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Original Research Article

CHRONIC POST-SURGICAL PAIN (CPSP) FOLLOWING LICHTENSTEIN MESH REPAIR: A PROSPECTIVE COMPARATIVE ANALYSIS OF NERVE IDENTIFICATION VS. NON-IDENTIFICATION

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ABSTRACT

Background: The objective is to assess the severity, nature and risk factors of chronic post-surgical pain over one year follow up in 200 patients undergoing Lichtenstein mesh repair. The study will compare outcomes between those people who had nerve identification, to those who did not.

Materials and Methods: Over one year, a prospective comparative study was conducted in 200 adult patients undergoing elective open Lichtenstein mesh repair. The patients were divided into two groups, in one group the nerve was identified and preserved (n = 100) and in the other group the nerve was not identified (n = 100). Post-operatively pain was measured using the Visual Analog Scale up to 12 months at various intervals. CPSP was defined as pain lasting for more than 3 months. We used multivariate logistic regression to determine independent risk.

Results: Patients who were in the nerve-identification group had significantly lower pain scores early after surgery ($p<0.05$). 12 months after surgery, chronic postsurgical pain (CPSP) occurred in 6 % of patients who had nerve identification versus 15 % in those who did not ($p = 0.03$). Neuropathic pain characteristics were more prevalent in the group that did not have a nerve identification. In the multivariate analysis absence of nerve identification (OR 2.4, p =0.02), high early postoperative pain (OR 2.7, p =0.01), preoperative groin pain (OR 2.1, p =0.04) each were independently predictive for development of CPSP.

Conclusion: Identifying the nerves routinely during Lichtenstein mesh repair significantly decreased frequency and severity of chronic post-surgical pain. Careful preservation of these nerves during the operation could help optimize long term postoperative results.

Keywords: Chronic post-surgical pain, Inguinal hernia, Lichtenstein repair, Nerve identification, Neuropathic pain, Mesh repair.

INTRODUCTION

Inguinal hernia repair is one of the most general surgical procedures in the world. The open Lichtenstein tension-free mesh repair is often chosen as it has a low recurrence rate, it is technically simple, and it provides reproducible outcomes.[1] Although the recurrence rates of hernias are very low, many patients experience chronic pain after the surgery (very commonly referred to as chronic post-herniorrhaphy pain (CPIP) or, in general, chronic postsurgical pain (CPSP)). This pain is a significant cause of long-term morbidity adversely affecting physical function, returning to work and quality of life.[2-4] Current pain classification systems define CPSP as pain that occurs after a surgical procedure or occurs when such a procedure has worsened in intensity; persists for longer than normal tissue healing, which is generally considered to be greater than 3 months; and cannot be attributed to other

causes such as infection or cancer.[5] Studies report a wide range of chronic groin pain incidence after mesh-based inguinal hernia repair, from a few percent to over 20% for any persistent pain. Variation includes differences in definition, follow up time, surgical methods, patient groups and outcome measures. Systematic reviews estimate that about 10–11% of patients experience chronic pain after mesh repair. A significant minority suffer from moderate to severe, often neuropathic pain which limits their daily activities.[3,6]

The causes of CPSP following inguinal hernia repair are varied. They include nociceptive factors such as mesh fibrosis, anchor or suture tension, and chronic inflammation; neuropathic factors such as direct nerve injury, nerve entrapment in sutures or scar tissue, and traction; and psychosocial factors such as pre-existing chronic pain syndromes, anxiety and catastrophizing.[4,7] Neuropathic pain commonly occurs in patients with post - herniorrhaphy pain and damage to the ilioinguinal, iliohypogastric or genitofemoral nerves during surgery is one likely cause of persistent neuropathic groin pain.[4,8] Because of the possible contribution of iatrogenic nerve injury to CPSP, the treatment of these nerves by surgeons performing open Lichtenstein repair is a controversial subject. Reported strategies include systematically identifying and preserving the ilioinguinal, iliohypogastric, and genitofemoral nerves; prophylactic neurectomy; or nerve division when the nerve is definitely at risk or is trapped in scar tissue.[9-11] Observational studies and meta-analytic analyses reveal large differences. First, the intra-operative identification rates vary: ilioinguinal ~80%, iliohypogastric ~60%, genitofemoral ~40%. Second, surgeons have different degrees of nerve-handling preferences: most favour preservation, if possible, yet there is evidence that both preservation and intent neurectomy can influence the degree of postoperative neuropathic pain and sensory loss risks.[11,12]

