formalin-fixed fetuses (10 females, 15 males), age ranging from 20 to 37 weeks of gestation. The formation of lumbar plexus and their branching pattern were observed. The findings were noted and tabulated. Multiple variations were observed in the formation and branching pattern of lumbar plexus. Anatomical variations found in the present case may be injured during certain surgical procedures in infants and children, particularly in the lower abdominal region, e.g. appendectomy, inguinal hernia repair, iliac crest bone graft harvesting etc. As a consequence to such operations, several clinical conditions may be encountered such as meralgia paresthetica, groin pain and testicular pain in which the lateral femoral cutaneous, ilioinguinal and the genitofemoral nerves are mostly involved. Thus, awareness about the regional anatomy and its variations is essential for preventing intra-operative complications.

Keywords: Lumbar plexus; fetus; variations

Özet

Pleksus lumbalis, psoas majör kasının içinde oluşan ve alt ekstremitenin inervasyonunu sağlayan ana sinir yollarından biridir. Pleksus lumbalis varyasyonları ile ilgili literatürlere baktığımızda erişkinlerde yapılanlar ile karşılaşmamıza rağmen, aynı konuda fetuslarda yapılanlarda çok eksiklik vardır. Çalışmanın amacı fetuslarda pleksus lumbalis varyasyonlarını incelemektir. Çalışma gestasyonel yaşı 20 ile 37 hafta arasında değişen, 25 adet formalin ile fiske edilmiş fetüste (10 kadın, 15 erkek) bilateral olarak yapıldı. Pleksus lumbalis'in oluşumu ve dallanma paterni incelendi. Bulgular kaydedildi ve tablo haline getirildi. Pleksus lumbalis'in oluşumu ve dallanma paterni ile ilgili çok sayıda varyasyonlar gözlemlendi. Bu çalışmada bulunan anatomik varyasyonlar özellikle alt karın bölgesinde, bebeklerde ve çocuklarda uygulanan bazı cerrahi işlemler sırasında yaralanabilir, örneğin apendektomi, kasık fitiği onarımı, crista iliaca'dan kemik grefti alma gibi. Bu tür operasyonların bir sonucu olarak, çoğunlukla lateral kutanöz femoral, ilioinguinal ve genitofemoral sinirlerin etkilendiği meralgia paresthetica, kasık ağrısı ve testis ağrısı gibi çeşitli klinik durumlarla karşılaşılabılır. Bu nedenle, bölgesel anatomi ve varyasyonları hakkında bilinçli olmak intra-operatif komplikasyonların önlenmesi için gereklidir.

Anahtar kelimeler: Pleksus lumbalis; fetus; varyasyonlar

Introduction

The lumbar plexus is formed within the substance of psoas major muscle by the union of ventral rami of the first three lumbar, most of the ventral ramus of the 4th lumbar and a slender branch arising from the 12th thoracic nerve.

Although we came across literature concerning the variations in lumbar plexus in adults (1-3), there is dearth of the same in fetuses.

Surgical procedures like inguinal hernia repair, colostomy, appendectomy frequently done in infants and children may accidentally involve these varied branches of the lumbar plexus and cause obvious damage. As it is difficult to get cadavers of that age group, the present study was conducted on dead fetuses.

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Materials and Methods

The present study was conducted in the department of Anatomy, Kasturba Medical College, Manipal. The study was done bilaterally in 25 formalin-fixed fetuses (15 males, 10 females) of age ranging from 20 to 37 weeks of gestation. The spontaneously aborted and stillborn fetuses were procured from the department of Obstetrics and Gynaecology, Kasturba Hospital Manipal. Fetuses with any external deformity were excluded from the study. The fetuses were meticulously dissected and the formation of lumbar plexus and their branching pattern were observed. The findings were noted and tabulated.

