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INTRODUCTION

In recent years there has been a growing interest in the practice of regional anesthesia. A broad spectrum of techniques (both single injection and continuous catheter techniques) allow anesthesiologists to facilitate most surgical procedures with regional anesthesia alone or in combination with general anesthesia ***(Brull et al., 2007).***

Peripheral nerve blocks have been found to be superior to general anesthesia as they provide effective analgesia with few side effects and can hasten patient recovery. Unfortunately, the practice of regional anesthesia does not enjoy widespread endorsement because of inconsistent success, varying from one anesthesiologist to another ***(Hopkins, 2007).***

Current methods of nerve localization (e.g., paresthesia and nerve stimulation) are essentially "blind" procedures, since they both rely on indirect evidence of needle-to-nerve contact. Seeking nerves by trial and error and random needle movement can cause complications. Although uncommon, complications such as intravascular local anesthetic injection resulting in systemic toxicity, inadvertent spinal cord injury following interscalene block, pneumothorax following supraclavicular block, and nerve injury have all been reported ***(Jeng et al., 2010).***

Imaging guidance for nerve localization holds the promise of improving block success and decreasing complications. Among imaging modalities currently available, ultrasonography seems to be the one most suitable for regional anesthesia. Perhaps the most significant advantage of ultrasound technology is the ability to provide anatomic examination of the area of interest in real-time. Ultrasound imaging allows one to visualize neural structures (plexus and peripheral nerves) and the surrounding structures (e.g., blood vessels and pleura), navigate the needle toward the target nerves, and visualize the pattern of local anesthetic spread ***(Hopkin et. al., 2008)***.

Aim of the Work

This study reviews the current evidence for the claimed benefits, techniques & complications of ultrasound-guided nerve block in lower limbs.

Chapter (1): Anatomy

Anatomy of the lumbar plexus

The lumbar plexus is an anastomostic complex formed by the anterior roots from L1 to L3 (lumbar), and the greater part of L4 (fig.1-1). It has a triangular form, with its base resting against the lumbar rachis and its apex formed by the union of the third roots with the ascendant rami of the fourth. There is frequent anastomosis between the upper part of the plexus with the subcostal nerve and between the L4 rami and the lumbosacral trunk ***(Aida et al., 1996).***

In the majority of cases, the fourth roots give rise to fibers for the three main trunks of the lower limb: the femoral, obturator, and the sciatic nerves (lumbosacral trunk) ***(Farny et al., 1994).***

The lumbar plexus lies anterior to the transverse processes between the two parts of the psoas muscle. All branches of the lumbar plexus emerge from the psoas muscle and all leave the pelvis. Near the vertebral body the psoas muscle divided into two planes: a superficial plane that arises from the lateral faces of the vertebral bodies from T12-L4 and a deep plane arising from the transverse process of L1-L5. Within these two planes lie the trunks of the lumbar plexus and the ascending lumbar vein. In addition, the lumbar arteries, which supply the psoas muscle, provide branches for the plexus. The two parts of the muscle fuse to form the psoas major ***(Capdevila et al., 2002).***

Besides two small branches for the quadratus lumborum and the psoas muscles, six branches originate from the lumbar plexus. They are classified either as collateral or terminal branches (tab. 1-1) ***(Rohen et al., 2002).***

Iliohypogastric Nerve (L1)

The iliohypogastric nerve emerges at the level of the psoas muscle and runs down and laterally along the anterior face of the quadratus lumborum muscle. Close to the iliac crest, it runs between the transversus abdominis and the oblique muscles. It leaves a lateral branch for the antero-superior part of the buttock, supplying the skin as far as the greater trochanter. The nerve divides into two branches ; an abdominal branch,which supplies the muscles and skin of the inferior part of the abdomen, and an inguinal branch, supplying the skin of the pubis and the scrotum (men) or labium majus (women).The inguinal branch perforates the internal oblique muscle and then runs between the oblique muscles ***(Rohen et al., 2002).***

