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Research article

VARIATIONS OF LUMBAR PLEXUS IN 30 ADULT HUMAN CADAVERS- A UNILATERAL PREFIXED PLEXUS

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ABSTRACT: Looking to the applied significance of lumbar plexus in the form of its involvement in various injuries and entrapment, it is imperative to have a thorough knowledge about its formation, branching pattern and variations. A recent increase in the retroperitoneal laparoscopic surgeries inspired us to revisit the anatomy of lumbar plexus. The purpose of this study was to describe the anatomical variations in the lumbar plexus. Comparing our findings to anatomical variations described elsewhere in the literature, we have also suggested possible clinical implications with regard to diagnosis of anatomical variations of the lumbar plexus. The study was conducted on 30 formalin embalmed cadavers in the Department of Anatomy, Govt. Medical College, Patiala. Following the removal of abdominal viscera and peritoneum, the lumbar plexus was approached by an anterior approach. The branches were identified and any variations were recorded and photographs were taken. An unusual pattern of lumbar plexus was observed in a male case. On the left side, the plexus was prefixed as there was a contribution from T12. Iliohypogastric and Ilioinguinal nerves were seen arising from T12 and L1. Three loops in the form of continuous trunks were formed from ventral rami of T12 to L3 nerves. The Genitofemoral nerve was seen arising from second loop whereas the Lateral femoral cutaneous nerve was seen arising from the third loop. Ultimately the whole trunk divided into obturator and femoral nerves. On the right side, the Ilioinguinal nerve originated from L2. Genitofemoral nerve was seen arising from ventral ramus of L2 and L3. The well-protected structure and safe location give the plexus more security. Lumbar plexopathies are therefore less common peripheral nerve lesions affecting the lower extremities. Knowledge of the anatomy of the lumbar plexus is essential for the surgeon who wishes to perform a surgical intervention to this plexus
Key Words: Lumbar plexus, Femoral nerve, Obturator nerve, Prefixed, Ilioinguinal nerve
Abbreviations: iig- Ilioinguinal nerve, ihg-Iliohypogastric nerve, gf-Genitofemoral nerve, on-Obturator nerve, fn-Femoral nerve, lfcn-Lateral femoral cutaneous nerve

INTRODUCTION

The branches of the lumbar plexus may be injured during certain surgical procedures, particularly in the lower abdominal region (appendectomy, inguinal hernia repair, iliac crest bone graft harvesting and gynecologic procedures through transverse incision). After such operations, several clinical conditions may be encountered such as meralgia paraesthetica, groin pain and testicular pain in which the Lateral femoral cutaneous nerve, 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.

Awareness of the possibility of encountering multiple variations at once may prevent from having postoperational complications [1]. The lumbar plexus is one of the potential anatomical fields to show variations in many ways. The posterior abdominal wall contains the origin of lumbar plexus and numerous autonomic plexuses and ganglia, which lie close to the abdominal aorta and its branches. The lumbar plexus originates from the ventral rami of the L1-L4 nerve roots and projects laterally and caudally from the intervertebral foramina, posterior to the psoas major muscle. A communicating branch from the T12, also known as the subcostal nerve, often joins the first lumbar nerve. Of the main branches, the iliohypogastric nerve(L1), ilioinguinal nerve(L1), lateral femoral cutaneous nerve(L2-3,dorsal), and femoral(L2-4,dorsal) appear in that order from above downwards, at the lateral border of psoas major muscle , the genitofemoral nerve(L1-2) appears on the anterior surface , and the obturator nerve(L2-4,ventral) appears along the medial border of that muscle. The same is the position of accessory obturator nerve, if present. The pattern of formation of lumbar plexus is altered if the plexus is prefixed or postfixed, that is, the fiber contribution is moved cranially or caudally, respectively.

MATERIALS AND METHODS

The study was conducted in the Department of Anatomy, Govt. Medical College, Patiala. The abdomen of 30 adult human cadavers comprised the material for this study. The cadavers were labelled from 1- 30. Both the sides of the abdomen were dissected to compare the morphology of the lumbar plexus. The muscles of the posterior abdominal wall were exposed by removing their fascial coverings. While doing so, injury to the vessels and nerves related to the muscles was avoided. The psoas major muscle was detached from the intervertebral discs and vertebral bodies. The genitofemoral nerve on the anterior surface of psoas was traced through that muscle to the lumbar nerves. The removal of psoas from the transverse processes of the lumbar vertebrae was carefully completed, disentangling the ventral rami of the lumbar nerves from its substance. The nerves and their branches were exposed.

