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Original Research Article

Spinal Nerve Contributions of the Ilioinguinal Nerve in Sudanese Subjects

Dr. Faiza Abdalla Saeed Khairy[1], Dr. Saadeldin A. Idris[2], Dr. Hozifa Mohammed Ali[3], Rida Elshaykh Babikir[4]
[1]BMS anatomy, Msc in Anatomy, Alzaiem Alazhari University (A.A.U), Sudan
[2]Al Zaeim Al Azhari University, Khartoum, Department of Surgery Disaster Medicine, Emergency Medical Care, Emergency Medicine, Sudan
[3]Orthopedics resident, Teaching Assistant Department of General Surgery, Alzaiem Alazhari University (A.A.U), Sudan
[4]BMS anatomy, Msc in Anatomy Department of Anatomy, Alzaiem Alazhari University (A.A.U), Sudan

***Corresponding author**
Dr. Faiza Abdalla Saeed Khairy
Email: faizakhiery@hotmail.com

Abstract: Proper anesthesia and knowledge of the anatomical location of ilioinguinal nerve is important during hernia repair and other surgical procedures. Surgical complications have also implicated this nerve, emphasizing the importance of the development of a clear topographical map for use in its identification. The aim of this study was to explore anatomical variations in the ilioinguinal nerve and relate this information to clinical situations. The study was conducted in Khartoum state – Sudan on 77 formalin embalmed cadavers which were dissected bilaterally to expose ilioinguinal by transperitoneal approach, in Sudanese male cadavers, age ranging from 24-56yaers. Regarding root origin, the study revealed that the Ilioinguinal nerve has varied root origin from L1, L1-3 and L3 in 151 (98.1%), 2 (1.3%) and 1 (0.6%) dissected cadaver respectively. In the right side 3 cadavers showed that aberrantly rise from either L3 or L1-3 root of origin, whereas, this aberrant observation was not seen in the left side. Of note, in the left side the Ilioinguinal nerve was originated solely from the first lumbar spinal segment. The result of this study will help the surgeons to avoid iatrogenic nerve injury as well as to assess them during lumber plexus block.
Keywords: ilioinguinal nerve, anesthesia, lumber plexus block

INTRODUCTION

The current study will endow with knowledge on the variation in the intra-abdominal course of ilioinguinal nerve which will assist surgeons in avoiding injury to this structure in various abdominal surgeries.

The ilioinguinal nerve originates from ventral ramus of the first lumber spinal segment, and emerges from the lateral aspect of upper part of psoas major muscle just below the iliohypogastric nerve, passes obliquely across quadratus lumborum and the upper part of iliacus and enters transversus abdominis muscle near the anterior end of the iliac crest. It pierces the internal oblique muscle and supplies it and then traverses the inguinal canal. It emerges with the spermatic cord from the superficial inguinal ring to supply the proximal medial skin of the thigh and the skin over the root of the penis and upper part of the scrotum in males, or the skin covering the mons pubis and the adjoining labium majus in females [1].

MATERIALS AND METHODS

A cadaveric study which was conducted in the department of anatomy of several faculties of medicine in Khartoum state-Sudan during the period of May 2015 to August 2017 on 154 inguinal nerves which were embalmed in formalin, cadavers ranging from 24-56 years, dissection performed bilaterally to observe formation, emergence and distributions of the nerve, dissection was completed by anatomist by making a horizontal incision which was made from anterior superior iliac spine (ASIS) on apponeurosis of external oblique muscle to linea alba in midline and from this point vertically down to pubic symphysis. The triangular flap of external oblique apponeurosis was reflected laterally and inferiorly to expose

inguinal ligament, inguinal canal with its contents. The nerve was exposed through anterior approach after removal of peritoneum and abdominal viscera. The nerve has been identified on the lateral border of psoas major muscle. The muscles of the posterior abdominal wall were exposed by removing their fascial coverings and the psoas major muscle was detached from the intervertebral discs and vertebral bodies, the removal of psoas from the transverse processes of the lumbar vertebrae was carefully completed, disentangling the ventral rami of the nerve from its substance, the nerve and its branches was exposed. All possible formation of the nerve was photographed. The observations so made were recorded and compared with standard texts as well as with accessible literature.

