Risk factors for postoperative complications of inguinal hernias: A single-center observational study.

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Summary

Introduction: Inguinal hernioplasty is one of the most common surgical procedures worldwide. Despite the use of tension-free techniques, postoperative morbidity remains a significant clinical and socioeconomic challenge. The aim of this study was to identify risk factors for postoperative complications among patients undergoing inguinal hernia repair at a regional surgical center.

Materials and Methods: A retrospective, observational, and analytical study was conducted at the Teodoro Maldonado Carbo Specialty Hospital in Guayaquil, Ecuador, between 2019 and 2021. From a population of 892 patients, a probabilistic sample of 142 records with surgical complications was selected for comparative analysis with records without complications. Demographic, technical, and clinical variables were analyzed using chi-square tests and Student's t tests, and odds ratios (ORs) were calculated in SPSS v.26.

Results: The overall incidence of complications was 15.9% (95% CI 13.5–18.3%). The most frequent adverse events were seromas (34.5%), infections (20.4%), and wound dehiscence (14.8%). The main statistically significant risk factors were the lack of prosthetic mesh application (OR: 3.76; P < 0.0001), the use of the Bassini technique compared with the Lichtenstein technique (OR: 2.59; P < 0.0001), type 2 diabetes mellitus (OR: 1.81; P = 0.0012), and a surgical time exceeding 90 minutes (OR: 1.50; P = 0.0277). Factors such as obesity and a history of hernia were not statistically significant.

Conclusions: The most critical risk factors for complications in inguinal hernioplasty are technical and metabolic. The nonuse of mesh and the application of tension techniques drastically increase morbidity. It is imperative to standardize the Lichtenstein technique and optimize preoperative glycemic control to reduce the burden of complications and improve institutional clinical outcomes.

Keywords:

Inguinal hernias, Herniorrhaphy, Risk factors, Postoperative complications, Surgical meshes.

Abbreviations

OR: odds ratio.

Supplementary information

No supplementary materials are declared.

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Authors' contributions

Joffre Joshua Lavid Alvarado: conceptualization, research, writing of the original draft, resources, software, supervision.

Jorge Alejandro Pazmiño Medina, Methodology, Data Curation, Formal Analysis, Fundraising, Project Management, Validation, Visualization, Writing – Review and Editing.

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Availability of data and materials

The datasets used and analyzed during this study are available to the corresponding author upon reasonable request.

Introduction

Inguinal hernia repair is one of the most common surgical procedures in general surgery practice worldwide, with an estimated 32.5 million interventions annually [1]. Despite significant advances in tension-free techniques and the rise of minimally invasive approaches (laparoscopy and robotic surgery), the incidence of postoperative complications remains a major clinical and socioeconomic challenge [2].

Complications following inguinal hernioplasty can be classified into immediate events, such as the development of hematomas and seromas, and chronic complications, the morbidity of which profoundly affects patients' quality of life [2]. Among the latter, chronic inguodynia—defined as persistent pain for more than three months after surgery—and hernia recurrence remain the main indicators of surgical success or failure. The current literature suggests that the genesis of these complications is multifactorial, involving complex interactions among host factors, including comorbidities, smoking, nutritional status, and connective tissue quality. Technical factors include the choice of prosthesis (polypropylene weight and macroporosity), the fixation method, and the surgeon's experience. Biological response factors include foreign body reactions and aberrant healing processes. Although the use of prosthetic mesh has standardized inguinal hernioplasty, its implementation has led to mesh-related visceral complications, the reported incidence of which appears to have tripled in the last decade. A systematic review of the literature from 1992--2018 suggested that although these complications are common across all techniques, the laparoscopic approach has the highest incidence, particularly involving the urinary bladder. Conversely, the Lichtenstein technique results in the lowest rate of these events [3].

The diagnosis of these complications is often delayed due to low initial clinical suspicion, frequently resulting in emergency laparotomies with complex visceral resections and the removal of infected prosthetic material. The evidence also indicates that compared with placement over the transversalis fascia, preperitoneal mesh placement accelerates the onset of these lesions [4].