All the formation of the lumbar plexus was photographed and sketches were drawn. The observations so made were recorded and compared with standard texts as well as with accessible literature.

RESULTS

In 2 out of 60 lumbar plexuses dissected, an unusual pattern of lumbar plexus was observed. On the left side, the plexus was prefixed as there was a contribution from T12 and the nerves were forming loops as shown in figure 1. T12 joined L1 and gave out Iliohypogastric nerve. L1 after joining with T12 divided into 2 branches- Ilioinguinal nerve and the other one further divided into Genitofemoral nerve and a branch which completed the loop with L2. L2 gave rise to Lateral femoral cutaneous nerve and then joined with L3 forming a trunk which divided into obturator and femoral nerves. So,Iliohypogastric and Ilioinguinal nerves were seen arising from T12 and L1. The Genitofemoral nerve was seen arising from L1 and there may be a contribution from T12 whereas it is difficult to comment morphologically any contribution from L2.

Figure-1; T12 joined L1 and gave out Iliohypogastric nerve. L1 after joining with T12 divided into 2 branches- Ilioinguinal nerve and the other one further divided into Genitofemoral nerve and a branch which completed the loop with L2. L2 gave rise to Lateral femoral cutaneous nerve and then joined with L3 forming a trunk which divided into obturator and femoral nerves.

Lateral femoral cutaneous nerve contained the fibres from L2 and preceeding segments but it is difficult to comment any contribution from L3. Ultimately the whole trunk divided into obturator and femoral nerves. So it is presumed that both the nerves contained fibres from T12 to L3. On the right side (figure 2) the plexus was not prefixed but variations were seen. The morphological root value of Iliohypogastric nerve was L1 but there was no contribution of L1 to Ilioinguinal nerve which originated from L2 alone. L2 divided into Ilioinguinal nerve and after giving Lateral femoral cutaneous nerve joined with L3. The loop formed between L3 and L4 gave rise to Genitofemoral nerve and Obturator nerve and femoral nerve

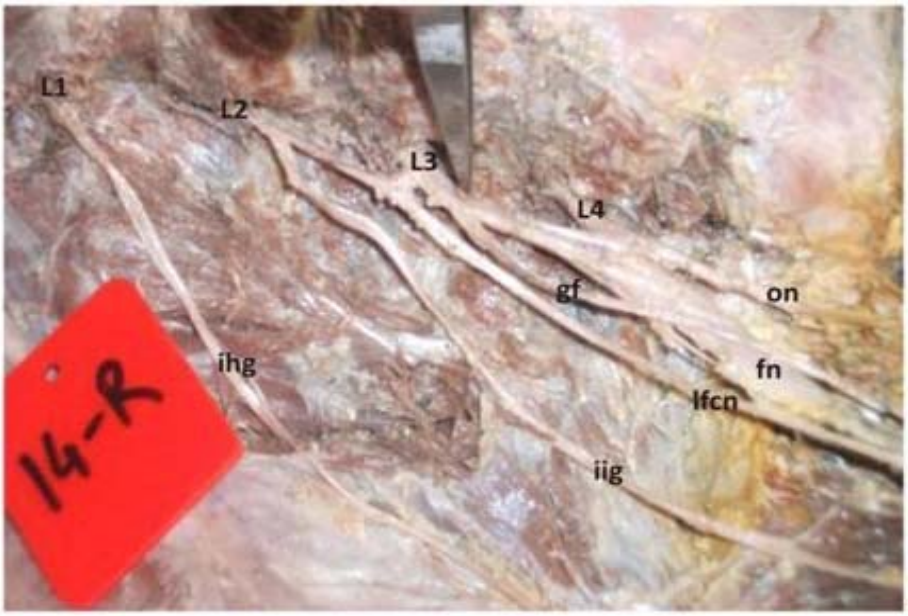

Figure-2: Iliohypogastric nerve arose from L1 but there was no contribution of L1 to Ilioinguinal nerve which originated from L2 alone. L2 divided into Ilioinguinal nerve and after giving Lateral femoral cutaneous nerve joined with L3. The loop formed between L3 and L4 gave rise to Genitofemoral nerve and Obturator nerve and femoral nerve.