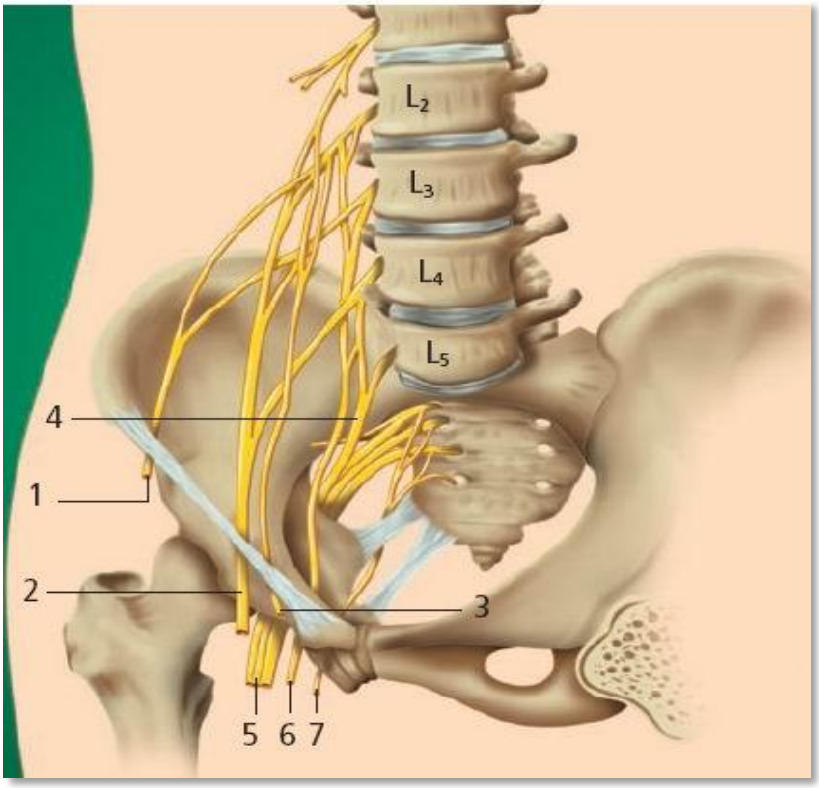

Figure (1-1): Anatomy of the Lumbosacral plexus (1= lateral femoral cutaneous nerve, 2= femoral nerve, 3=genitofemoral nerve, 4= fourth lumbar nerve, 5= sciatic nerve, 6=obturator nerve and 7= pudendal nerve) ***(Kirchmair et al., 1992)***

Ilioinguinal Nerve (L1)

The ilioinguinal nerve follows the iliohypogastric nerve. It gives rise to an abdominal branch, which is frequently anastomosed with the abdominal branch of iliohypogastric nerve, and the inguinal branch, which supplies the skin of the superior and medial aspects of the thigh and the genital area ***(Farny et al., 1994).***

Genitofemoral Nerve (L1-L2)

This nerve crosses the psoas muscle and extends along its anterior surface before dividing into genital and femoral branches. The genital branch passes through the inguinal canal and supplies the cremaster muscle and the skin of the pubis and scrotum (or labium majus). The femoral branch enters the thigh under the inguinal ligament in the femoral sheath and then supplies the skin of the upper part of the femoral triangle. This branch is probably the most variable of the lumbar plexus. It supplies an important part of the anterior aspect of the thigh ***(Farny et al., 1994).***

Lateral Femoral Cutaneous Nerve (L2-L3)

After crossing the psoas muscle, the lateral femoral cutaneous nerve follows an oblique and lateral course between the iliac muscle and the fascia iliaca in the direction of the anterior superior iliac spine. It provides branches for the peritoneum. It then enters the thigh by passing through or under the inguinal ligament and then divides into: a posterior branch, which supplies the skin of the superior and lateral aspects of the thigh, and an anterior branch, which supplies the antero-lateral part of the thigh as far as the knee. Variation of the course of this nerve is described; it may arise from the femoral nerve in 18% of cases ***(Bergman et al., 2003).***

