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Original Research Article

A STUDY OF VARIATIONS IN ILIOHYPOGASTRIC AND ILIOINGUINAL NERVES IN HUMAN ADULTS

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ABSTRACT

Introduction: Lumbar plexus is one of the main nervous pathways supplying the lower limb which is bound to show variations. Surgeons should be aware of these variations to avoid possible injuries to the structure and their consequences. This study was conducted to observe the formation of Iliohypogastric nerve and Ilioinguinal nerve

Material and methods: Dissection of 40 bilateral lumbar plexuses from formalin fixed adult human cadavers procured from department of anatomy JJMMC Davangere.

Results: Many significant variations were found in the anatomy of the iliohypogastric and ilioinguinal nerve.

Conclusion: Knowledge of the variations in the branching pattern and formation of the lumbar plexus is essential to prevent nerve injury during routine surgical procedures like inguinal hernia surgery, low transverse incision of gynecological procedures.

KEY WORDS: Anatomical Variations, Ilioinguinal nerve, Iliohypogastric nerve, lumbar plexus.

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INTRODUCTION

The lumbar plexus is formed by the union of all the ventral rami of the first three lumbar, most of the ventral ramus of the 4th lumbar and the slender branch coming mostly from the 12th thorasic nerve [1]. It is located within the substance of the posterior part of psoas major muscle in front of transverse processes of lumbar vertebrae [2]. The L1-L4 ventral rami initially bifurcate into an anterior and posterior primary division. Both primary divisions then on entering lumbar plexus give rise to six nerves. Within this plexus, the first lumbar nerve divides into a cranial and caudal branch. The cranial branch further divides into the iliohypogastric and ilioinguinal nerves. The anterior divisions of the L2-L4 roots form the obturator nerve [3]. Each of the dorsal rami of L2 and L3 gives rise to several small and big branches of which the smaller ones unite to form the lateral femoral cutaneous nerve (LFCN). The bigger ones unite with the dorsal ramus of the L4 to form the femoral nerve [1].

The lumbar plexus is one of the potential anatomical fields to show variations in a number of ways due to genetic composition. Most of the anatomical variations are benign and are due to the errors of embryological development [4].

The third lumbar root may sometimes give a branch to the furcal nerve and this situation is called a “prefixed plexus”. If the fifth lumbar root participates in the formation of the furcal nerve, the plexus is called a “postfixed plexus” [5].

Table 1: Normal origin and course of Iliohypogastric and ilioinguinal Nerves.

Nerve	Origin (Ventral Rami)	Course and Function
Iliohypogastric	L1	Emerges from the superior aspect of the lateral margin of the psoas major; enters the abdomen posterior to the medial arcuate ligaments and courses inferiolaterally along the anterior surface of the quadratus lumborum, then pierces and innervates the posterior fibers of the transverse abdominis near the iliac crest and traverses through the internal and external oblique abdominis muscle to which it supplies motor branches. Superficial innervation is supplied to the skin of the gluteal region posterior to the lateral cutaneous branch of T12 via a lateral cutaneous branch. The anterior cutaneous branch of the iliohypogastric nerve innervates the skin of the hypogastric region.
Ilioinguinal	L1	Runs caudal to the iliohypogastric nerve; pierces and innervates the transverse abdominis near the anterior part of the iliac crest, communicates with the iliohypogastric, then supplies motor branches to the internal oblique abdominis. Follows the spermatic cord through the superficial inguinal ring and terminates superficially over the proximal and medial aspect of the thigh, the root of the penis and the scrotum, or mons pubis and labia majora.

The purpose of this study was to describe the anatomical variations in the ilioinguinal and iliohypogastric nerve based on study of human cadavers as compared to the above description of normal anatomy. The branches of the lumbar plexus may be injured during certain surgical procedures with subsequent development of clinical conditions mainly meralgia paraesthetica, groin pain and testicular pain in which the lateral femoral cutaneous nerve (LFCN), ilioinguinal nerve (IIN) and the genitofemoral nerves (GFN) are mostly involved [5]. Absence of the iliohypogastric (IHN) nerve may also have implications for the likelihood and presentation of nerve damage in this region during surgical procedures such as inguinal herniotomy [6].

