Review Article


Entrapment neuropathy in laparoscopic herniorrhaphy

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Abstract. In laparoscopic hernia repairs, the staples used to affix prosthetic mesh have resulted in entrapment neuropathies. This paper describes the diagnosis and treatment of nine cases of entrapment neuropathy. Injuries to all the branches of the lumbar plexus, with the exception of the obturator nerve, have been treated. Generally, the entrapments are self-limiting, but chronic disability requiring surgical intervention can occur. Staple removal and neurolysis controlled the severe, chronic pain of one femoral nerve entrapment. A thorough understanding of the anatomy of these nerves can prevent stapling in the areas of danger and thus greatly reduce the incidence of this complication.

Key words: Laparoscopic herniorrhaphy — Entrapment neuropathy — Prosthetic mesh — Lumbar plexus — Anatomy

Persistent pain (neuralgia) and a burning sensation (dysesthesia) in the groin after inguinal hernia repairs is a common, usually transient, complication. These symptoms, produced by entrapment of the genital branch of the genitofemoral nerve (GBGFN), the ilioinguinal nerve (IIN), or the iliohypogastric nerve (IHN), occur in an estimated 1–2% of conventional herniorrhaphies. Usually these nerve entrapments are self-limiting, but persistent, severe symptoms can cause significant morbidity and necessitate surgical intervention such as neurectomy, neurolysis, or neuroma excision.

Initially, it was predicted that laparoscopic hernia repair would reduce the number of entrapments because its dissection is entirely preperitoneal. Consequently, it was believed that the ILN and IHN, which lie between the internal and external oblique muscles, would not be injured as is the case during conventional repair. However, recent unpublished reports of laparoscopic hernia repairs have described not only a significant number of GBGFN, ILN, and IHN entrapments, but also injuries to the femoral branch of the genitofemoral (FBGFN), lateral femoral cutaneous (LFCN), and femoral nerves (FN). This paper describes the pertinent anatomy, mechanism of injury, and management of nerve entrapment injuries in laparoscopic herniorrhaphy.

Anatomy

The lumbar plexus (Fig. 1) is formed by the ventral primary divisions of L1, 2, 3 and most of L4 and usually with a branch of T12 joining L1. There are several branches of the lumbar plexus. The IHN is formed from the first lumbar and a communicating branch of T12 joining L1. It emerges from the upper lateral border of the psoas muscle and crosses the quadratus lumborum to

Fig. 1. Lumbar plexus.
the anterior superior iliac spine where it penetrates the transversus abdominis. The anterior branch then lies between the transversus and internal oblique and ultimately passes through the internal oblique 2 cm above the external inguinal ring to supply the skin of the hypogastric region (Fig. 2).

The IIN is formed from L1 and L2 and follows a course parallel and slightly caudad to the IHN, continues to the iliac crest where it, too, penetrates the transversus, and subsequently passes through the internal oblique and travels between the internal and external obliques. Then it accompanies the spermatic cord through the external inguinal ring to supply the skin of the proximal and medial thigh, root of the penis, and upper scrotum.

The genitofemoral nerve (GFN) is formed from L1 and L2 and emerges through the psoas muscle at L3 or L4. It descends retroperitoneally on the surface of the psoas and at a variable distance above the inguinal ligament divides into the genital and femoral branches.

The GBGFN follows the psoas muscle and passes through the internal inguinal ring where it follows the spermatic cord and supplies motor fibers to the cremaster muscle and sensation to the scrotum.

The FBGFN courses caudal lateral to the GBGFN and passes under the inguinal ligament lateral to the external iliac artery to supply the skin of the midanterior thigh.

The LFCN arises from L1 and L2 and emerges from the lateral border of the psoas and passes obliquely across the iliacus. At a variable distance medial to the anterior superior iliac spine, it passes beneath the inguinal ligament and supplies sensation to the lateral thigh.

The FN, the largest branch of the lumbar plexus, is formed from L2, 3, 4. It emerges at the lateral border of psoas and descends in the groove between the psoas and iliacus muscles and passes under the inguinal ligament lateral to the femoral artery. After exiting the pelvis, it breaks up into motor branches supplying muscles of the thigh and into sensory branches supplying the skin of the medial and anterior thigh and medial calf down to the ankle. The obturator nerve is also a branch of the lumbar plexus, but since it does not appear to be at risk, it is omitted from this discussion.

The above description is for the most common anatomy. However, numerous variations frequently occur. The IIN and IHN arise from the same T12 and L1 roots, but can vary in size, with one of the nerves being large and the other insignificant. Also, there is often communication and overlap of the sensory distribution of the GFN, IIN, and IHN. Additionally, there can be varying sensory functions of the LFCN, FN, and FBGFN [7].

**Mechanisms of injury**

In conventional repairs, the GBGFN, IIN, and IHN are at risk because sutures are placed medial to the internal inguinal ring. On the other hand, early published descriptions of laparoscopic repairs did not report any nerve injuries [1, 5, 9-11]. This can best be explained by the fact that stapling devices were not yet available. However, as the technique evolved, larger mesh demanded more dissection and affixation of the prosthetic with stapling devices. With this change, reports of nerve injuries began to be described [3, 4]. Laparoscopic repair actually poses risks to more nerves than does the conventional repair. In the laparoscopic repair, the prosthetic mesh is affixed to the abdominal wall with staples which are placed from the symphysis pubis to the anterior superior iliac spine, thus jeopardizing all the lumbar plexus nerves. Furthermore, in the conventional repair the nerves at risk are generally visible and can be dissected free and avoided during the sutured repair. In contrast, with the laparoscopic repair the staples are placed preperitoneally and the nerves cannot be seen. A thorough understanding of the anatomy is essential to avoid entrapping these nerves.

The crucial anatomical fact is that the LFCN, FN, and FBGFN all exit the pelvis lateral to the internal inguinal ring inferior to the inguinal ligament. Thus, injury to these structures can be avoided by keeping the lateral affixing staples superior to the iliopubic tract. The area of danger, i.e., where staples must not be placed, initially described by Spaw as the "triangle of doom" (Fig. 3), must be extended further laterally to the anterior superior iliac spine [12]. Therefore, a larger area which is bordered by the iliopubic tract superiorly, the vas deferens medially, and the anterior superior iliac spine laterally must be off-limits to staple placement. We have termed this area the "trapezoid of disaster" (Fig. 4).

Even if this "trapezoid of disaster" is avoided, the IIN, IHN, and GBGFN can still be injured from stapling. However, they are at risk only when excessive pressure is put on the stapling device. This pressure can compress the muscles enough to permit the 4-mm