RESULTS

The patterns of origin of ilioinguinal nerve were classified according to spinal nerve contributions. The ilioinguinal nerve arose solely from the lumbar plexus in 100% of the cases.

Regarding root origin, the study revealed that the Ilioinguinal nerve has varied root origin from L1, L1-3 and L3 in 151 (98.1%), 2 (1.3%) and 1 (0.6%) dissected cadaver respectively. In the right side 3 cadavers showed that aberrantly rise from either L3 or L1-3 root of origin, whereas, this aberrant observation was not seen in the left side. Of note, in the left side the Ilioinguinal nerve was originated solely from the first lumbar spinal segment. In spite this observational difference, it did not reach the level of statistical significance as p= 0.217 (Table 1 and figure 1).

Among of the group where the Ilioinguinal nerve originated from L1 (151 (98.1%)); either it might arise individually or in a common trunk with Iliohypogastric nerve as it was prevalent in 142/151 (94.04%) and 9/151 (5.96%) respectively, (Figures 2, 3, 4).

When it originates in a common trunk with iliohypogastric the trunk divides at the lateral border of psoas muscle in to superior ilioihypogastric and inferior ilioinguinal nerves, both nerves running parallel to each other on the anterior surface of quadrates lumbraum muscle.

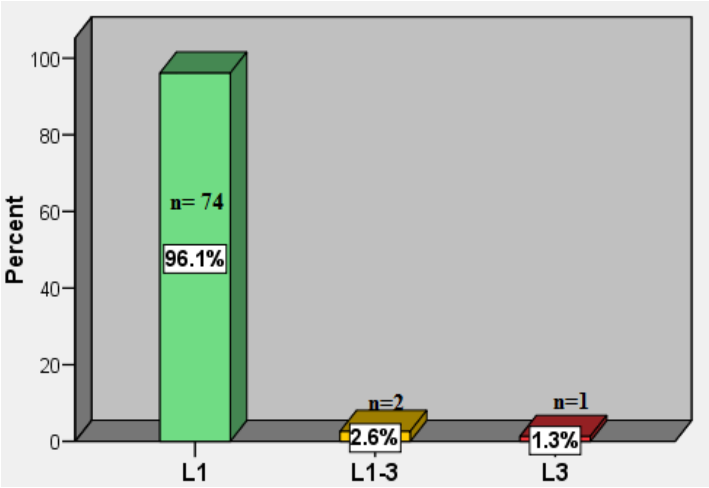

Fig-1: The root origin of the Ilioinguinal nerve in the right side of the studied cadavers (n=77)

In one case of the common origin of both nerves on the left side, the trunk passed in the groove between psoas and quadrates lumborum muscles, then the trunk is divided in to two branches in this groove, after reflection of quadrates muscle carefully upward and extend laterally, the nerves were found passing deep to the medial border of quadrates lumborum muscle (Figure5).

When the nerves appear in a separate origin they were found on the lateral border of posas muscle parallel to each other on the anterior surface of quadrates lumborum muscle (Figure 4).

