

Original Article

A cadaveric study of the anatomical variations of the lumbar plexus with clinical implications



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ABSTRACT

Introduction: The main objective was to study the normal and abnormal lumbar plexus.

Material and methods: We analyzed 131 lumbar plexuses from 68 embalmed cadavers at the Cadaveric Surgical Training Center, Faculty of Medicine, Chiang Mai University in the period between April 2012 and June 2013. Morphometric measurements were taken.

Results: The lumbar plexus was located within psoas major muscle (100.0%). The iliohypogastric nerve originated from the ventral rami of L₁ (96.5%) followed by the ilioinguinal nerve (90.1%). The genitofemoral nerves originated from the ventral rami of L₁ and L₂ (98.5%). The lateral femoral cutaneous nerves (LFCN) originated from the ventral rami of L₂ and L₃ (84.0%). The femoral and obturator nerves originated from ventral rami of L₂–L₃–L₄ (100.0%). The distance between the origin of LFCN to L₃ transverse process was at an average 1.96 ± 0.67 cm. The distance from nerve to L₄ transverse process was above L₃ and between L₃ and L₄ transverse process at an average 2.8 ± 1.63 cm. The distance between femoral nerve to L₃ and L₄ transverse process was inferior to L₄ transverse process at an average of 5.13 ± 2.18 cm and 2.53 ± 2.26 cm, respectively. The distance between obturator nerve to L₃ and L₄ transverse process was found inferior to L₄ transverse process at an average 5.42 ± 1.73 cm and 2.75 ± 1.75 cm, respectively.

Discussion: The knowledge of anatomical variations of LP may be important for administration of local anaesthetic agents and avoid any inadvertent injuries.

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1. Introduction

Lumbar plexus (LP) is formed by the ventral rami of the spinal nerves level L₁–L₄ and related to the psoas major muscles. The nerves that emerge from the spinal cord divide into anterior and posterior divisions and unite forming six branches of lumbar plexus i.e. iliohypogastric, ilioinguinal, genitofemoral, lateral femoral cutaneous, femoral and obturator nerves.^{1–3} The LP is located on the posterior abdominal wall. The LP is very complex and often varied.

Variations of the origin and branches of the LP bear immense clinical importance. Lesions of the lumbar plexus are most

commonly iatrogenic but maybe due to birth trauma, hematoma, entrapment in fibrous or muscular bands, tumors (both intrinsic and extrinsic), or wounds such as those incurred by a sharp object or gunshot.⁴ Lumbar plexopathies are therefore less common peripheral nerve lesion affecting the lower extremities groin region and abdominal wall muscle.^{2,5} Compression syndrome of the femoral nerve is termed as neuralgia paresthetica.⁶ Furthermore, the anatomical knowledge of LP may help anesthesiologists to know the exact location of the nerves and its branches and this may result in better treatment. Understanding normal anatomy of lumbar plexus is also important for administration of local anesthetic agents especially during sacroiliac and groin surgery. The local anesthetic drug is administered to LP nerve group (i.e. lumbar plexus block).^{7,8}

It is used in treating children and adults who experience chronic groin pain. Performing LP block is uncommon in lower extremity surgery because it is a difficult technique with a high risk. The

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difficulty in performing such nerve block is attributed to the fact that the nerves in this area are separated unlike performing spinal block or epidural block which is much easier. On the other hand, this kind of nerve block is less risky than performing spinal block and epidural block. This method has lower risk as it does not affect the patient's blood pressure and patient may experience numbness only in the operated leg.

Administration of local anesthetic may be a failure in the presence of anomalous LP and its branches. Anloague and Huijbregts studied variations in the anatomy of lumbar plexus and its clinical importance.³ It was found that iliohypogastric and ilioinguinal nerves were formed from spinal nerve L₁. On few occasions, iliohypogastric nerve may be absent but only ilioinguinal nerve may be found.^{3,9}

Genitofemoral nerve may divide into genital and femoral branches in the psoas major muscle before emerging out at the anterior border of this muscle.¹⁰ Lateral femoral cutaneous nerve may divide into two branches before passing deep to inguinal ligament or received communicating branch from femoral nerve instead.^{11,12}

Femoral nerve was observed to separate into superior and inferior branches before traversing inferior to the inguinal ligament.^{13,14} The knowledge of origin and variations of the lumbar plexus may be important for anatomists, anesthetists, and surgeons to avoid iatrogenic lumbar plexus injury.