The controversy surrounding the ideal approach for inguinal hernia repair persists, centered on the comparison between the open Lichtenstein (LMR) and laparoscopic techniques. A prospective randomized study involving 174 patients compared the total extraperitoneal (TEP) laparoscopic technique with the open LMR technique. The results demonstrated that while the TEP approach requires a significantly longer operative time (84.6 vs. 59.2 minutes), it offers superior clinical advantages in patient recovery [4]. Specifically, a notably lower incidence of severe postoperative pain was observed in the laparoscopic group (7.9%) than in the open group (15.1%), as was a drastic reduction in the prevalence of chronic groin pain (3.4% vs. 22.09%). Furthermore, patients who underwent TEP had shorter hospital stays and earlier return to normal activities (13.6 vs. 19.8 days). The study concluded that although the laparoscopic technique has a longer learning curve, its benefits in reducing chronic morbidity and improving postoperative comfort position it as a preferred option when performed by experienced surgeons, with recurrence rates comparable to those of the conventional technique [4].

The objective of this study was to identify risk factors for postoperative complications in patients with inguinal hernias referred to a regional surgical center.

Materials and methods

Studio design

This study is observational. The source is retrospective.

Scenery

The study was conducted in the statistics department of the Teodoro Maldonado Carbo Specialty Hospital of the Ecuadorian Social Security Institute in Guayaquil, Ecuador. The study period was from January 1, 2019, to December 31, 2021.

Participants

Records of patients who were diagnosed with inguinal hernia and who underwent surgical treatment were included. No records were excluded.

Study groups

The samples were divided into a group without complications and a group with postoperative complications for analysis.

Variables

The variables included age, sex, surgical technique, operating time, mesh placement, comorbidities, history of inguinal hernia, body mass index, and presence of obesity.

Data sources/measurements

The source was indirect. The data were collected through the institutional computer system, in accordance with privacy protocols and patient consent.

Biases

Observational and selection bias were avoided by applying participant selection criteria. A medical representative from each coordinating center was assigned to collect the data, which were recorded on a single online form. The principal investigator consistently maintained the data in accordance with the research protocol's guidelines and records to avoid potential interviewer, information, and recall biases. In cases of doubt about the data's standard deviation, corrections were made through onsite reviews of outliers. Two researchers independently analyzed each record in duplicate, and variables were entered into the database after verifying their consistency.

Study size

The sample was probabilistic. The study population consisted of 892 patients with inguinal hernias at the institution. Using Epi Info (CDC, Atlanta, USA, 2023), with an expected frequency of 12.4%, a 5% confidence limit, and a 95% confidence level, the sample size was 141 patients.

Quantitative variables

The results are presented as frequencies and percentages. Variables collected on a scale were not converted to categorical variables.

Statistical analysis

Qualitative variables were analyzed using frequencies and percentages. Proportions were compared via the chi-square test, and means were compared via Student's t-test. The statistical package used was IBM Corp. (published in 2018). IBM SPSS Statistics for Windows, version 26.0. Armonk, NY: IBM Corp.

Results

Participants

Among the 892 patients, 142 (15.9%; 95% CI 13.5–18.3%) experienced complications. All 142 patients were included, representing 100% of the sample. There were 39 women (27.5%) and 103 men (72.5%).

Complications of inguinal hernias

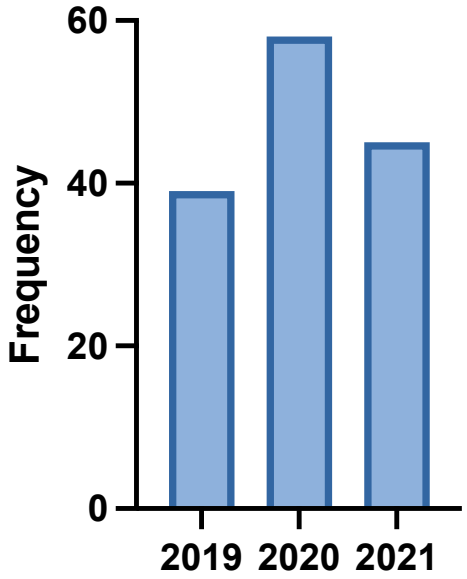
The main complications were the presence of seromas, infections and dehiscence (Table 1).

Table 1. Associated infections in patients with HIV.

	N=142	N=892
Seroma	49 (34.5%)	5.5%
Infection	29 (20.4%)	3.3%
Dehiscence	21 (14.8%)	2.4%
Postsurgical pain	18 (12.7%)	2.0%
Hematoma	13 (9.2%)	1.5%
Relapse	12 (8.5%)	1.3%

The incidence of complications was higher in 2020 (58 cases), 2019 (39 cases), and 2021 (45 cases) (Figure 1).