Results

Multiple variations were observed in the formation and branching pattern of lumbar plexus (Table 1). Absence of the ilioinguinal nerve (IIN) was common and was reported in four cases (Figure 1). A double IIN was also observed in one case. The nerve was initially single close to its origin but later



divided into two in the pelvic cavity. Both the nerves then perforated the transversus abdominis muscle near the anterior part of the iliac crest (Figure2).

Anomalous formation of the lateral femoral cutaneous nerve (LFCN) was also observed. The two roots of the nerve i.e., L2 and L3 were arising separately from the lateral side of the psoas major

Table 1. Showing the number of specimens examined and the percentage of variations obtained in the branching pattern of the lumbar plexus

VARIATIONS	Number of specimens examined (50)	Percentage %
Normal	39	78
Absence of ilioinguinal nerve (IIN)	4	8
Double ilioinguinal nerve (IIN)	1	2
Anomalous formation of LFCN	1	2
Early splitting of Genitofemoral nerve (GFN)	5	10

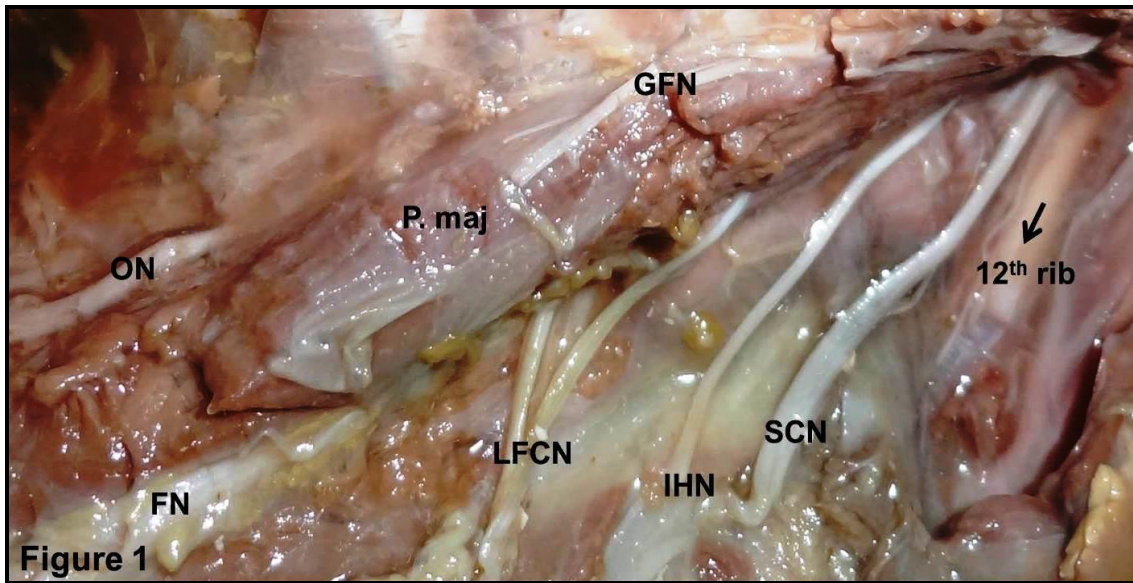


Figure 1. Showing the absence of ilioinguinal nerve and the anomalous formation of the lateral femoral cutaneous nerve (LFCN). SCN- Subcostal nerve, IHN- Iliohypogastric nerve, FN- Femoral nerve, ON- Obturator nerve, GFN- Genitofemoral nerve, P. maj- Psoas major muscle.

