



ROLE OF SURGICAL ANATOMY IN PRESERVATION OF REGIONAL NERVES IN PREVENTING POST HERNIOPLASTY INGUINODYNIA

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ABSTRACT

Post inguinal Hernioplasty inguinodynia (ranges from mild moderate to severe pain with a variable aetiology (somatic/visceral/ neuropathic/nociceptive/ psychological) and is often a rare complaint of the patient who have undergone Lichtenstein tension free mesh Hernioplasty which is noted either in immediate post operative period or in subsequent follow up post operatively as a chronic pain entity.

In immediate post operative period it can be caused by acute inflammatory response, meshoma, nerve injury or intraoperatively nerve entrapment and mesh adherence by fibrosis, where as in regular follow up at 1 week, 2 week or at 3- 4 weeks or even delayed up to 12 or more weeks post operatively it can be due to causes like neuropathy, hernial recurrence or due to regional inguinal nerve injury or scarring.

The symptom of type of pain is variable to a great extent therefore the actual cause of pain with which the patient presents makes both diagnosis and treatment challenging. A cohort of 30 patients (n=30) who have undergone open inguinal mesh Hernioplasty (A modified Lichtenstein tension free repair was done using polypropylene mesh) for left / right inguinal hernia (direct/indirect) and were observed post operatively and on follow up at surgical out door, for any post operative complications including for complaint of inguinodynia post operatively at 1/2/3/4 week interval respectively. A total of 2 patients presented with post operative complications. Of which 1 patients developed immediate post operative complication of meshoma causing inguinodynia, managed post operatively with single skin stitch removal and evacuation without re exploration along with post operative intravenous medication and oral anti-inflammatory medication. On discharge and on regular follow up he was asymptomatic. The second patient developed single stitch line infection which was managed conservatively without a need of re-exploration. No patient had inguinodynia after 3 week on follow up postoperatively. Understanding the gross and neuro-anatomy of the inguinal region, tissue respect and meticulous dissection is of great value in preventing nerve injury /scarring or nerve entrapment intraoperatively and taking a prompt notice of any post operative complication including inguinodynia of variable aetiology in immediate or in follow up is must improving the outcome post operatively in patients undergoing inguinal mesh Hernioplasty.

KEYWORDS : Inguinal canal, Inguinal neuroanatomy, Ilio inguinal nerve (IIN), Ilio hypogastric nerve (IHN), Genito femoral nerve (GFN), Lichtenstein tension free mesh repair, Femoral nerve (FN), Obturator nerve(ON)

LITERATURE REVIEW

INTRODUCTION AND RELEVANT ANATOMY PERTINENT ANATOMY AND FUNCTION OF THE ABDOMINAL WALL

The recurrence rate of the inguinal hernia has significantly reduced by the use of mesh and tension free techniques. Post Hernioplasty chronic pain remain as a concern.

Based on classification of International Association of study of Pain (IASP) post Hernioplasty inguinodynia can be broadly divided into nociceptive pain and neuropathic pain. Nociceptive is caused by activation of nociceptors due to tissue injury or inflammatory reaction and is transmitted to brain via A-delta and C fibres. Nociceptive pain can be reduced by gentle tissue handling and by avoiding forceful tissue retraction.[1]

Neuropathic pain is caused by direct nerve injury and characterised by inguinodynia which leads to pain in scrotum, femoral triangle, paraesthesia, hypoesthesia and positive Tinel's sign. The neuropathic pain can be reduced by identification of the nerves and their protection from direct contact with the mesh as the mesh can lead to structural changes of the nerve fibres. Moreover the in depth knowledge of neuroanatomy of groin is of paramount importance to prevent post Hernioplasty inguinodynia.[2,3]

NEUROANATOMY OF GROIN

Ilioinguinal nerve is located over spermatic cord covered and protected by investing fascia of internal oblique muscle. The protective fascia should not be damaged by removing the nerve from its nerve bed, to avoid the perineural scarring and direct contact of nerve and mesh.

The genital branch of genitofemoral nerve is located under the cord covered and protected by the deep cremasteric fascia. Therefore the nerve must be kept with the cord while separating the cord from the inguinal floor to prevent perineural scarring and to avoid the direct contact of nerve with the mesh.

