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The Effects of High Ligation Versus Peritoneal Reduction on Postoperative Pain in Lichtenstein Repair: A Randomised Trial

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ABSTRACT

The Lichtenstein hernioplasty technique is one of the most commonly preferred approaches in inguinal hernia surgery today. However, the impact of different surgical maneuvers on postoperative pain remains controversial. This study aimed to compare the effects of high ligation of the hernia sac (excision and removal) versus peritoneal reduction without sac excision on postoperative pain following Lichtenstein repair.

Eighty patients with indirect inguinal hernia who underwent elective Lichtenstein repair were included and divided into two groups. High ligation was performed in 41 patients, while peritoneal reduction was applied in 39 patients. Postoperative pain levels were assessed using the Visual Analog Scale (VAS) at the 6th and 24th hours.

At the 6th postoperative hour, no significant difference in pain intensity was observed between the two groups ($p=0.150$). However, at the 24th hour, the pain level was significantly higher in the high ligation group ($p=0.010$). In both groups, pain scores significantly decreased at 24 hours compared to the early postoperative period ($p=0.010$).

Preservation of peritoneal integrity during inguinal hernia repair may reduce early postoperative pain and improve patient comfort. Therefore, the peritoneal reduction technique can be considered a preferable option in Lichtenstein repair to enhance postoperative recovery.

Keywords: Hernia, Inguinal; Hernia, Inguinal / surgery; Lichtenstein Hernioplasty; Ligation; Postoperative Pain

Introduction

Inguinal hernia constitutes the most common abdominal wall defect and remains a major issue in general surgical practice, with a markedly higher prevalence among males. The lifetime risk is approximately 27% in men and 3% in women, and more than 20 million procedures are performed annually worldwide, reflecting both its clinical and socioeconomic impact (1).

Over time, numerous surgical approaches have been introduced for inguinal hernia repair. Among these, the Lichtenstein tension-free mesh repair has become the most widely adopted due to its reproducibility, feasibility, and low recurrence rates (2). This procedure reinforces the posterior wall of the inguinal canal with prosthetic mesh and has been established as the benchmark against which other techniques are compared (3). Despite its advantages, postoperative pain remains a significant drawback, affecting immediate recovery, delaying return to daily activities, and contributing to reduced quality of life (4).

Pain following hernia repair is multifactorial. Factors such as nerve handling, extent of dissection, and peritoneal trauma are major contributors (5). Early postoperative pain can prolong hospitalization and impair mobilization, while persistent pain may evolve into chronic post-herniorrhaphy pain syndrome, which is recognized as one of the most challenging long-term complications after groin hernia surgery (6). From a mechanistic perspective, peritoneal injury triggers the release of inflammatory mediators such as cytokines, prostaglandins, and bradykinin, leading to peripheral sensitization and amplified nociceptive signaling (7). Furthermore, injury to the richly innervated peritoneal surface may directly stimulate nociceptors and exacerbate postoperative pain perception (8).

One specific technical factor influencing these outcomes is the management of the hernia sac.

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High ligation involves dissection, ligation, and excision of the sac at the internal ring, providing technical ease for the surgeon but potentially increasing pain due to tissue trauma and inflammatory activation (9). Conversely, peritoneal reduction preserves the integrity of the sac by reducing it intact into the abdominal cavity, which may attenuate tissue injury and limit inflammatory response, thereby decreasing postoperative pain (10). Given that peritoneal manipulation is a key determinant of postoperative nociception, preserving the peritoneal sac in indirect inguinal hernia repair may provide a clinically meaningful benefit by reducing tissue trauma and improving early postoperative comfort.

Despite these theoretical and clinical considerations, comparative evidence between high ligation and peritoneal reduction within the context of Lichtenstein repair remains limited. In the current emphasis on patient-centered care in hernia surgery, the incorporation of patient-reported outcome measures (PROMs) is essential. Recent reviews have highlighted the inconsistent validation and reporting of these measures in inguinal hernia repair trials, underscoring a need for standardized, patient-centered metrics in future studies (11). Therefore, the present study was designed to compare the effects of high ligation and peritoneal reduction on early postoperative pain in patients undergoing Lichtenstein repair for indirect inguinal hernia.

Materials and Methods

Study Design and Patient Selection: This prospective, randomized clinical trial was conducted between March 2025 and May 2025 in the Department of General Surgery at our institution. A total of 80 patients who underwent elective surgery for indirect inguinal hernia with the Lichtenstein tension-free mesh repair technique were enrolled. All participants, or their legal representatives, received a detailed explanation of the study protocol, and written informed consent was obtained prior to inclusion. Patients were randomized into two groups according to the surgical technique performed: Group 1 (high ligation, n = 41) and Group 2 (peritoneal reduction without sac excision, n = 39). Randomization was performed by an independent ward nurse using a coin-flip method.

Sample Size Calculation: The sample size was determined by power analysis prior to the study. Assuming a two-sided α level of 0.05, a power of 80%, and an expected moderate effect size in postoperative pain scores, it was estimated that at least 35 patients per group would be required. Therefore, a minimum of 70 patients was planned for inclusion. To compensate for possible dropouts, 80 patients were randomized (41 in the high ligation group and 39 in the peritoneal reduction group).

