EDITORIAL

Inguinodynia following Lichtenstein tension-free hernia repair: A review

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Abstract

Chronic Groin Pain (Inguinodynia) following inguinal hernia repair is a significant, though under-reported problem. Mild pain lasting for a few days is common following mesh inguinal hernia repair. However, moderate to severe pain persisting more than 3 mo after inguinal herniorrhaphy should be considered as pathological. The major reasons for chronic groin pain have been identified as neuropathic cause due to inguinal nerve(s) damage or non-neuropathic cause due to mesh or other related factors. The symptom complex of chronic groin pain varies from a dull ache to sharp shooting pain along the distribution of inguinal nerves. Thorough history and meticulous clinical examination should be performed to identify the exact cause of chronic groin pain, as there is no single test to confirm the aetiology behind the pain or to point out the exact nerve involved. Various studies have been performed to look at the difference in chronic groin pain rates with the use of mesh *vs* non-mesh repair, use of heavyweight *vs* lightweight mesh and mesh fixation with sutures *vs* glue. Though there is no convincing evidence favouring one over the other, lightweight meshes are generally preferred because of their lesser foreign body reaction and better tolerance by the patients. Identification of all three nerves has been shown to be an important factor in reducing chronic groin pain, though there are no well conducted randomised studies to recommend the benefits of nerve excision *vs* preservation. Both non-surgical and surgical options have been tried for chronic groin pain, with their consequent risks of analgesic side-effects, recurrent pain, recurrent hernia and significant sensory loss. By far the best treatment for chronic groin pain is to avoid bestowing this on the patient by careful intra-operative handling of inguinal structures and better patient counselling pre- and post-herniorraphy.

INTRODUCTION

Chronic Groin Pain (Inguinodynia) is a potential complication following inguinal hernia mesh repair and has significant impact on the quality of life[1]. The incidence varies among studies, ranging between 0% and 62.9%, with 10% of patients fitting in the moderate to severe pain group[2-6]. However, only 2%-4% of the patients are adversely affected by chronic groin pain in their everyday

life. This is significant, considering the volume of the operations performed worldwide[7]. Management of chronic groin pain constitutes challenging issues for the clinician. Additionally, it has an impact on the health system and economy. In this review, we highlight various aspects of chronic groin pain (inguinodynia) following Lichtenstein's open inguinal herniorraphy.

LICHTENSTEIN TENSION-FREE HERNIA REPAIR

Lichtenstein *et al*[8] described the tension-free hernioplasty in 1989. By using prosthetic mesh, Lichtenstein showed that inguinal hernias could be repaired without distortion of the anatomy and, most importantly, without any tension along the suture line. In spite of various modifications over the last two decades, Lichtenstein hernia repair (LHR) is still considered the gold standard in the management of inguinal hernia by open technique[9]. With significant reduction in recurrence with LHR, the most common morbidity has been chronic groin pain.

CHRONIC GROIN PAIN (INGUINODYNIA)

It is vital to differentiate early post-operative pain from chronic groin pain. The post-operative pain is usually relieved with analgesics, whereas chronic groin pain would need further assessment and medical or surgical intervention[10,11]. Different studies have quoted various time scales for chronic groin pain. These range from first postoperative day to any empirical time period after surgery. However, the International Association for the Study of Pain (IASP) described chronic groin pain as "groin pain reported by the patient at or beyond 3-mo following inguinal hernia repair"[12]. Major consensus currently has been to take 3 mo as a cut-off point to differentiate between patients with post-operative pain and chronic groin pain due to various causes[13].

REASONS FOR INGUINODYNIA

The main reasons hypothesised for chronic groin pain are peri-operative nerve damage, post-operative fibrosis, or mesh-related fibrosis. They have been classified as either neuropathic or non-neuropathic pain. The three nerves potentially involved are the Ilioinguinal Nerve (IIN), Iliohypogastric Nerve (IHN) and genital branch of the Genitofemoral Nerve (GFN). These nerves can be damaged either by trauma during dissection or retraction of tissues, or nerve entrapment from post-operative fibrosis, mesh-related fibrosis or sutures used to fix the mesh. Smeds *et al*[14] suggested that the injury is mainly due to inadequate dissection, failure to visualise and protect the nerves, and failure to recognise the aberrant location and anatomic variations of the nerves. Any partial or complete transection of the nerve leads to neuroma formation and consequent pain along the distribution of that nerve.