The Iliohypogastric nerve is located between external and internal oblique muscle covered and protected by investing fascia of internal oblique muscle. Iliohypogastric nerve lies under the internal oblique aponeurosis in the subaponeurosis location. No suture or fixation device should be inserted into internal oblique aponeurosis in the region in order to prevent the Iliohypogastric nerve running inferolaterally underneath the internal oblique aponeurosis.

Cause of Neuropathic pain

- (a) Structural injuries
 - Axonotmesis(axon and myelin sheath disruption)
 - Neurotemesis(partial or complete severance of the nerve)
- (b) Entrapment Injuries

By sutures, fixating devices or wrinkled mesh or meshoma)

There is no sharp demarcation between nociceptive and neuropathic pain and his gray zone is further complicated by genetic, social, psychological and biochemical factors like higher level of collagen 3 in the harvested nerve from the patient with neuropathic pain.

Inguinodynia has no universally accepted aetiology, classification or surgical approach except for a post operative remedy of triple neurectomy. A failure to identify nerve is a main factor for development of inguinodynia.

LICHTENSTEIN TENSION FREE HERNIOPLASTY AND PREVENTION OF NERVE DAMAGE.

There are five elements of Lichtenstein's tension free Hernioplasty based on:[9]

1. The physiodynamic characteristics of the abdominal wall and intra abdominal pressure gradient, which rises from the 8 cm of water, with the subject spine to more than 80 cm of water on physical exertion, resulting in forward protrusion of the transversalis fascia; and

2. shrinkage of the mesh in vivo, which according to clinical studies (reported during the year 1995 Annual Meeting of the American College of Surgeons), published in 1997 and confirmed by other investigators, is approximately 20%.

Based on randomised controlled comparative studies, tension free Hernioplasty with mesh is superior to Bassini and Shouldice methods. Placement of mesh behind the transversalis fascia, although a sound concept requires extensive dissection in the highly complex preperitoneal space, and exposes the preperitoneal nerves to direct contact with the mesh and may lead to chronic inguinodynia. [10].

The most important to remember is visualise and protect the Ilioinguinal, iliohypogastric and genital nerves throughout the operation. The iliohypogastric nerve can be identified while the external oblique aponeurosis is being separated from the internal oblique layer to make room for the mesh. Because of the natural anatomical cleavage, separation of these two layers from each other is easy, fast and blood less. The most vulnerable part of the iliohypogastric nerve in its intramuscular segment, which runs along the lower edge of the internal oblique muscle (i.e. conjoint tendon). We should prevent passing the suture through the internal oblique muscle to approximate the layer to the inguinal ligament to a plug or to the upper edge of the mesh during Lichtenstein repair portion of the iliohypogastric nerve with the needle or entrap the nerve with the suture. [11]

The genital branch of the genitofemoral nerve is located under the cord, covered and protected from the direct contact with the mesh by the deep cremasteric fascia. The Ilioinguinal nerve is located over the spermatic cord, covered and protected from the mesh by the investing layer of fascia should not be damaged by removing the nerve from its natural bed. [10,11]

ABDOMINAL WALL FACTORS WHICH CAUSES INGUINAL HERNIA

The pin hock action of musculature of the internal ring during abdominal muscular straining prohibits protrusion of the intestine into a patent processes. paralysis or injury to the muscle can disable the shutter effect. In addition, the transversus abdominis aponeurosis flattens during tensing, thus reinforcing the inguinal floor. A congenitally high position of the aponeurotic arch might preclude the buttressing effect. Neuropraxia or neurolytic squeal of appendectomy or femoral vascular procedures may contribute to a greater incidence of hernia in these patients.