Eligibility criteria included patients aged 18–65 years with ASA physical status I–II and a diagnosis of unilateral indirect inguinal hernia. Exclusion criteria were bilateral or direct inguinal hernia, recurrent hernia, a history of chronic pain, or comorbid conditions such as malignancy, diabetes mellitus, or neuropathic pain disorders.

Surgical Procedure: All procedures were performed by the same surgical team under spinal anesthesia. In both groups, the hernia sac was dissected and mobilized up to the internal ring. In Group 1, the sac was ligated at the internal ring with a Vicryl suture and excised. In Group 2, the sac was preserved and reduced into the abdominal cavity without excision. In both groups, a standard polypropylene mesh was placed to reinforce the posterior wall of the inguinal canal using the Lichtenstein technique, and mesh fixation was performed with 2-0 polypropylene sutures.

Outcome Measures: Demographic characteristics of all patients were recorded. Postoperative pain was assessed at the 6th and 24th hours using the Visual Analog Scale (VAS), where 0 indicated no pain and 10 represented the worst possible pain. The VAS was administered verbally, with patients verbally reporting a numerical score between 0 and 10. All assessments were performed by the same physicians to minimize interobserver variability.

Statistical Analysis: All statistical analyses were performed using SPSS for Windows version 22.0 (SPSS Inc., Chicago, IL, USA). Prior to analysis, data were inspected for accuracy, missing values, and outliers. The distributional characteristics of continuous variables were evaluated using the Kolmogorov–Smirnov test, skewness–kurtosis values, and visual assessment of histograms.

A priori power analysis was conducted using G*Power 3.1 to determine the required sample size. Assuming a moderate effect size (Cohen's d = 0.50), a two-tailed α level of 0.05, and β = 0.20 (power = 80%), a minimum of 35 patients per group was required. To account for potential dropouts, 80 patients were ultimately included.

Randomization was performed using a computer-generated block randomization method (block size = 4) to ensure balanced allocation between the high ligation and peritoneal reduction groups. The allocation sequence was prepared by an independent researcher who was not involved in patient recruitment or follow-up.

For between-group comparisons of continuous variables, the independent samples t-test was applied. Within-group comparisons of pain scores at different time points were performed using the paired samples t-test. Categorical variables were analyzed using the chi-square test where appropriate. Continuous variables were expressed as Mean ± Standard Deviation (SD). A p-value < 0.050 was considered statistically significant.

Ethical Approval: The study protocol was approved by the Institutional Ethics Committee of Malatya Turgut Özal University (Approval no: E-30785963-020-285838; date: February 5, 2025) and conducted in accordance with the principles of the Declaration of Helsinki and its later amendments.

Informed consent

Written informed consent was obtained from all individual participants included in the study.

Results

A total of 80 patients diagnosed with indirect inguinal hernia were included in the study, of whom 75 were male. The gender distribution was comparable between the two groups. High ligation was performed in 41 patients (51.2%), while peritoneal reduction without sac excision was performed in 39 patients. The mean age of the study population was 56.2 ± 12.2 years, with no significant difference between the groups ($p > 0.050$).

Postoperative pain scores were assessed according to the surgical technique (peritoneal reduction vs. high ligation) and the time of evaluation (6th hour and 24th hour). At 6 hours postoperatively, the mean pain score was 4.93 ± 1.68 in the high ligation group and 4.41 ± 1.45 in the peritoneal reduction group. This difference was not statistically significant ($t = -1.47$; $p = 0.150$), indicating that early postoperative pain levels did not differ significantly between the two techniques.

However, at 24 hours postoperatively, the mean pain score in the high ligation group (3.44 ± 1.64) was significantly higher compared with the peritoneal reduction group (2.26 ± 0.94) ($t = -3.98$; $p = 0.010$). These findings demonstrate that preservation of the peritoneum was associated with lower pain intensity in the later postoperative period (Table 1).

In both groups, postoperative pain scores decreased significantly over time. In the peritoneal reduction group**,** pain scores between the 6th and 24th hours demonstrated a statistically highly significant reduction ($t=9.83$; $p=0.010$). Similarly, the high ligation group also showed a significant decrease in pain during the same interval ($t=5.08$; $p=0.010$).

When postoperative pain levels were evaluated between male and female patients at two time points (6th and 24th hours), the mean pain score at the 6th hour was 4.71±1.62 in males and 4.20±0.84 in females. The difference between sexes was not statistically significant ($t=0.69$; $p=0.490$). Similarly, at the 24th hour, the mean pain score was 2.88±1.51 in males and 2.60±0.55 in females, with no significant difference observed ($t=0.41$; $p=0.680$). These findings suggest that sex does not have a significant effect on postoperative pain perception (Table 2)

In addition, within-group comparisons revealed a statistically significant reduction in postoperative pain levels over time in both sexes. Among male patients, pain scores significantly decreased from the 6th to the 24th hour ($t=9.20$; $p=0.010$). Similarly, female patients also demonstrated a marked reduction in pain during the same interval ($t=6.53$; $p=0.010$).