The explanations for non-neuropathic causes are ex-

cessive scar formation resulting from prosthetic mesh reaction, periosteal reaction from sutures or staples inserted into the pubic tubercle or due to rolled-up bulky mesh leading to mechanical pressure. Another group of patients may have diffuse pain situated in the proximity of the spermatic cord without nerve entrapment, which may be due to venous congestion or mesh-related inflammation of the spermatic cord[15].

Fränneby *et al*[16] predicted the possible factors contributing to inguinodynia. It has been shown that age below median, absence of a visible bulge before the operation, recurrent hernia repair and history of moderate to severe pre-operative groin pain are some of the common factors that influence the post-operative inguinodynia.

Sexual dysfunction secondary to chronic groin pain

Ducic *et al*[17] and Aasvang *et al*[18] have shown that chronic groin pain contributes to sexual dysfunction with symptoms of chronic genital pain, erectile dysfunction and dysejaculation. A nationwide survey in Denmark by Aasvang *et al*[19] showed pain during sexual activity in 22.1% of patients, of whom 6.7% had moderate or severe pain occurring every third time or more. Ejaculatory pain was noted in 12.3% of post-herniorraphy patients, with a quarter of them describing that the pain impaired their sexual activity significantly resulting in the avoidance of sexual activity. The ejaculatory pain was usually secondary to compression and dilatation of the vas deferens resulting from post-operative fibrosis or direct contact between the mesh and the vas deferens causing inflammation and fibrosis. The study also pointed out that only 1.8% of the patients who reported pain during sexual activity reported this to the physician, thereby showing under-reporting of this problem.

A prospective follow-up study was conducted by Zieren *et al*[20] to assess post-herniorraphy sexual function by preserving IIN in the control group and elective division in the intervention group. This study showed that prophylactic IIN excision led to reduced sexual symptoms post-operatively in comparison with those who had preserved nerve.

ASSESSMENT TOOLS USED FOR DIAGNOSING INGUINODYNIA

The symptom complex of chronic groin pain varies from a dull ache to sharp shooting pain along the distribution of inguinal nerves. Walking, twisting or hyperextension of the hip often triggers the symptoms. They can be relieved by bed rest, sedentary life style or flexion of the thigh. The complex nature of chronic groin pain has led researchers to use diverse measurement tools, thereby leading to difficulty in comparison of the studies. The most frequently used self-rating pain tools that assess multidimensional nature of the pain are the Visual Analogue Scale (VAS) and McGill Pain Questionnaire, both of which have been shown to be reliable, valid and consistent[21]. The McGill Pain Questionnaire assesses the

multidimensional nature of the pain using 78 different pain descriptors[22]. The most commonly used simple assessment tool has been VAS and this uses a scale 10 cm in length, with no pain at 0 to severe pain at 10.

Neuropathic pain can be reproduced by tapping the skin medial to the antero-superior iliac spine or over an area of tenderness. It is extremely difficult to identify the exact nerve involved in causing the pain because of the overlapping nature of their sensory innervations and peripheral communication between the nerves. All three nerves arise from T12-L1 nerve roots. One, two or all three of them can be involved in the aetiology of chronic groin pain, thus making it difficult to pinpoint the entrapped nerve. Clinicians have tried peripheral nerve block or paravertebral block to differentiate the neuropathic pain. Beldi *et al*[23] showed that the objective assessment of pain and hypoesthesia by von Frey monofilament prior to and after surgery is a good clinical tool. Ultrasound and computed tomography scans have helped in the diagnosis of non-neuropathic chronic groin pain by identifying excess fibrosis or mesh-related factors.

MESH *VS* NO-MESH

In an attempt to reduce chronic groin pain, researchers have tried tension-free repairs without mesh. A Cochrane review showed that the recurrence rate is reduced by 50%-75% when mesh is used for inguinal hernia repair compared to repairs without mesh[24]. There is also some evidence of earlier return to work and of lower rates of persisting pain following mesh repair. A meta-analysis of RCTs comparing hernia repair with or without synthetic mesh showed a significant reduction in chronic groin pain when a mesh was applied, by the simple principle of reducing tension between suture lines[25]. As a general consensus, mesh repair is considered to be more effective in reducing recurrence and chronic groin pain, in comparison with no-mesh repair.