The present study aimed to dissect, identify and describe the anatomical variations in the lumbar plexus with respect to their origin and its branches and we firmly believe that it would be beneficial to neurologists, anesthesiologists and clinicians for proper diagnosis and treatment.

2. Materials and methods

2.1. Cadaveric specimens

The cadavers were obtained from the Cadaveric Surgical Training Center, Faculty of Medicine, Chiang Mai University in

the period between April 2012 and June 2013. Prior ethical approval was sought from institutional ethical committee. The study was carried out on 131 lumbar plexuses from 68 embalmed cadavers of known sex and age at the time of decease and without any pathology and abnormality of abdomen. The age of the cadavers ranged from 38 to 85 years. No specimen with any pathology and abnormality of abdomen and posterior abdominal wall was included.

2.2. Dissection procedure

The posterior abdominal wall and its structures were carefully dissected in the cadavers. Psoas major muscle was exposed in order to study the anatomical location of LP, trace their branches and note their relationship to the lateral femoral cutaneous (LFCN), femoral and obturator nerves.

2.3. Morphometric measurements

Morphometric measurements were taken for distance between the three branches and transverse processes of L₃ to L₄ vertebrae. A Vernier caliper was used (Fig. 1). Two independent observers took the measurements in order to avoid any bias and error.

2.4. Statistical analysis

We evaluated the data by using descriptive statistical analysis using Chi-square test.

3. Results

The study was carried out on LP spinal nerve roots from 68 cadavers; with 131 lumbar plexuses available (5 cadavers had 1 lumbar plexus for this study). The details of the 6 branches of lumbar plexuses were shown in Table 1. Eighty-three iliohypogastric nerves (96.5%) were composed of root L₁ with three nerves of T₁₂ uniting with L₁ (3.5%). The sensory area was supplied by

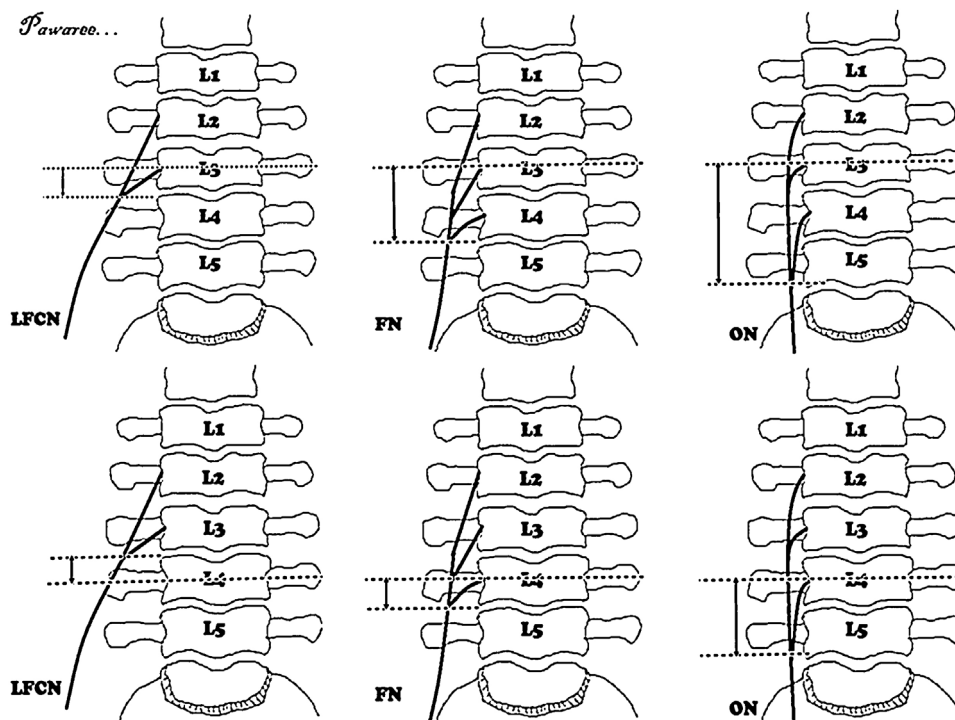


Fig. 1. Measurement of the distance between lateral femoral cutaneous, femoral and obturator nerve with the transverse process of L₃ and L₄ vertebrae.

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