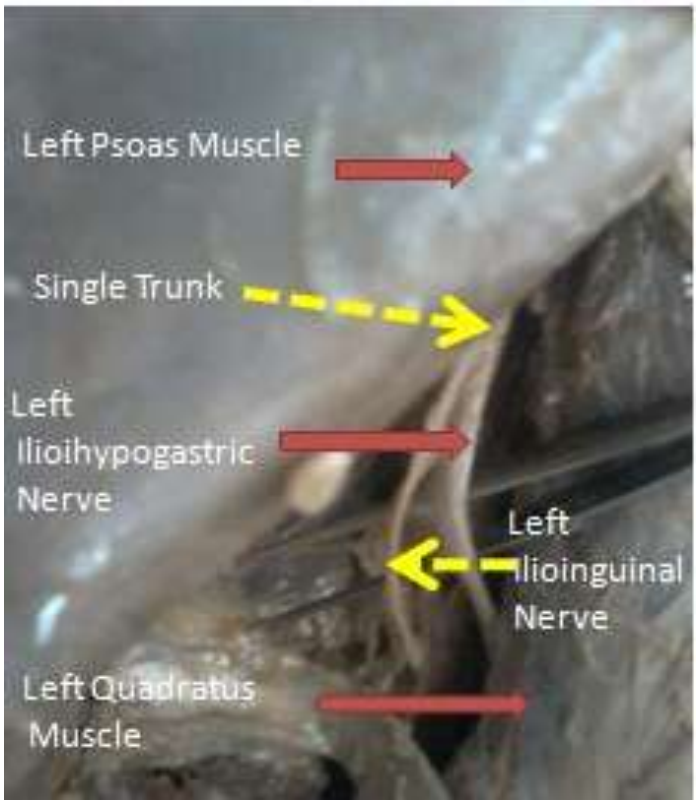

Fig-2: Origin of the left Ilioinguinal and Iliohypogastric nerves as a common trunk from first lumbar spinal segment

When the Ilioinguinal nerve originated from L1- L3; in this type of origin a common trunk from the first, second, and third lumbar ventral lumbar spinal segments was a rise on the right sides of two cadavers (1.3%), this trunk divided on the lateral border of psoas muscle into ilioohypogtric, ilioinguinal, and lateral cutaneous nerves of thigh (Fig 6, 7).

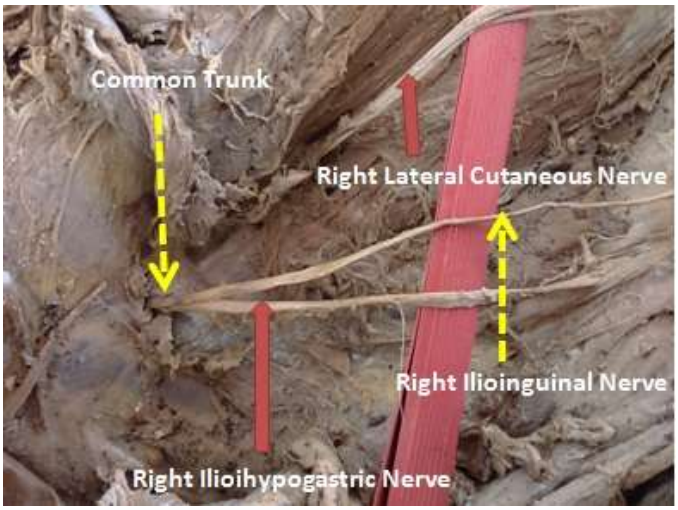

Fig-3: Right common Ilioinguinal and Iliohypogastric nerves from the first lumbar spinal segment

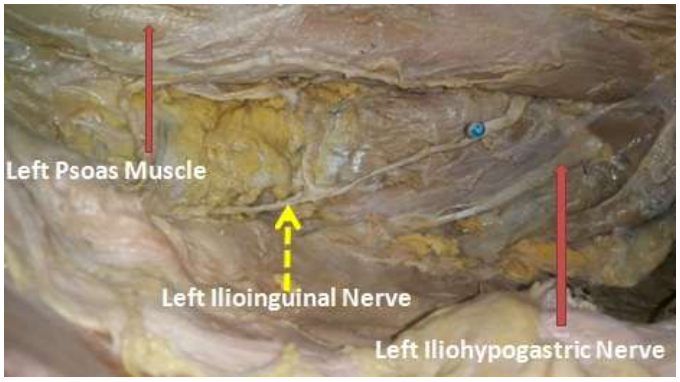

Fig-4: Separate origin of the left Ilioinguinal and Iliohypogastric nerves from the first lumbar spinal segment