Several factors are continually known to increase the risk of CPIP. They include younger age, female sex, severe pre-operational pain, high early post-operational pain, recurrent hernia and use of open repair techniques. The role of nerve preservation versus other nerve management strategies is not clear. Some studies suggest that nerve handling (i.e., neurolysis, unintentional injury), may contribute to persistent pain.[4,13] The inconsistent results reported stem from differences in methodology: different follow-up periods, different pain scores (e.g., different VAS, DN4-Douleur Neuropathique 4 questionnaire), and different indications of whether surgeons made an effort to identify and spare nerves. As such, no definitive evidence exists that nerve identification and preservation performed systematically intra-operatively during Lichtenstein repair results in a reduction in CPSP as compared with a standard approach that does not search for nerves. Due to the burden on the patient, CPSP has become a major objective for the WHO and the medical societies, who seek to minimize chronic pain following hernia surgery, and work to create guidelines aimed to keep surgery effective while minimizing pain. Therefore, high-quality prospective comparisons are required, to find out the best intra-operative nerve strategy for Lichtenstein repairs.[1,12]

This is a prospective, comparative study for 200 patients over a one-year period. It was conducted to evaluate if routine identification and preservation of the inguinal nerves during Lichtenstein mesh repair decreases the incidence and alters the characteristics of CPSP at specified points of postoperative follow-up, compared to a non-identification (standard anatomic) approach that does not look for nerves. Secondary aims were to characterize the type of pain (neuropathic or nociceptive), severity and effect on function and identify perioperative risk factors associated with persistent pain in our cohort. The results will help establish whether the routine identification of nerves should be recommended to reduce chronic post-surgical pain of the groin area after Lichtenstein repair.

Aim of the Study

To investigate the impact of inguinal nerves identification on the development and severity of chronic post-surgical pian (CPSP) following Lichtenstein mesh repair.

Objective

To evaluate the severity, characteristics, and risk factors of chronic post-surgical pain over a one-year follow-up period in 200 patients undergoing Lichtenstein mesh repair with and without nerve identification.

MATERIALS AND METHODS

This is a prospective comparative study, lasting one year examining the incidence and features of chronic post-surgical pain (CPSP) following open Lichtenstein tension-free mesh repair for inguinal hernia. Patients were randomized into two groups based on whether or not the nerve of interest, i.e., intra-operative nerve identification, was conducted (Group A the ilioinguinal, iliohypogastric and genitofemoral nerves are actively identified and preserved and Group B no intentional nerve identification was conducted). All procedures were performed by experienced surgeons following a standardised Lichtenstein procedure and this helped to reduce procedural variation.

The study population consisted of adult patients with a primary unilateral inguinal hernia, who came in the general surgery department during the study period. A total of 200 patients was studied, in two groups of equal sizes of 100 participants each. The size of the sample was selected to have sufficient statistical power to find a clinically significant difference in the incidence of chronic post-surgical pain among the groups. Consecutively eligible patients were admitted to minimise selection bias. All patients were followed

for a minimum of one year following surgery for the evaluation of the development of chronic pain.

Inclusion Criteria

Patients 18 years or older, diagnosed with primary unilateral inguinal hernia, who would undergo elective open Lichtenstein mesh repair were included. Only patients giving written informed consent and willing to comply with the postoperative follow-up schedule were included. Participants with ASA physical status I to III were selected to ensure they were fit for surgery.

Exclusion Criteria

- Patients with recurrent inguinal hernia were excluded.
- Patients presenting with bilateral inguinal hernias were excluded.
- Patients with strangulated or obstructed inguinal hernias requiring emergency surgery were excluded.
- Patients with a history of previous lower abdominal or inguinal surgery were excluded.
- Patients with pre-existing chronic groin pain were excluded.
- Patients with known neuropathic disorders were excluded.
- Patients on chronic analgesic therapy were excluded.
- Patients with psychiatric illness affecting pain perception were excluded.
- Patients with systemic inflammatory conditions were excluded.
- Patients with malignancy were excluded.
- Patients who were lost to follow-up during the study period were excluded from the final analysis.