Figure 1. Incidence of complications in he study period .



Risk factors for the presence of complications

The main risk factors for complications were the lack of mesh application (odds ratio: 3.764; P<0.0001) and the use of the Basini technique (odds ratio: 2.5995; P<0.0001). The other factors are presented in Table 2.

Discussion

This research revealed a 15.9% incidence of postoperative complications in inguinal hernia repair, highlighting the persistent morbidity of this procedure in the studied population. The analysis identified the lack of mesh application and the use of the Bassini technique as the most significant risk factors, increasing the probability of complications by 3.76 and 2.59 times, respectively. Among the most frequent adverse events, seroma (34.5%) and surgical site infection (20.4%) predominated, findings that are closely related to modifiable factors, such as prolonged surgical time (greater than 90 minutes) and the presence of metabolic comorbidities, such as type 2 diabetes mellitus (OR: 1.81).

Table 2. Risk factors associated with surgical complications of inguinal hernia.

Associated factors	Patients with complications N=142	Patients without complications N=750	OR	95% CI	*P*
No HE applied mesh	110 (77.5%)	358 (47.7%)	3.7640	2.4757-5.7225	<0.0001
Technique of Bassini vs Liechtenstein	88 (62.0%)	289 (38.5%)	2.5995	1.7967-3.7610	<0.0001
Elderly to 90 minutes	81 (57.0%)	352 (46.9%)	1.5014	1.0455-2.1561	0.0277
Diabetes Mellitus Guy 2	71 (50.0%)	266 (35.5%)	1.8195	1.2677-2.6116	0.0012
A history of Inguinal Hernia	19 (13.4%)	90 (12%)	1.0762	0.6326-1.8306	0.7866
Obesity	52 (36.6%)	270 (36.0%)	1.0272	0.7077-1.4909	0.8879

These results suggest that although variables such as obesity or a history of recurrence did not show a statistically significant association in this sample, optimizing the surgical technique toward tension-free methods (Lichtenstein) and preoperative glycemic control are critical axes to reduce the burden of complications in the hospital center. The importance of these findings lies in identifying modifiable risk factors that directly affect patient prognosis and healthcare costs. The fact that omitting prosthetic material and the Bassini technique have the highest odds ratios confirms that the transition to tension-free repairs (Lichtenstein) is not only a technical recommendation but also an imperative to mitigate recurrence and other postoperative complications in this setting. Furthermore, the significant association between a surgical time exceeding 90 minutes (OR: 1.50) and the occurrence of complications underscores the importance of the surgeon's learning curve and the standardization of processes to improve operating room efficiency. These data allow us to establish a clear risk profile: a patient with type 2 diabetes mellitus undergoing prolonged surgery without the use of mesh represents the scenario of greatest vulnerability, which requires the implementation of presurgical optimization protocols and close monitoring to reduce the incidence of seromas and infections, which in this study affected more than one-third of the complicated population.

When these results are compared with the international literature, the 15.9% complication rate reported in this study is higher than the 10% to 12% range reported in contemporary series published in Europe and the United States [5-7]. The meta-analysis by Lockhart et al. [5] revealed that the absence of prosthetic material is the most robust predictor of surgical failure, reporting odds ratios for recurrence ranging from 2.0--3.8, which closely correlates with the OR of 3.76 found in our cohort. However, while the present study identified seroma (34.5%) as the most prevalent complication, international registries, such as the Danish Hernia Database [7], report chronic pain as the main complication, with a lower incidence of fluid collection. This discrepancy could be attributed to the high proportion of patients in our sample who underwent the Bassini technique (62%), which, by generating greater tissue tension, differs from current global standards, where the Lichtenstein technique predominates in more than 90% of cases. Finally, the relevance of diabetes mellitus as a risk factor (OR: 1.81) is consistent with multicenter cohort studies linking elevated glycated hemoglobin to a 40% to 60% increase in the risk of surgical site infection, thereby validating the statistical significance observed in the present analysis.