TYPE OF MESH AND PAIN

The majority of patients who present with chronic groin pain also suffer from foreign body sensation and stiffness in the groin area. Post *et al*[26] and O'Dwyer *et al*[27] suggested that the pain might be caused by the weight and composition of implanted prosthetic material itself. Heavyweight (HW) polypropylene meshes such as Prolene® (Ethicon) and polymer meshes with both polypropylene and polyglactin fibres such as Vypro I® and Vypro II® increase the surface area of the mesh, thereby causing extensive fibrosis and greater risk of infection and pain. An implant knitted from monofilament fibres, such as Ultrapro® (Ethicon) which is composed of polypropylene and poliglecaprone absorbable fibres, causes less tissue reaction[28,29]. Alternatively, light-weight (LW) meshes have shown promise in reducing the groin pain rate. However, because of their lesser tensile strength, there have been recent reports of increases in early and mid-term recurrence rates[30,31].

A randomised controlled trial comparing HW with LW mesh showed higher incidence of groin pain for HW mesh at 6 mo follow-up (6.3% *vs* 0%, respectively). This was statistically significant[32]. Randomised controlled trials have shown that the feeling of foreign body sensation is higher in HW mesh groups compared to LW mesh: 43.8% *vs* 17.2% by Post *et al*[26] and 32.8% *vs* 20.9% by Nikkolo *et al*[32]. However, the follow-up in both these RCTs was only for 6 mo, thereby they did not account for higher recurrence rates associated with LW meshes. O'Dwyer *et al*[27] randomised 162 patients in a LW group and 159 in a HW group and showed that the recurrence rate was higher in the former group (5.6% *vs* 0.4%) at 12 mo follow-up, which was statistically significant.

There are very few reports of well controlled RCTs on LW meshes with long-term follow-up. In a RCT of 590 patients with 3 year follow-up, Bringman *et al*[33] showed no differences in neuralgic pain, hypoaesthesia or hyperaesthesia between the HW and LW mesh groups. There were no major differences in response to the pain questionnaire, except that fewer men with LW mesh had pain when rising from lying down to a sitting position. Significantly more men in the standard mesh group could feel the mesh in the groin: 22.6% *vs* 14.7%. More importantly, this study with longer follow-up showed no difference in recurrence rates with either HW or LW meshes[33]. Similar views were shared by a single centre RCT on three different composite meshes with a 2 year follow-up[34].

European hernia guidelines for open hernia repair emphasise a Grade A recommendation for the use of synthetic non-absorbable flat mesh or composite mesh with a non-absorbable component. Though the use of lightweight/material-reduced/large pore (1000 μm) meshes in open inguinal hernia repair can be considered to decrease long-term discomfort, this is possibly at the cost of increased recurrence rate (possibly due to inadequate fixation and/or overlap). Large randomised studies with longer follow-up are needed to justify the routine use of LW meshes.

MESH FIXATION *VS* PAIN

Complications associated with sutured fixation of the mesh have prompted surgeons to use atraumatic fixation using substances such as human fibrin glue[35]. These adhesives have shown reduced incidence of chronic groin pain, foreign body sensation and groin numbness in both randomised trials and observational studies[36-39].

Randomised controlled trials regarding skin staples to fix the mesh have shown reduced intra-operative times and early return to normal activity. However, there was no difference in complications or post-operative pain rates[40]. A randomised trial in which bilateral hernias received sutured fixation of the mesh on one side and glue fixation on the opposite side showed less inflammatory reaction and therefore post-operative pain on the glue fixed side, with no increased recurrence rates[37]. Similar results were shown in a RCT with 3 mo of follow-up[36].

A randomised study comparing sutures, fibrin glue and

N-butyl-2-cyanoacrylate for mesh fixation showed higher post-operative pain, numbness and haematoma formation both in the short term and 12 mo following hernia repair, with an increased rates of foreign body sensation and chronic groin pain, in the sutured fixation group[39]. There was no recurrence in any group, confirming the fact that tissue adhesives form enough fibrotic reaction to give the much needed tensile strength and at the same time negate the nerve or tissue damaging effects of suture repair. However, the lack of long-term follow-up reports on recurrence rates with glue fixation and increased cost of these glues have made their routine use uncommon.

IMPORTANCE OF NERVE IDENTIFICATION

Lange *et al*[41] and Alfieri *et al*[42] showed there was less incidence of chronic groin pain with identification of all 3 nerves during open inguinal hernia repair compared to no nerve identification. A large prospective multicentre study conducted at 11 Italian institutions involving 955 patients showed that the overall pain rate was 5.5% and moderate to severe pain rate was 1.3% when all three nerves were identified. If no nerves were identified the rates of overall pain and moderate to severe pain were 21.6% and 4.7%, respectively. This was statistically significant. Alfieri *et al*[42] showed that relative risk of chronic groin pain increases from 2.2 to 19.2 if one or three nerves have not been recognised during the inguinal hernia repair.