MATERIALS AND METHODS

Dissection of 40 bilateral lumbar plexuses was carried out from formalin fixed adult human cadavers procured from department of anatomy JJMMC Davangere. The cadavers were meticulously dissected and the formation of lumbar plexus and their branching pattern were observed. The findings were noted and tabulated. There were 38 male and 2 female cadavers in our study. Specimens were excluded if there was evidence of surgical intervention involving the abdomen, lumbar spine, or lumbar plexus to rule out iatrogenic anatomical deviations.

Cadaver Dissection: Dissections were performed by removing the anterior abdominal wall from the diaphragm superiorly to the pubic symphysis inferiorly. Abdominal structures including retroperitoneal organs were next removed to expose the posterior abdominal wall in the retroperitoneal space. The Iliohypogastric nerve and Ilioinguinal nerve were identified and isolated bilaterally using blunt dissection from point of emergence at the lateral border of the psoas major muscle.

Data Analysis: Data analysis was limited to descriptive statistics. The prevalence of variation were calculated for both the nerves derived from the lumbar plexus and for all structures combined.

RESULTS

Anatomical variation of Iliohypogastric and Ilioinguinal Nerves are given in terms of percentage of variation and is presented in Table 2.

A total of 40 cadavers were dissected. 25 (62.5%) of iliohypogastric nerve were seen to be arising from L1 (Normal). 15 (37.5%) of iliohypogastric nerve were seen to be arising from T12, L1. 27 (67.5%) of ilioinguinal nerve were arising from L1(Normal). 09 (22.5%) of ilioinguinal nerve were arising from L1, L2. Absence of the ilioinguinal nerve (IIN) was noted in 04 (10%). (Table 2)

Table 2: Variation in the iliohypogastric and ilioinguinal nerve in present study.

Variations	Number of specimens (40)	Percentage
Iliohypogastric nerve arise from L1 (Normal)	25	62.50%
Iliohypogastric nerve arise from T12, L1	15	37.50%
Ilioinguinal nerve arising from L1(Normal)	27	67.50%
Ilioinguinal nerve arising from L1, L2	9	22.50%
Absent ilioinguinal nerve	4	10%

Fig. 1: Iliohypogastric nerve arising from L1.

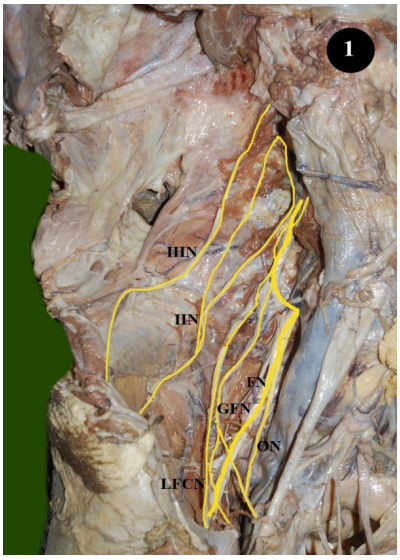


Fig. 2: Iliohypogastric nerve arising from T12 L1.

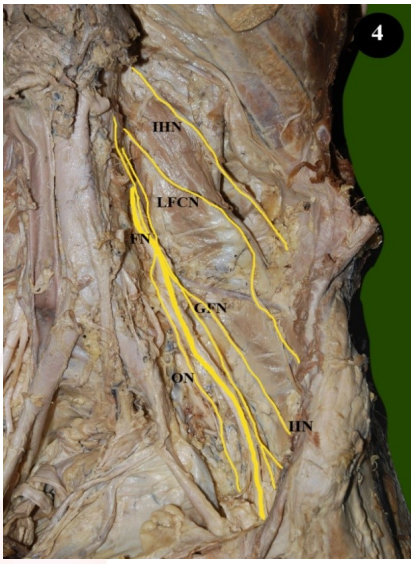


Fig. 3: Ilioinguinal nerve arising from L1.