Furthermore, no statistically significant correlation was found between age and changes in pain scores ($r=0.14$; $p=0.680$), indicating that demographic factors such as sex and age may have limited influence on postoperative pain perception and warrant further discussion in the context of existing literature.

Discussion

Although inguinal hernia repair has long been established as a standard surgical procedure, the optimal management of the hernia sac remains controversial. In particular, it has not yet been clarified whether high ligation or peritoneal reduction provides a distinct advantage in terms of postoperative pain. In this study, we aimed to address this question by comparing the outcomes of these two techniques.

The comparison of two different surgical techniques, high ligation and peritoneal reduction, performed during Lichtenstein hernioplasty revealed distinct effects on early postoperative pain. No statistically significant difference was observed between the groups in VAS scores at the 6^{th} postoperative hour. At the 24^{th} hour,

Table 1: Postoperative Pain Scores According to Surgical Technique and Time of Assessment

Time point	Peritoneal reduction (Mean ± SD)	High ligation (Mean ± SD)	Between-group comparison**
6th hour	4.41±1.45	4.93±1.68	t:-1.47; p:0.150
24th hour	2.26±0.94	3.44±1.64	t:-3.98; p:0.010
Within-group change*	t:9.83; p:0.010	t:5.08; p:0.010	

Mean ± SD: Mean value ± Standard deviation
***Paired samples t-test:** Used to compare 6th-hour and 24th-hour pain scores within each group
****Independent samples t-test:** Used for comparisons between the two groups

Table 2: Pain Assessment According To Time and Sex

Time point	Male (Mean ± SD)	Female (Mean ± SD)	Between-group comparison**
6th hour	4.71±1.62	4.20±0.84	t:0.69;p:0.490
24th hour	2.88±1.51	2.60±0.55	t:0.41;p:0.680
Within-group difference*	t:9.20;p:0.010	t:6.53;p:0.010	

Mean ± SD: Mean value ± Standard deviation
***Paired samples t-test:** Used to compare 6th-hour and 24th-hour pain scores within each group
****Independent samples t-test:** Used for comparisons between males and females

however, pain scores were significantly lower in the group without peritoneal sac transection. This finding suggests that preservation and reduction of the peritoneum into the intra-abdominal cavity may reduce trauma to the surrounding tissues, thereby leading to less inflammation and lower pain levels. A plausible explanation is that peritoneal reduction requires less manipulation of the sac and surrounding structures, thereby avoiding excessive traction or dissection that may irritate the ilioinguinal or iliohypogastric nerves. Additionally, maintaining the integrity of the peritoneal sac likely limits exposure of raw peritoneal surfaces, reducing the local inflammatory response and subsequent nociceptive stimulation. Conversely, patients who underwent high ligation exhibited significantly higher pain scores at the 24th hour compared to those treated with peritoneal reduction, a difference that can be explained by increased tissue trauma, nerve tension, and enhanced inflammatory response. Similar results have been reported in recent literature, where omission of sac ligation was associated with reduced postoperative pain without increasing recurrence risk (12).

Preservation and reduction of the peritoneum into the intra-abdominal cavity appeared to minimize surrounding tissue trauma and inflammation, leading to a significant reduction in early postoperative pain levels. This observation aligns with data from Ciftci et al., who found that invagination of the hernia sac significantly reduced early postoperative pain compared to sac ligation in Lichtenstein mesh hernioplasty, particularly in EHS grade 3 hernias, without increasing complication or recurrence rates (13).

Differences in surgical technique, operative time, and the learning curve can also influence postoperative pain. Additionally, factors such as mesh type, placement technique, anesthesia method, and postoperative analgesic regimen are known to affect pain perception. A randomized clinical trial comparing three postoperative analgesic regimens in open inguinal hernia repair demonstrated significant reductions in pain scores at multiple early time points (45 min, 2, 6, 12, and 24 h) when using a multimodal analgesic approach (14). Moreover, a recent randomized controlled study showed that perioperative pain neuroscience education enhanced analgesic effectiveness and improved recovery quality in laparoscopic inguinal hernia repair (15). Therefore, despite the primary focus of the present study being surgical technique, it is crucial to consider a multivariate approach.

The findings of this study indicate that Lichtenstein hernioplasty with preservation of peritoneal integrity is associated with lower pain levels in the early postoperative period. When compared with the high ligation technique, peritoneal reduction appears to provide greater postoperative comfort. Surgical technique selection should therefore consider not only success rates but also patient satisfaction and pain control.

Limitations: The limitations of this study include the small sample size, the lack of long-term follow-up, and its single-center design. Future research conducted in multiple centers with larger patient cohorts and long-term pain assessment may provide stronger evidence to support these findings.

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Conflict of Interest: The authors declare that they have no competing interests or financial relationships that could have influenced the conduct or outcomes of this study.

Human and Animal Rights Statement: All human participants were evaluated in accordance with the principles of the Declaration of Helsinki. Due to the retrospective nature of the study, the requirement for informed consent was waived by the ethics committee.

Scientific Responsibility Statement: The authors declare full responsibility for the scientific content and conclusions of this study.

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