Smeds *et al*[43] showed that non-identification of nerves leads to worse pain rates and that non-identification of IIN is worse than actual identification of both IHN and GFN. Amid and Wijsmuller suggested that identification of inguinal nerves helps avoid damage to them by mesh or sutures and also that it is beneficial to cut clean if already damaged during dissection in order to avoid neuroma formation[44,45]. This is from the understanding that neurectomy causes only numbness, whereas nerve injury causes pain.

The practice of identification of all 3 nerves is quite poor. Ravindran *et al*[46] conducted a survey in the United Kingdom regarding the handling of inguinal nerves during open hernia repair and showed that IIN was routinely identified by 88% of surgeons, IHN by 58% and GFN by 54%. The individual nerves were routinely divided by 7%, 5% and 6% of surgeons, respectively. There was no definite consensus available on routine identification of inguinal nerves and preservation or division. The survey also pointed out that those surgeons who performed more than 50 hernias per year were more likely to preserve the nerve and others were more likely to ignore it[46].

The difficulty in nerve identification has been shown to be due to variation in the anatomy and absence of one or more nerves, which is not uncommon in the inguinal area. An anatomical study by Wijsmuller *et al*[47] defined identification zones which make all three nerve identifications feasible. Lange *et al*[41], in a prospective anatomical study, showed that identifying all three inguinal nerves should only add 3-4 min of operating time. Overall, the general consensus has been to identify all 3 nerves during open inguinal hernia repairs to avoid iatrogenic injury and consequent chronic groin pain.

NERVE EXCISION *VS* NERVE PRESERVATION

Traditional teaching has always been to preserve the nerve, but recent studies have looked into the intentional severance based on the concept of "no nerve, no pain"[48]. RCTs comparing deliberate IIN neurectomy *vs* preservation have shown conflicting results. Two RCTs have shown significant reduction in chronic groin pain post-neurectomy[49,50], whereas two other studies concluded there was no influence of neurectomy on pain rates[46,51]. The diverse results may be due to different assessment tools used and poorly conducted and underpowered studies. All of these studies have taken only IIN into consideration, leaving the other two nerves unaccounted for.

A recent RCT by Karakayali *et al*[52] has shown significant reduction in chronic groin pain with IIN and IHN neurectomy in comparison with all 3 nerves preserved. Nevertheless, this study does not address the fact that all 3 nerves traverse the inguinal area, and that any of the 3 nerves can be involved in causing chronic groin pain. Though studies have shown high incidence of groin numbness and sensory loss following deliberate neurectomy of the inguinal nerves, no significant differences have been shown in the quality of life with such neurosensory changes[52].

A previous systematic review by Wijsmuller *et al*[47] in 2007 showed no significant difference in pooled mean percentage of patients with chronic groin pain following either IIN preservation or division. A Cochrane systematic review is currently being undertaken to address this issue.

SOLUTION FOR CHRONIC GROIN PAIN

Avoiding chronic groin pain should be a prime goal for any hernia surgeon, considering that 5-7% of patients with post-herniorraphy groin pain will sue their surgeons[53] amidst proposed measures to avoid chronic groin pain. These important steps are: leaving the cremasteric layer to safeguard IIN; not to recreate too small an external ring to prevent constriction of the IIN during external oblique closure; not to lift the IIN from its bed; careful adequate dissection to prevent injury to the prematurely surfaced branches of the IIN or IHN; and also, avoid suturing the lower edge of the internal oblique muscle to the inguinal ligament because passing sutures can lead to injury to the intramuscular portion of the IIN. One way to avoid nerve scarring in the operative field is to transect the nerve under tension so that it retracts behind the peritoneum or else to implant the transected nerve within the fibres of internal oblique muscle, to prevent it adhering to the inguinal ligament or external oblique aponeurosis.

Even if conventional thinking dictates that every effort should be made for preservation of the nerves from trauma, this is often impossible. Detailed discussion about various treatment options is beyond the remits of this article.

CONCLUSION

There has been increasing evidence in the literature over the last decade regarding the growing incidence of chronic groin pain. The exact cause for the pain is still unclear and various aetiologies have been suggested, including the type of mesh, suture materials and tissue handling techniques. It is important to understand the definition of chronic groin pain occurring after 3 post-operative months following herniorraphy and this should not be confused with immediate post-operative pain. This will give the opportunity for better reporting of this complex problem and proper understanding of its aetiology. By far the best treatment for chronic groin pain is to avoid bestowing this on the patient by careful intra-operative handling of inguinal structures and better patient counselling pre- and post-herniorraphy.

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