Repetitive stress as a factor in Hernia development is suggested by clinical presentations. Increased intraabdominal pressure is seen in variety of disease state and seems to contribute to hernia formation in these populations. [5,6] While it is not imperative to be experts in abdominal wall anatomy and function, surgeons operating in the abdominal cavity should have a general knowledge of wound healing and abdominal wall anatomy. The general principles of wound healing, including the phases of inflammatory, proliferative, and maturation, apply to the fascia, and laparotomy incisions. [7,8] The abdominal wall includes layers of skin, subcutaneous tissue, superficial fascia, deep fascia, muscle, extraperitoneal fascia, and peritoneum. The linea alba is a key structure in the abdominal wall anatomy, and surgeons undertaking laparotomy incisions should have a thorough understand of the linea alba and surrounding anatomic structures. The linea alba runs from the xiphoid process to the symphysis pubis in the midline and is formed by the fusion of the anterior and posterior rectus sheath. Lateral to the linea alba on both sides run the rectus muscles. If laparotomy incisions are not done with caution and veer off midline, the rectus muscle can be exposed making closure more difficult. The lateral boundary of the rectus muscle is comprised of the fusion of the external and internal oblique and the transversus abdominis and is called the linea semilunaris.

MATERIALS AND METHODS

All cases operated between 11th November 2017 to July 2018 were included in the study. The study was conducted in Combined Divisional Hospital and Trauma centre Darshan Nagar, Faizabad. All age groups right from 18 to 70 years were operated. A follow up of 3 weeks postoperative was charted to judge the recovery and complications if any.

Lichtenstein's mesh repair Hernioplasty with nerve sparing technique to prevent inguinodynia was used in all the cases operated. [9,10].

In the past decade, the use of mesh tension free Hernioplasty has ubiquitous and perhaps the new Gold standard technique. [12,13,14]. The mesh material used was polypropylene mesh [18].



FIGURE 1 INCISION OF THE CRIBRIFORM FASCIA BELOW THE INGUINAL LIGAMENT

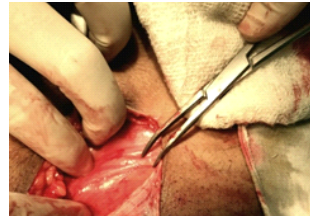


FIGURE 2 ILIOHYPOGASTRIC NERVE IDENTIFIED AND PRESERVED BETWEEN EXTERNAL AND INTERNAL OBLIQUE MUSCLE



FIGURE 3 ILIOINGUINAL NERVE LOCATED OVER THE CORD IDENTIFIED

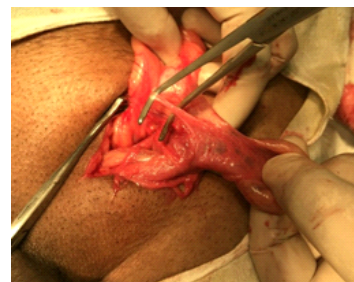


FIGURE 4 THE GENITAL BRANCH OF GENITOFEMORAL NERVE IS LOCATED UNDER THE CORD, COVERED AND PROTECTED BY THE DEEP CREMASTIC FASCIA.

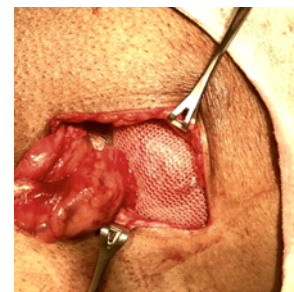


FIGURE 5 LICHTENSTEIN'S TENSION FREE MESH REPAIR.

RESULTS

The age group varied from 18 till 70 years of included cases in this study

| | |
|--------------------------|----|
| Number of total patients | 30 |
|--------------------------|----|

Table 1: Total Number Of Patients Included In Study

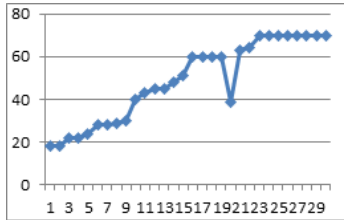


Diagram 1: Age Of Operated Patients

| | |
|------|--------|
| MALE | FEMALE |
| 30 | 0 |

Table 2: Male And Female Ratio In This Study

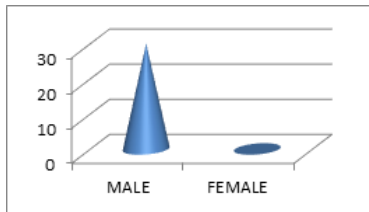


DIAGRAM 2. MALE AND FEMALE RATIO

As it is already established, it was true in this study as well. All 30 operated cases were male gender, which is also true in children as well. In the ratio of inguinal hernia in children of age 10 to 20 per 1000 only 17% of female child are affected and 83% of male child is affected. And answer lies in probably the anatomy of pelvis again.