Possible explanations for the high incidence of complications and the strong association with technical factors could be the nature of the hospital and the epidemiological context of the study period. The high prevalence of the Bassini technique (62%) in patients with complications suggests a possible limitation in the availability of prosthetic materials (meshes) or in the selection of the technique based on urgency criteria, in which the presence of hernia strangulation or contamination of the surgical field contraindicates the use of synthetic material. Furthermore, the peak in complications observed during 2020 (58 cases) coincides with the most critical phase of the COVID-19 pandemic, which may have caused a delay in elective surgeries, resulting in more complex clinical presentations, larger hernias, and more friable tissues that hinder dissection and prolong the surgical time beyond 90 minutes. On the other hand, the high rate of seromas (34.5%) could not only be a consequence of the surgical technique but also of inadequate early postoperative mobilization or the lack of systematic use of drains in large-volume hernias, factors that were not controlled in this analysis but that usually contribute significantly to local morbidity.

The clinical relevance of these findings transcends statistical analysis, as they offer a roadmap for implementing strategies to improve surgical safety in the management of hernia pathology. The strong association between the absence of mesh and an increased risk of complications (OR: 3.76) reinforces the need to ensure the systematic supply and use of polypropylene prostheses, even in resource-limited settings, given

their proven ability to reduce morbidity. Likewise, recognizing type 2 diabetes mellitus as a significant risk factor (OR: 1.81) necessitates the adoption of strict prehabilitation and metabolic control protocols prior to elective surgery, enabling more rigorous patient selection and immune status optimization. The fact that prolonged surgical time predicts complications suggests that supervision of the technique by physicians in training and standardization of operative steps can reduce tissue exposure time. Taken together, these results allow a shift from empirical surgical practice to local evidence-based medicine, where early identification of the patient's risk profile enables anticipation and prevention of adverse events that compromise quality of life and functional recovery.

Despite the relevance of the results obtained, this research has limitations that must be considered when interpreting its conclusions. First, its retrospective and observational design limits the ability to establish a definitive causal relationship, allowing only the identification of statistical associations. Furthermore, the study was conducted at a single hospital, which could introduce selection bias and limit the generalizability of the findings to other populations with different input standards or epidemiological profiles. Another important limitation is the lack of control over potential confounding variables, such as the surgeon's level of experience (learning curve), the size of the hernia defect according to the Nyhus classification, and the patient's adherence to postoperative recommendations—factors that could influence the occurrence of seromas and recurrences. Finally, the absence of long-term follow-up prevents the evaluation of late complications, such as persistent chronic pain or recurrences after the first year, suggesting that the reported complication rate may actually be an underestimation of overall morbidity.

Based on the findings presented, several lines of research emerge to deepen the understanding of the safety of hernia repair. The development of prospective, multicenter studies evaluating the impact of technical standardization (Lichtenstein) on resource availability in public hospitals is a priority to validate whether the consistent provision of mesh significantly reduces the costs of reinterventions. Likewise, future research should focus on analyzing chronic postoperative pain, a complication that requires follow-up exceeding 24 months to determine the influence of the mesh fixation method and the anesthetic technique employed. Furthermore, given the relevance of diabetes mellitus identified in this study, it would be valuable to evaluate the effectiveness of "metabolic prehabilitation" protocols in abdominal wall surgery and to analyze whether strict glycemic control in the preoperative period achieves the same surgical outcomes for diabetic patients as for the normoglycemic population. Finally, the use of digital health and telemedicine tools for early postoperative follow-up has emerged as a fertile field for the early detection of seromas and infections, optimizing surveillance in patients identified as high risk according to the criteria of this analysis.

Main messages

Technical priority: The mesh is not optional if safety is sought (risk OR of 3.76 if not used).
Preventive focus: Diabetic patients require special attention before entering the operating room.
Time management: Operating quickly and well (less than 90 min) is a safe measure for patients.
The Bassini technique should be abandoned in favor of the Lichtenstein technique to reduce morbidity.

Conclusions

The most critical risk factors for postoperative complications of inguinal hernia are technical in nature, such as the omission of prosthetic material and the use of the Bassini technique, which drastically increase the probability of adverse events by 3.76 and 2.59 times, respectively. Similarly, a surgical time exceeding 90 minutes and the presence of type 2 diabetes mellitus act as cofactors that worsen the postoperative prognosis.

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Statements

Ethics committee approval and consent to participate

The Bioethics Committee of the Faculty of Medical Sciences, University of Guayaquil, approved the study. The study was conducted in accordance with the Declaration of Helsinki.

Publication consent

This information was not needed, as the present study did not publish images, radiographs, or specific patient studies.

Conflicts of interest

The authors report no conflicts of interest.

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