Data Collection: Preoperative data - age, gender, BMI, comorbidities, duration of hernia and preoperative pain scores - were obtained using a structured form. All surgeries had the same anesthesia protocol. In Group A we did have surgeons, who routinely identified and preserved the ilioinguinal, iliohypogastric and genital branch of genitofemoral nerves. In Group B nerves were not routinely identified.

Postoperative pain was assessed by Visual Analog Scale (VAS) after 24 hours, 1 week, 1 month, 3 months, 6 months and 12 months. Chronic postoperative pain was defined as a pain lasting beyond three months after the operation and without being caused by another. Pain type - neuropathic pain or nociceptive pain - was classified using a standard neuropathic pain screening questionnaire. We also documented functional impairment; painkiller use as well as the impact on daily activities at follow up visits.

Data Analysis: Data were entered and analyzed with the aid of using the statistical package software (SPSS) version 25.0. Continuous variables, such as age and pain scores, were expressed as mean ± standard deviation. Categorical variables (including gender and the presence of chronic post-surgical pain (CPSP)) were reported as frequencies and percentages. Mean pain scores between the two groups were compared by independent sample t-test and the incidence of chronic pain and other categorical variables were compared according to chi-square test. p-Value less than 0.05 was regarded as statistically significant. Multivariate logistic regression was carried out to determine independent risk factors of chronic post-surgical pain.

RESULTS

Table 1: Baseline Demographic and Clinical Characteristics

Variable	Group A (Nerve Identification) n=100	Group B (Non-Identification) n=100	p-value
Mean Age (years)	44.8 ± 12.6	46.2 ± 11.9	0.41
Male Gender	92 (92%)	90 (90%)	0.61
Mean BMI (kg/m²)	25.1 ± 3.2	25.4 ± 3.5	0.53
Diabetes Mellitus	18 (18%)	20 (20%)	0.71
Hypertension	22 (22%)	24 (24%)	0.74
Preoperative Groin Pain	28 (28%)	31 (31%)	0.64

Patients in Group A had a mean age of 44.8 ± 12.6 years, compared with 46.2 ± 11.9 years in Group B. Most participants were male, with 92% in Group A and 90% in Group B. Age, gender distribution, BMI, comorbidities, and pre-operative groin pain did not differ significantly between the groups ($p > 0.05$). The two groups were thus considered to be similar at the start.

Table 2: Early Postoperative Pain Scores (VAS)

Time Interval	Group A (Mean ± SD)	Group B (Mean ± SD)	p-value
24 Hours	4.9 ± 1.2	5.3 ± 1.4	0.03
1 Week	3.2 ± 1.1	3.8 ± 1.3	0.01
1 Month	1.6 ± 0.9	2.1 ± 1.0	0.004

At 24 hours after surgery, Group A had a significantly lower mean VAS pain score (4.9 ± 1.2) than Group B (5.3 ± 1.4) ($p = 0.03$). Similar significant differences were noted at 1 week and 1 month follow ups with the nerve identification group experiencing lower pain scores. These findings suggest that identification and preservation of the nerve is associated with less early postoperative pain.

Table 3: Incidence of Chronic Post-Surgical Pain (CPSP)

Outcome	Group A (n=100)	Group B (n=100)	p-value
CPSP at 3 Months	12 (12%)	22 (22%)	0.04
CPSP at 6 Months	9 (9%)	18 (18%)	0.048
CPSP at 12 Months	6 (6%)	15 (15%)	0.03

At three months, chronic post-surgical pain was observed in 12% of patients in Group A versus 22% in Group B, a statistically significant difference ($p = 0.04$). At six months and twelve months, the incidence of CPSP remained significantly lower in the nerve-identification group—9% versus 18% ($p = 0.048$) and 6% versus 15% ($p = 0.03$), respectively. These results report that targeted identification and preservation of nerve significantly decrease long-term chronic pain after Lichtenstein mesh repair.

Table 4: Characteristics of Chronic Pain at 12 Months

Pain Characteristic	Group A (n=6)	Group B (n=15)
Neuropathic Features	2 (33.3%)	9 (60%)
Nociceptive Pain	4 (66.7%)	6 (40%)
Moderate to Severe Pain	2 (33.3%)	8 (53.3%)
Activity Limitation	1 (16.7%)	6 (40%)

At 12 months, patients with persistent pain showed a higher frequency of neuropathic pain features in Group B (60%) than in Group A (33%). Moderate and severe pain and functional limitations were also found to be more prevalent in those in the non-identification group. Such results suggest that failure to identify nerves may be associated with increased occurrence, severity and neuropathic nature of chronic pain.