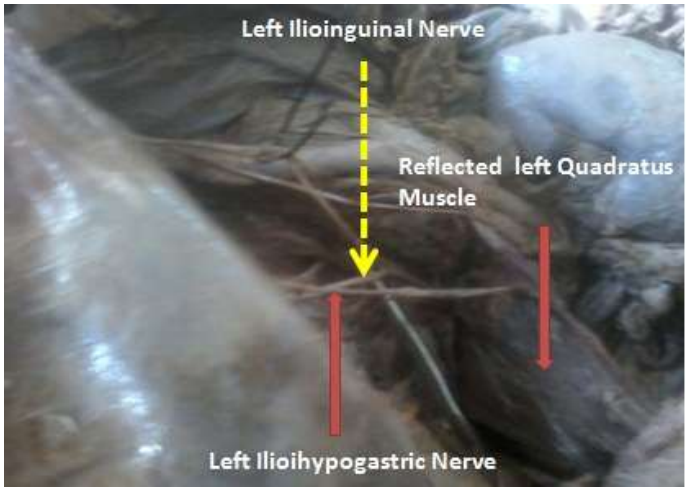

Fig-5: Left Ilioinguinal and Iliohypogastric nerves deep to quadratus lumborum muscle

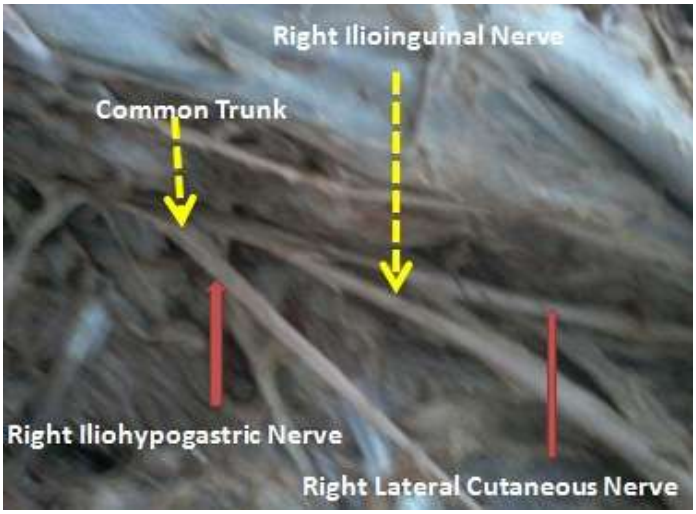

Fig-6: Right common trunk from first, second, and third lumbar spinal segments, giving origin to Ilioinguinal, Iliohypogastric, and lateral femoral cutaneous nerve

On other hands, where the Ilioinguinal nerve originated from L3; this type of origin was observed in one cadaver (0.6%) on the right side (Figure 8).

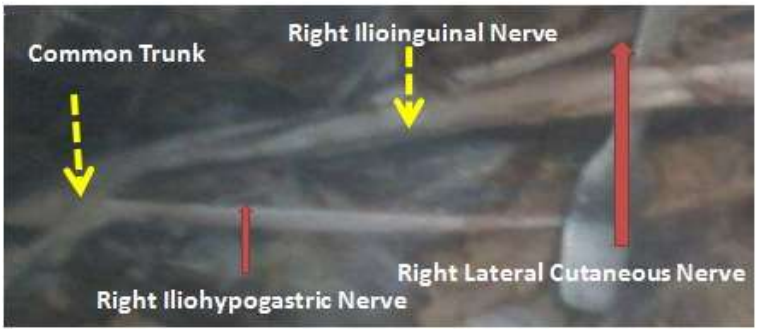

Fig-7: Right common trunk from first, second, and third lumbar spinal segments, giving origin to Ilioinguinal, Iliohypogastric, and lateral femoral cutaneous nerve

Table 1: The root origin of the Ilioinguinal nerve in the right side versus left side among study group (n=154)

The side	**Root origin**			**Total**	**P value**
	L1	L3	L1-3		
Right	74 (48.1%)	1 (0.6%)	2 (1.3%)	77 (50.0%)	
Left	77 (50.0%)	0	0	77 (50.0%)	***0.217***
Total	**151 (98.1%)**	**1 (0.6%)**	**2 (1.3%)**	**154 (100%)**	

Fig-8: Right Ilioinguinal nerve originates from third lumbar spinal segment

DISCUSSION

An extant search of literature revealed several anatomical variations in the lumbar plexus. Six peripheral branches were described in various studies. The lumbar plexus lay within the substance of the psoas major muscle [2-4]. The lumbar plexus

plays an important role in regional anesthesia, especially in sacroiliac and pelvic region surgery. Lumbar plexus block is a useful technique, especially in the management of chronic pain and in the provision of surgical analgesia for adults and children [5]. The origin of the iliohypogastric and ilioinguinal nerves significantly differs from the description in standard anatomical texts [6].