Obturator Nerve (L2-L4)

The obturator nerve exits the psoas muscle at the level of the sacro-iliac joint. It runs outward and downward close to the ureter and the internal iliac artery. After it leaves the psoas muscle, it reaches the obturator groove at the upper part of the obturator foramen and enters the thigh. It then divides into an anterior and a posterior branch. In 50% of cases, this division occurs in the obturator groove, but it may also occur before or after the groove. In the pelvis, it sometimes provides a ramus for the articular capsule of the hip joint. This represents an additional argument for using a posterior lumbar plexus approach for hip surgery ***(Atanassoff et al., 2001).***

Anterior Branch

This branch runs in the front of the adductor brevis and adductor magnus muscles and behind the adductor longus. It innervates the pectineus, adductor longus, gracilis, and the adductor brevis muscles. It typically supplies a limited skin territory at the medial surface of the thigh and the knee. However, there are important variations in the location and extent of this area. The frequent anastomosis of the anterior branch with the saphenous and anterior femoral cutaneous nerves in the adductor canal (the subsartorial plexus) is responsible for significant overlaps ***(Bouaziz et al., 2002).***

Posterior Branch

This branch runs between the adductor brevis and adductor magnus muscles. It supplies the obturator externus, adductor magnus and adductor brevis muscles, and produces articular branches for the hip and the knee joints ***(Bouaziz et al., 2002).***

Accessory Obturator Nerve (L3-L4)

This nerve is found in 10% to 12% of cases. It follows the same course as the obturator nerve, except that it enters the thigh over the pubic anterior branch. It supplies the obturator and the pectineus muscles and give rise to a branch for the hip joint ***(Bergman et al., 2003).***

Femoral Nerve (L2-L4)

The femoral nerve is the largest branch of the lumbar plexus. It exits the lateral side of the psoas muscle and runs in the iliopsoas groove towards the inguinal ligament, beneath which it enters the thigh. In the pelvis, it produces branches for the psoas and iliac muscle. Generally, it divides in four terminal branches at the level or immediately below the inguinal ligament; although in some cases the division occurs before ***(Vloka et al., 1999).***

In the femoral triangle, there are two planes to be considered. The anterior femoral nerve is located within the anterior plane, which innervates the skin over the front and medial sides of the thigh and contributes to the subsartorial plexus and branches to the sartorius, pectineus, and

sometimes part of the adductor longus muscles. The posterior plane consists of the quadriceps femoris and the saphenous nerve. The saphenous nerve also contributes to the subsartorial plexus. It supplies the skin of the medial part of the knee and the anteromedial part of the leg as far as the foot, although in some cases it may extend as far as the base of the first toe. Additionally, the saphenous nerve also plays an important role in the innervation of the knee joint ***(Marhofer et al., 2000).***

Anatomy of the Sacral Plexus

The sacral plexus is formed by the anterior sacral roots from S1 to S3 (Sacral), and the lumbar roots from L5 are associated with a branch from L4 (fig. 1-1). The L5 roots and the L4 branch form the lumbosacral trunk ***(Rohen et al., 2002).***

The lumbosacral trunk and the sacral roots converges towards the sciatic foramen and merge before entering the buttock. The sacral plexus is shaped like a triangle, with its base lying against the anterior sacral foramina and its vertex corresponding to the anteromedial border of the sciatic foramen. The sacralplexus transverses the sciatic foramen lying anterior to the piriformis muscle and is covered by the pelvic aponeurosis (corresponding to the fascia of the pelvic muscles), which separates it from the visceral structures of the pelvis. In this section only the collateral branches of the sacral plexus for the lower limb are described ***(Hogan et al., 1994)***.