Table 5: Multivariate Logistic Regression Analysis for Risk Factors of CPSP

Variable	Odds Ratio (OR)	95% CI	p-value
Non-Identification of Nerves	2.4	1.1 – 5.3	0.02
Preoperative Pain	2.1	1.0 – 4.4	0.04
Age < 40 years	1.8	0.9 – 3.6	0.07
High Early Postoperative Pain (VAS ≥5)	2.7	1.3 – 5.8	0.01

Multivariate analysis demonstrated that non-identification of nerves was independently associated with increased odds of developing CPSP (OR 2.4, $p = 0.02$). Pain and high early postoperative pain were also significant predictors as was preoperative groin pain. Younger age group showed a trend toward significance but did not reach the threshold.

DISCUSSION

Chronic post-surgical pain (CPSP) following inguinal hernia repair remains a major problem even with the use of modern mesh techniques. In this prospective study of 200 patients who underwent Lichtenstein mesh repair, surgeons who recognized and preserved nerves during the surgical procedure reported fewer pain scores early after surgery, and less CPSP at 3, 6, and 12 months. Non identification of nerves was a significant independent predictor of chronic pain on multivariate analysis. The overall CPSP rate at 12 months was 10.5%, within the international range of about 6–20% depending on how pain is defined and how long patients are followed. Importantly, the rate dropped from 15% in the non-identification group to 6% in the nerve-identification group, showing that careful nerve handling can reduce chronic groin pain.

Previous systematic reviews have observed that injury, entrapment or fibrosis involving the ilioinguinal, iliohypogastric or genitofemoral nerves play a significant role in neuropathic groin pain. Reinpold mentioned that the damage of nerves during open mesh surgery is also one of the most consistent modifiable risks factors for chronic pain after surgery. Moseholm et al documented the large variation in nerve identification practices and suggested that the standardization of nerve visualization may help improve pain outcomes. Our results also are consistent with these observations: Routine identification and preservation of nerves was associated with fewer neuropathic pain features after one year. Lower early post-operative pain scores are clinically important as high early postoperative pain strongly predicts chronic pain. In our multivariate model, an early postoperative VAS of 5 or higher was associated with nearly tripled the risk of CPSP, which supports earlier findings that early nociceptive sensitization can progress to chronic neuropathic pain if it is not controlled.

Among patients who still had symptoms, the proportion with neuropathic pain was higher in the non-identification group (60% vs 33.3%). This is in line with previous reports that there often are neuropathic symptoms of lower abdominal pain after herniorhaphy such as burning, paresthesia, and hyperesthesia, attributed to direct nerve trauma or nerve entrapment in suture or mesh. Routine visualization of nerves may minimize unintentional injury to nerves and limit fibrotic entrapment.

However, nerve management is still up for debate. Some studies have attempted prophylactic neurectomy in an attempt to prevent chronic pain, with mixed results. Neurectomy may be beneficial for some patients but may lead to numbness and sensory loss. Our study was on nerve identification and preservation, and attempting not to cause nerve injury while trying to keep sensation normal.

Younger age and pre operative pain were also linked to an increased risk of CPSP, replicating risk factors documented in several meta-analyses. These findings emphasize the multifactoriality of CPSP including patient characteristics, surgical technique, and peri-operative pain control. Strengths of our study include a prospective design, appropriate sample size, standardised technique and 1-year follow-up. Limitations include the fact that this is a single center study and may not be generalizable, and that pain is a subjective measure despite the use of VAS and neuropathic screening tools. We also didn't follow patients past one year, so it could be that we are missing really late onset pain. Overall, the study supports the idea that adequate intraoperative nerve identification and preservation during Lichtenstein mesh repair can reduce incidence and severity of chronic post-surgical pain.

CONCLUSION

Identifying and preserving the inguinal nerves during Lichtenstein mesh repair also significantly reduces early postoperative pain and reduces the incidence of chronic post-surgical pain at 1-year follow up. Not being able to identify the nerves is also independently associated with increased risk of persistent and neuropathic pain. Thus, the routine identification of nerves may be a protective strategy in order to minimise the chronic groin pain following open mesh repair.

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