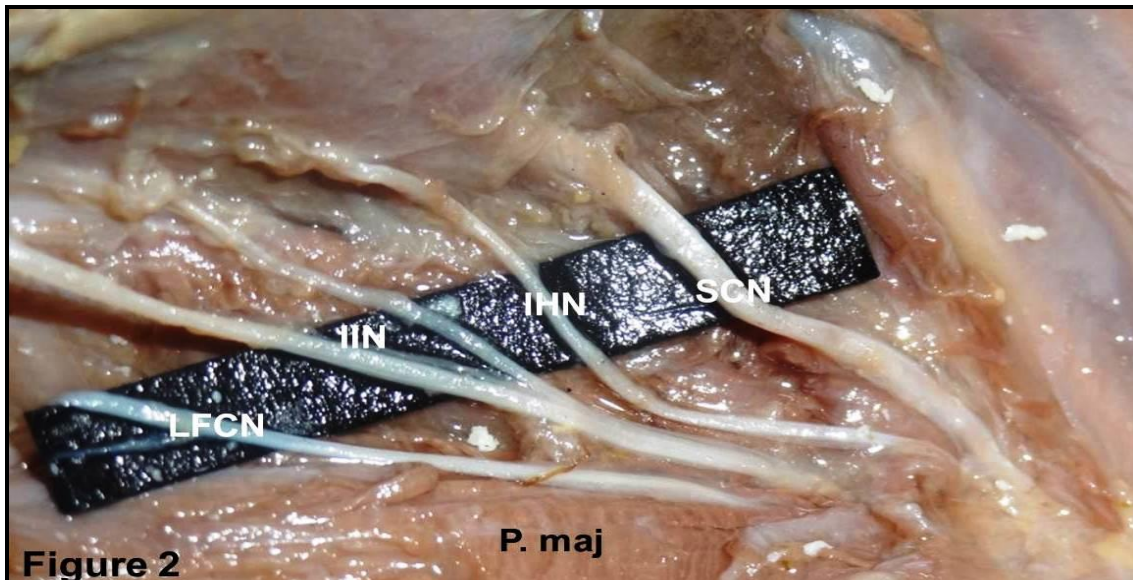


Figure 2. Showing double ilioinguinal nerve (IIN). SCN- Subcostal nerve, IHN- Iliohypogastric nerve, LFCN- Lateral femoral cutaneous nerve, FN- Femoral nerve, ON- Obturator nerve, P. maj- Psoas major muscle.

muscle and in the pelvic cavity united to form a single nerve (Figure 1).

Early separation of the genitofemoral nerve (GFN) was also commonly observed and reported in five cases (Figure3).

Discussion

The lumbar plexus is a network of nerves supplying the lower limb and is located within the substance the psoas major muscle (3). The detailed anatomy of lumbosacral plexus was first described by Longnecker (4), and the variations in its formation and position were then presented by Hollinshead (5).