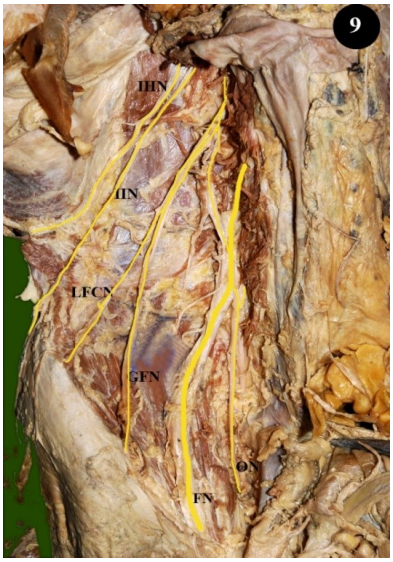


Fig. 4: Ilioinguinal nerve arising from L1, L2.

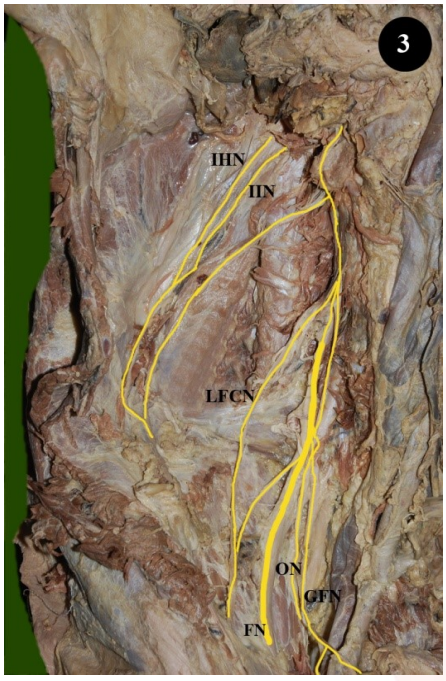
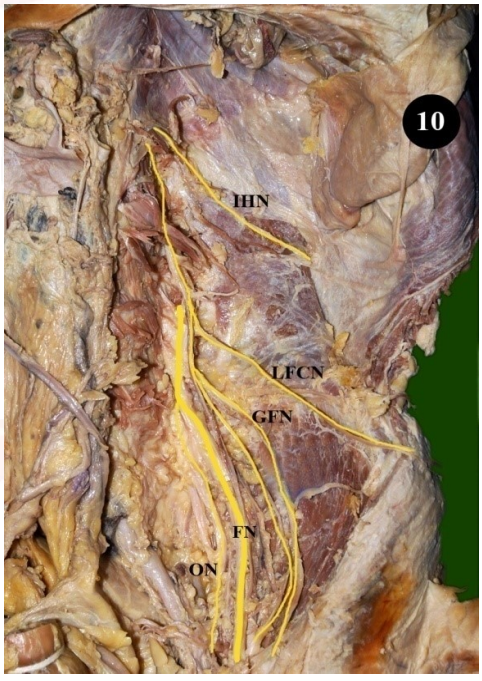


Fig. 5: Ilioinguinal nerve absent.



DISCUSSION

In the present study, Iliohypogastric nerve were seen to be arising from L1 which is expected to be normal in 62.5%, similar findings were observed by Mallikarjun et al [6] (74%), Arora et al [7](78.3%) and Anandhi et al [8] (86%). However, Bardeen et al [9] observed (32%) and Geh et al (47%) [10]. In our study about 37.5% showed variation in origin of iliohypogastric nerve arising from T12, L1. Similar findings were observed by Bardeen et al [9] (34%), Mallikarjun et al [6] (26%) and Anandhi et al [8] (10%). However Arora et al [7] showed very less variation (8.33%). In our study iliohypogastric nerve was seen in all the cadavers and no other variation were observed. Kotian et al [11] showed no variations at all and according to their study iliohypogastric nerve always arised from L1. Anloague & Hujibregts [12], Arora et al [7], Erbil et al [13] and Anandhi et al [8] have reported 20.6%, 13.34%, 20.58%, 2% absent iliohypogastric nerve respectively. Philip et al [3] and Geh N et al [10] have shown 5.8% and 53% cadavers with conjoint IIN and IHN. Anandhi et al [8] observed 2% of cadavers with nerve arising from T12.Gray's Anatomy noted that the iliohypogastric or ilioinguinal nerves may or may not arise from a common trunk or that these nerves may communicate at the iliac crest. In the event that the nerves join at the iliac crest,

Table 3: Variation in origin of Iliohypogastric nerve compared with various studies.