It has been previously stated that the iliohypogastric and ilioinguinal nerves are derived from L1 and occasionally from T12 [2, 6, 8].

The best known classification of ilioinguinal nerve root origin is by Ronald A. Bergman *et al* [7]. Ten types of origin of the nerve were distinguished depending on its origin from the lumbar plexus and formation:-

Type 1: Directly from ventral ramus of T12.
Type 2: A united loop formed by ventral rami of T12 & L1.
Type 3: From both ventral rami of T12 & L1.
Type 4: Directly from ventral ramus of L1.
Type 5: From a common trunk from L1 which was divided into ilioinguinal and iliohypogastric nerves.
Type 6: A united loop formed by ventral rami of L1 & L2.
Type 7: From both ventral rami of L1 & L2.
Type 8: Directly from ventral ramus of L2.
Type 9: From both ventral rami of L1 & L2.
Type 10: From both ventral rami of L2 & L3.

Klaassen Z *et al* [6] studied 100 cadavers and reported that the ilioinguinal nerve originates from twelfth thoracic and first lumbar spinal segments in 28 specimens (14%), and Ronald A. Bergman *et al* [7] reported that the ilioinguinal nerve originates from twelfth thoracic and first lumbar spinal segments in (11%) of cases out of 200 formalin embalmed cadavers, also Pawaree Nontasaen *et al* [8] reported that the ilioinguinal nerve originates from twelfth thoracic and first lumbar spinal segments in (3.8%) out of the 68 cadavers, while the result of the current study shows no contribution of the twelfth thoracic spinal segment in the formation of our nerve.

Ronald A. Bergman et al [7] and Klaassen Z et al [6] proposed the origin of the nerve from the first lumber spinal segment in (86.5%) & (65%) % respectively.

Kusum R. Gandhi *et al* [9] studied 60 ilioinguinal nerves and reported the origin of the nerve from the first lumber spinal segment in (88.33%), the result of the current study shows that the nerve originates from the first lumbar spinal segment in (98.1%).

PhiliP A. Anloague *et al* [10], Klaassen Z *et al*, [6] and Kusum R. Gandhi [9] were reported that the iliohypogastric and ilioinguinal nerves originates from the first lumbar spinal segment as single trunk in (10.5%), (20%), and (11.66%), respectively.

Assane Ndiaye [11] studied 100 ilioinguinal nerves and reported the origin of the common trunk with the iliohypogastric nerve in (14%) of cases.

In our study the nerve originates in common with iliohypogastric nerve in (1.3%) of cases. Ronald A. Bergman *et al* [7] and Dr. J Jayarani *et al* [12], reported the origin of the nerve from ventral ramus of the third lumbar spinal segment in (0.5%) and (2%) respectively.

In our study the nerve originates from ventral ramus of the third lumbar spinal segment in (0.6%). In our study the nerve originates in common with iliohypogastric and lateral cutaneous nerves from a single trunk which attached to the ventral rami of the first, second, and third lumber spinal segments in (1.3%) of cases. According to our knowledge there's no literature reporting this type of root origin.

CONCLUSION

The lumber plexus is composed of complex and variable structures interrelated to their surroundings and any injury to them may also involve the surrounding structures. The present study revealed basic anatomical knowledge concerning the origin and variation in the branches of lumber plexus. The results of the study may be beneficial for clinicians treating patients with lumbar plexopathies and anesthesiologists performing successful block in the lumber plexus.

Regardless of the favored technique, the origin of fibers comprising the ilioinguinal nerve is important for spinal anesthesia. Furthermore, the anatomical route followed by the nerve is important for proper administration of local anesthetic.

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