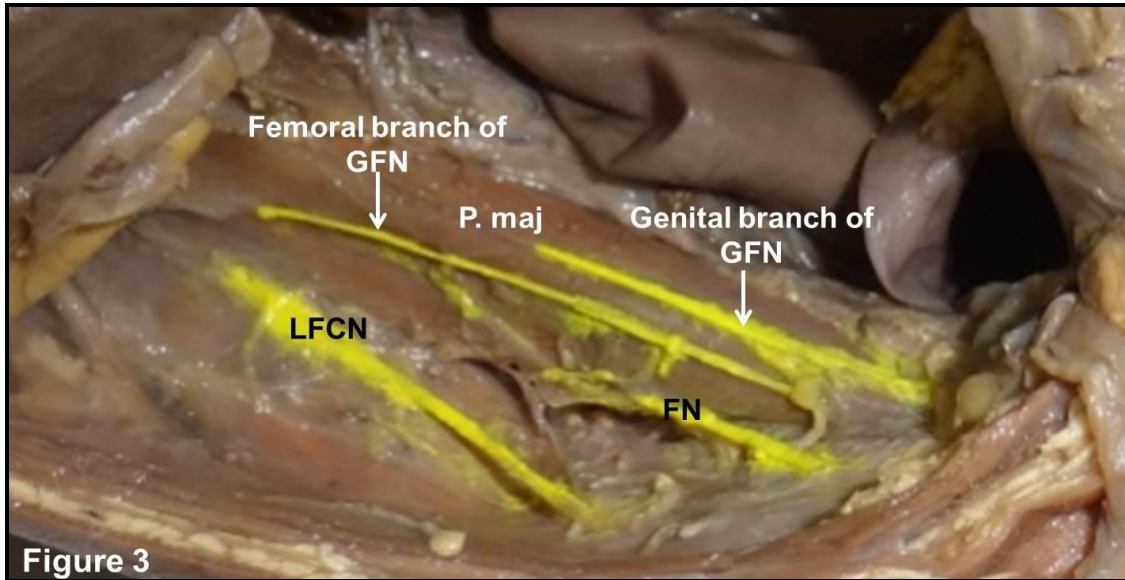


Figure 3. Showing early separation of the genitofemoral nerve (GFN). P. maj- Psoas major muscle, LFCN- Lateral femoral cutaneous nerve, FN- Femoral nerve

Many authors have studied the possible variations of the lumbar plexus and its branches in the adults. Anloague&Hujibregts in their descriptive anatomical study stated the absence of the iliohypogastric nerve (IHN) in 20.6% of the lumbar plexuses. They have also noted that the IHN or IIN nerves may or may not arise from a common trunk or that they may communicate at the iliac crest. If these nerves join at the iliac crest, the IHN is reported to supply the missing IIN branches. The genital branch of the GFN compensating the absence of the IIN is also reported (1). The present study in fetuses also reported the absence of the IIN.

The IIN can also be paired unilaterally as reported by Uzmannel et al. (2). The present study also reported a double IIN. The nerve was initially single close to its origin but later divided into two in the pelvic cavity. The GFN could also be variable. Sim and Webb found that the nerve at times divided into genital and femoral branches prior to its emergence from the psoas major. This was reported in 8.3% of the cases (6). Anloague&Hujibregts reported this high division of the GFN in 26.5% of the cases (1). The present study also reported the same in 10% of the cases in fetuses.

The LFCN usually arises from the posterior divisions of the L2 and L3 roots. However in the study by Anloague&Hujibregts, the LFCN arose from the L1

and L2 nerveroots in 4 plexuses (11.8%) and in one plexus it had its origins solely from the L2 nerve (2.9%)(1). This finding was supported by many authors (6,7). Authors have also reported various other variations like absence of the LFCN (8), bifurcation of the LFCN (1, 8). An anomalous branch from LFCN to femoral nerve and the existence of an accessory LFCN was reported by Uzmannel et al. (2). Dimitropoulos et al in their case report had also mentioned about the aberrant origin of LFCN (9).

However in the present case an anomalous low formation of the LFCN was observed. Both the roots i.e., L1 and L2 were arising separately deep to psoas major muscle and later in the pelvic cavity united to form the LFCN. This finding is rare and is not reported in the available literature.

The variations in the lumbar plexus have clinical implications in Lumbar Plexus Blockade (LPB) during procedures like hip and knee arthroplasties (5), inguinal hernioraphy, obstetric surgeries, appendectomy (10-12), femoral artery angiography (10) and pelvic surgeries (2,11-13).

Postoperatively, several clinical conditions may be encountered such as meralgia paresthetica, groin pain and testicular pain due to the involvement of the LFCN, IIN and the GFN (8,14,15). During the separation of the psoas major muscle during

retroperitoneal endoscopic surgery, injury of the lumbar plexus is a major risk, particularly for the GFN coursing on the muscle (6).

Although we came across literature concerning the variations in lumbar plexus in adults, there is dearth of the same in fetuses, newborns and infants. Therefore, this was a genuine attempt made to study such variations of the lumbar plexus in the fetuses as these could be involved when a surgeon plans for different surgical procedures in children and infants. In conclusion, a better knowledge of the regional anatomy and its variations is essential for preventing from the injury to the branches of the lumbar plexus and thereby avoiding postoperative complications.

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