IHN	Bardeen et al[9]	Mallikarjun et al [6]	Philip et al[3]	Kotian et al [11]	Geh et al [10]	Arora D et al [7]	Anandhi et al [8]	Present study
L1	32%	74%	-	100%	47%	78.30%	86%	62.50%
T12,L1	34%	26%	-	-	-	8.33%	10%	37.50%
Absent	-	-	20.60%	-	-	13.34%	2%	-
Conjoint IIN and IHN	-	-	5.80%	-	53%	-	-	-
T12	-	-	-	-	-	-	2%	-

Table 4: Variation in origin of Ilioinguinal nerve compared to various stuties.

IIN	Mallikarjun et al [6]	Kotian et al [13]	Arora et al [7]	Bergman et al [5]	Erbil et al [13]	Anandhi et al [8]	Present study
L1	62%	78%	73.30%	86.50%	51.50%	80%	67.50%
L1, L2	14%	-	1.66%	5.50%	38.30%	8%	22.50%
Absent	20%	8%	14.97%	-	6.60%	-	10%
T12, L1	-	-	8.33%	5.50%	-	8%	-
T12	-	-	-	-	3.50%	-	-
L2	-	-	1.66%	-	-	2%	-
Double IIN	-	2%	-	-	-	2%	-

the iliohypogastric typically is reported to supply the missing ilioinguinal branches. Gray's Anatomy also reported that the ilioinguinal nerve may be absent with compensation via the genital branch of the genitofemoral nerve. Likewise, the genital branch may be absent with the ilioinguinal nerve substituting for it [14]. (Table 3).

In the present study, ilioinguinal nerve (IIN)were seen to be arising from L1 which is expected to be normal in 67.5%. Similar observations were made by Mallikarjun et al [6] (62%), Kotian et al [11] (78%), Arora et al [7] (73.3%), Bergman et al [5] (86.5%), Erbil et al [13] (51.5) and Anandhi et al [8] (80%). In our study 22.5% of cadavers showed ilioinguinal nerve to be arising from L1, L2. Similar observations were seen in Erbil et al [13] (38.3%), Mallikarjun et al [6] (14%), However Arora et al [7] (1.66%), Bergma et al [5] (5.5%) and Anandhi et al [8] (8%) have shown much lesser variation. In our study the nerve was absent in 10% of cadavers. Similar findings were observed by Mallikarjun et al [6] (20%), Kotian et al [11] (8%), Arora et al [7] (14.97%), Erbil et al [13] (6.6%). Some studies have shown other variations like the nerve was seen to arise from T12, L1 as observed by Arora et al [7] (8.33%), Bergman et al [5] (5.5%) and Anandhi et al [8] (8%). Erbil et al [13] have observed it to be arising from T12 alone in 3.5% of cadavers. Arora et al [7] and Anandhi et al [8] have seen it to be arising from L2 in 1.66% and 2% of cadavers respectively. Kotian et al [11] and Anandhi et al [8] have observed double IIN in 2% of cadavers each. The genital branch of the GFN compensating the absence of the IIN is also reported [11]. The IIN can also be paired unilaterally.[1] (Table IV)

These variations are important during various operations. Several clinical conditions may be encountered such as meralgia paresthetica, groin pain and testicular pain in which the LFCN, ilioinguinal and the genitofemoral nerves are mostly involved. Thus, a better knowledge of the regional anatomy and its variations is essential for preventing from the lesions of the branches of the lumbar plexus. Injury to the ilioinguinal and iliohypogastric nerves is likely during the lower abdominal surgical procedures or anterior abdominal wall sections lower to the SIAS.[1]

CONCLUSION

The present study looked at the prevalence of anatomical variations in the iliohypogastric and ilioinguinal nerve. Prevalence of anatomical variation in the individual nerves ranged from 0–38% and includes even absence of the iliohypogastric and ilioinguinal nerves.

Comparison with relevant research literature showed a wide variation of reported prevalence of the anatomical variations. The branches of the lumbar plexus may be injured during lumbar plexus block and certain surgical procedures, particularly in the lower abdominal region (appendectomy, inguinal hernia repair, iliac crest bone graft harvesting and gynecologic

procedures through transverse incisions). Thus, a better knowledge of the regional anatomy and its variations is essential for preventing from the lesions of the branches of the lumbar plexus.

Conflicts of Interests: None

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