DISCUSSION

Variations are principally due to the variable genetic composition, which is an inheritance carried over from an ancestral origin. Most of the anatomical variations are benign. These variations are due to the errors of embryological development.

In our present study, Genitofemoral nerve originated from L2 and L3 in 1(1.67%) and T12 and L1 in 1(1.67%) out of 60 lumbar plexuses. Bergman [2] stated that the Genitofemoral nerve arose as a single root in 80% and as a double root in 20%, of the cases. He also claimed that these roots may originate from L1 and L2, or L2 and L3.

Bardeen and Elting [3] found a contribution from the first lumbar nerve to the femoral nerve in 60 per cent of the plexuses that they classified as prefixed. Erbil et al [4] described a complex bilateral variation in the formation of lumbar plexus in a 32 year old male cadaver. On the left side the plexus was postfixed and located posterior to the psoas major muscle. The femoral nerve was formed by the union of anterior rami of the second, third, fourth and fifth lumbar spinal nerves. On the right side, the lumbar plexus was prefixed. The femoral nerve was formed by branches from the first, second, third and fourth lumbar spinal nerves. Similarly in our study, the plexus was prefixed on the left side and the femoral nerve was seen originating from T12, L1, L2 and L3 in 1(1.67%) whereas it had its normal origin, that is from L2, L3 and L4) in 18(30%) out of 60 lumbar plexuses.

The lumbar plexus may be as high as the 11th thoracic ventral ramus (prefixed variety) or as low as the first lumbar (post fixed variety). Extreme cases like nervus furcalis with L3, L4 (pre fixed) or L5 (post fixed); obturator with L1, 2,3 (pre fixed) or L2, 3,4,5 (post fixed) and femoral with T12, L1, L2 (pre fixed) or L2, 3,4,5 (post fixed) have been observed. The commonest variation is towards the post fixed variety and some evidence exists that vertebral anomalies are often associated [5].

Sim and Webb [6] reported that in 22 (36.7%) of 60 plexuses, the lateral femoral cutaneous nerve arose from the first two lumbar nerves; in one plexus (1.7%), the nerve arose solely from the second lumbar ventral ramus and in 6 plexuses (10%), it arose directly from the femoral nerve, making for a total of 48.3% variation for the lateral femoral cutaneous nerve. De Ridder et al [7] reported that in 24 of 200 cadavers, the lateral femoral cutaneous nerve arose from the L1 and L2, and even solely from the second or third lumbar nerve. In the present study, the nerve arose from L2, L3 in 33 (55%) and T12, L1 and L2 in 1(1.67%) out of 60 lumbar plexuses.

Bardeen and Elting[3] found that when the plexus was prefixed, the obturator nerve usually also received fibres from L1, and when it was postfixed, it usually received fibres from L5. Horwitz[8] said that in his series of 228 plexuses, the Obturator nerve arose from the third and fourth lumbar nerves in 175, and from the second through the fourth lumbars in only 23; in the remainder it arose from the first through the fourth lumbars twice, from third through fifth 10 times, from the third alone 3 times, from the fourth alone 12 times, and from fourth and fifth 3 times. In the present study, the obturator nerve originated from L2,3,4 in 20(33.3%) and from T12,L1,L2,L3 in 1(1.67%) out of 60 lumbar plexuses.

Three loops in the form of continuous trunks were formed from ventral rami of T12 to L3 nerves on the left side in our study. Schmidt [9] also described the plexus of Martin and Gunther, which he found in seven bodies. In one of the two plexuses, a considerable branch came from the union of communicating loops of the first three lumbar nerves before the third joins the fourth, and lower down united with the Anterior Crural.

CONCLUSION

So the overall conclusion of the study is that prefixed lumbar plexuses are rare but can be seen. Other variations are also seen in the origin of the nerves of llumbar plexus. The branches of the lumbar plexus may be injured during 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.

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