| | |
|---|----|
| Causes ratio of inguinal Hernia in this study | |
| Obesity | 1 |
| Heavy Lifting Job | 12 |
| Chronic Constipation | 9 |
| Chronic Cough | 8 |

Table 3: Common Causes Of Hernia In This Study

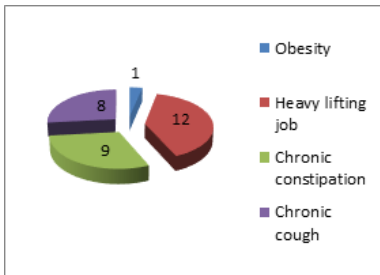


Diagram3: The Common Causes In Patients

| | |
|-------------|----|
| Smokers | 23 |
| Non smokers | 7 |

Table 4: Smokers And Non-smokers In This Study

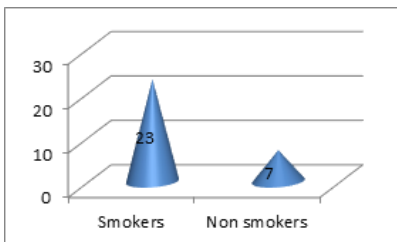


Diagram 4: Relation Of Smoking And Hernia

Both indirect inguinal and direct inguinal hernia were included in the study.

| | |
|-----------------|----|
| Indirect Hernia | 19 |
| Direct Hernia | 11 |

Table 5: Number Of Direct And Indirect Inguinal Hernia In This Study

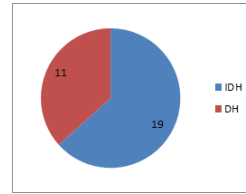


Diagram 5: Showing number of direct and indirect hernia operated

KEY: IDH- INDIRECT HERNIA; DH - DIRECT HERNIA

| | |
|---------------------------|---|
| Right sided direct Hernia | 9 |
| Left sided Direct Hernia | 2 |

Table 6: Direct Hernia Side Right>left

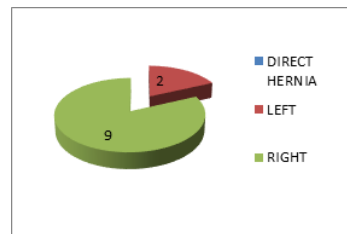


Diagram 6: Direct Hernia Side Right>left

Among the registered and operated cases Indirect hernia was more than Direct Hernia and right sided hernia was more than left in both types.

| | |
|-----------------------------|----|
| Indirect left sided hernia | 5 |
| Indirect right sided hernia | 14 |

Table 7: Indirect Inguinal Hernia Right>left

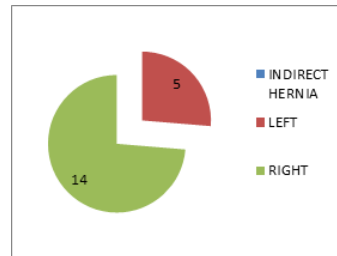


Diagram 7: Indirect Hernia Right>left

| | |
|---|----|
| Cases operated | 30 |
| Meshoma and inguinodynia | 1 |
| Other complication like stitch line infection | 1 |

Table 8: Outcome Of Lichtenstein's Mesh Repair With Nerve Sparing Technique

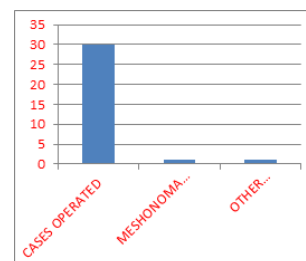


Diagram 8 :outcome Of Lichtenstein's Mesh Repair With Nerve Sparing Technique

In my clinical study I observed that knowing neuroanatomy in and around inguinal canal and preventing damage was of utmost benefit in preventing inguinodynia in all my operated cases. Only one patient landed in meshoma and one had serosanguinous discharge out of 30 operated cases.

DISCUSSION

The incidence of posthernioraphy inguinodynia is greater than recurrence of inguinal hernia and ranges between 6% and 8%. Based on evidence based evidence studies identification and protection during inguinal nerve repair reduces the rate of chronic pain to a fraction of 1%.

There are some studies which advocate higher level of collagen 3 in the harvested nerves from the patients with neuropathic pain. At any time if a nerve is in a way of the repair or suspected of being injured, its resection is universally recommended.

The neuroanatomy of the inguinal canal is complex and highly variable from the retroperitoneal lumbar plexus to the terminal branches exiting through the inguinal canal. Neuropathic pain from nerve injury or entrapment is a common mechanism. While it is not possible to completely prevent injury due to the considerable neuroanatomy variability and inevitability of postoperative scarring, nerve injury is often technical and related to inadvertent iatrogenic damage. Multiple studies have demonstrated the feasibility of routine nerve identification, the benefit of focused neuroanatomy teaching, and the efficacy of nerve sparing in the reduction of post Hernioplasty inguinodynia. An in-depth understanding of groin neuroanatomy and potential causes of pain unique to each operative technique allows for a "nerve-mindfulness" approach that increases nerve identification and preservation, decreases injury, and improves patients outcomes.

The nerves most commonly affected in post Hernioplasty inguinodynia are the iliohypogastric, Ilioinguinal, and genital branch of the GFN.[2]. In open anterior tissue and mesh repairs, techniques such as three-nerve identification, local anaesthesia infiltration, preservation of the investing fascia around the inguinal nerves, meticulous avoidance of nerve injury during suture repair of the canal or fixation of the mesh, lightweight mesh usage, and pragmatic neurectomy of nerves deemed to be injured or at risk during the primary operation all help to decrease the risk of post Hernioplasty inguinodynia. In laparoscopic and minimally invasive repair, techniques such as preserving the transversalis fascia to prevent over dissection of the inguinal nerves, judicious use or avoidance of penetrating mesh fixation, avoidance of posterior suturing of the myopectineal orifice, and careful deployment and positioning of mesh prostheses all help to prevent technical complications that may lead to nerve injury. Although infrequent, the LFC nerve, femoral branch of the GFN, FN, and Obturator nerve may also be injured in the preperitoneal space and similar avoidance of over dissection, limited or no penetrating fixation, and meticulous mesh placement will help to limit the risk of these infrequent injuries.

Lichtenstein tension free repair with Polypropylene mesh reduced the recurrence rate to only one case in 35 patients in a 3 year follow up and there is also reduced incidence of pain postoperatively[18].

CONCLUSIONS

Prevention is the most important measure in mitigating neuropathic pain. Recognizing the typical neuroanatomy of the lumbar plexus, the highly variable nature of these nerves, and the operation-specific mechanisms for nerve entrapment will limit the potential for injury and improve outcomes in inguinal hernia repair. In this surgical study experience of 30 cases of Leicenstein's tension free mesh Hernioplasty there was a significant reduction in chronic pain by preventing the damage to protective fascia of the Ilioinguinal nerve by removing the nerve from its natural bed, and by not passing any suture through the internal oblique muscle to avoid injuries in plane of muscle, and by protecting cremastic fascia which is a protective fascia of genitofemoral nerve. At this point of time, what we can best do to our patient is preventing the debilitating complication of hernia surgery. And this requires in depth knowledge of surgical neuroanatomy of groin and inguinal hernia.[19,20,21]. By careful dissection and separation of the cord from its floor prevented both nociceptive and neuropathic type of inguinodynia.

A number of investigators have shown that failure to identify the nerves is a risk factor for development of chronic pain: some have gone

far to advocate the prophylactic neurectomy to avoid chronic pain.[21,22,].

In this study it was taken care that nerve was well identified, protected and protecting fascia was not damaged, no suture was passed through the nerve and careful dissection of the cord from the inguinal floor was taken care of and hence with a 12 weeks follow we achieved satisfactory results.

Shortcomings and further scope in this study:

The duration of follow up should have been beyond 12 weeks as well.

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