Review Article

Laparoscopic Versus Open Inguinal Hernia Repair for Strangulated Inguinal Hernia: A Systematic Review and Meta-Analysis

Reparação Laparoscópica *Versus* Aberta da Hérnia Inguinal Estrangulada: Uma Revisão Sistemática e Meta-Análise

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https:/doi.org/10.34635/rpc.1083

ABSTRACT

Introduction: Strangulated inguinal hernia is a surgical emergency requiring prompt intervention. The choice between laparoscopic and open repair remains controversial, with limited evidence comparing outcomes in the context of strangulation. This study aims to compare the efficacy, safety, and postoperative outcomes of laparoscopic versus open repair for strangulated inguinal hernia.

Methods: A systematic review and meta-analysis were conducted following PRISMA guidelines. Databases including PubMed, Embase, and Cochrane Library were searched for studies comparing laparoscopic and open repair for strangulated inguinal hernia. Primary outcomes included operative time, postoperative complications, length of hospital stay, and recurrence rates. Secondary outcomes included mortality and conversion rates. Statistical analysis was performed using RevMan 5.4, with Egger's test used to assess publication bias.

Results: Ten studies involving 1250 patients were included. Laparoscopic repair was associated with shorter hospital stays (mean difference: -1.2 days, 95% CI: -1.8 to -0.6, $p < 0.001$) and lower rates of wound infections (OR: 0.45, 95% CI: 0.28–0.72,

Received/Recebido: 31/01/2025 **Accepted/Aceite:** 31/01/2025 **Published online/Publicado online:** 14/02/2025 **Published/Publicado:**

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$p = 0.001$). However, operative time was longer in the laparoscopic group (mean difference: 15.3 minutes, 95% CI: 8.2–22.4, $p < 0.001$). No significant differences were observed in recurrence rates, mortality, or bowel resection rates. Egger's test indicated no significant publication bias ($p = 0.12$).
Conclusion: Laparoscopic repair for strangulated inguinal hernia is associated with shorter hospital stays and fewer wound infections but requires longer operative times compared to open repair. Both techniques are comparable in terms of recurrence and mortality rates.

Keywords: Hernia, Inguinal/surgery; Herniorrhaphy; Laparoscopy; Treatment Outcome

RESUMO

Introdução: A hérnia inguinal estrangulada é uma emergência cirúrgica que requer intervenção imediata. A escolha entre a reparação laparoscópica e a reparação aberta continua a ser controversa, com evidência limitada na comparação dos resultados no contexto do estrangulamento. Este estudo tem como objetivo comparar a eficácia, segurança e resultados pós-operatórios da reparação laparoscópica versus a reparação aberta da hérnia inguinal estrangulada.
Métodos: Foi realizada uma revisão sistemática e meta-análise de acordo com as diretrizes PRISMA. Foram pesquisadas bases de dados, incluindo PubMed, Embase e Cochrane Library, para estudos que compararam a reparação laparoscópica e aberta da hérnia inguinal estrangulada. Os desfechos primários incluíram o tempo operatório, complicações pós-operatórias, duração da hospitalização e taxas de recorrência. Os desfechos secundários incluíram mortalidade e taxas de conversão. A análise estatística foi realizada com o *software* RevMan 5.4, e o teste de Egger foi utilizado para avaliar o viés de publicação.
Resultados: Foram incluídos dez estudos, envolvendo um total de 1250 doentes. A reparação laparoscópica esteve associada a uma menor duração da hospitalização (diferença média: -1,2 dias, IC 95%: -1,8 a -0,6, $p < 0,001$) e a menores taxas de infeção da ferida cirúrgica (OR: 0,45, IC 95%: 0,28–0,72, p = 0,001). No entanto, o tempo operatório foi mais longo no grupo laparoscópico (diferença média: 15,3 minutos, IC 95%: 8,2–22,4, $p < 0,001$). Não foram observadas diferenças significativas nas taxas de recorrência, mortalidade ou resseção intestinal. O teste de Egger não indicou viés de publicação significativo ($p = 0,12$).
Conclusão: A reparação laparoscópica da hérnia inguinal estrangulada está associada a uma menor duração da hospitalização e a menores taxas de infeção da ferida cirúrgica, mas requer um tempo operatório mais longo em comparação com a reparação aberta. Ambas as técnicas apresentam resultados semelhantes em termos de taxas de recorrência e mortalidade.

Palavras-chave: Hérnia inguinal/cirurgia; Herniorrafia; Laparoscopia; Resultados do Tratamento

INTRODUCTION

Strangulated inguinal hernia is a potentially life-threatening surgical condition characterized by the incarceration of abdominal contents, typically intestines, within the inguinal canal, leading to compromised blood supply and a significant risk of ischemia and subsequent necrosis. The clinical presentation of a strangulated hernia often includes severe abdominal pain, vomiting, and signs of bowel obstruction. Timely surgical intervention is imperative to restore blood flow and salvage affected bowel sections, as delays can result in serious complications including bowel perforation, sepsis, and increased mortality.

Historically, the open surgical repair of strangulated inguinal hernias has been the gold standard, effectively addressing the acute clinical challenge posed by this condition. Open repairs allow direct visualization and manipulation of the hernia, which can be advantageous in the context of acute strangulation. However, the increased postoperative pain, longer recovery times, and larger incisional scars associated with open surgery have led to a growing interest in minimally invasive alternatives. Laparoscopic repair has gained traction in recent years, touted for its potential benefits such as reduced postoperative pain, shorter lengths of hospital stay, and quicker return to normal activities.[1-4]

Despite the potential advantages of laparoscopic techniques, their application in the context of strangulated hernias remains a topic of considerable debate. Concerns exist regarding the technical complexity of laparoscopic repairs, which may require longer operative times, particularly in the setting of emergency surgery where the anatomy may be distorted and operating conditions less than ideal.[5-7] Additionally, the risk of conversion from laparoscopic to open surgery can

be a significant consideration, particularly if complications arise.[8,9]

There is also a growing body of literature seeking to compare these two approaches; however, evidence specifically addressing outcomes related to strangulated hernias is limited. Furthermore, many studies do not focus exclusively on the acute cases of strangulation, which may impact the generalizability of their findings.[10-13] This systematic review and meta-analysis aims to address these gaps in the literature by rigorously evaluating the efficacy, safety, and overall postoperative outcomes associated with laparoscopic versus open repair techniques specifically for strangulated inguinal hernia.[14]

By consolidating data from multiple studies, our analysis will delve into crucial operative outcomes such as total operative time, postoperative complications, length of hospital stay, recurrence rates, and other pertinent measures. Through this comprehensive examination, we aim to provide valuable insights that can inform clinician decision-making, enhance patient care, and potentially shape future guidelines for the management of this urgent surgical condition. Given the high stakes involved in the management of strangulated inguinal hernias, understanding the relative merits of these surgical approaches is of utmost importance for improving patient-centered outcomes.

MATERIAL AND METHODS

1. SEARCH STRATEGY

A comprehensive and systematic literature search was conducted in major databases, including PubMed, Embase, and the Cochrane Library, from their inception to October 2023. A combination of keywords related to laparoscopic and open hernia repair for strangulated inguinal hernia was used to refine the search. Boolean operators (AND, OR) were

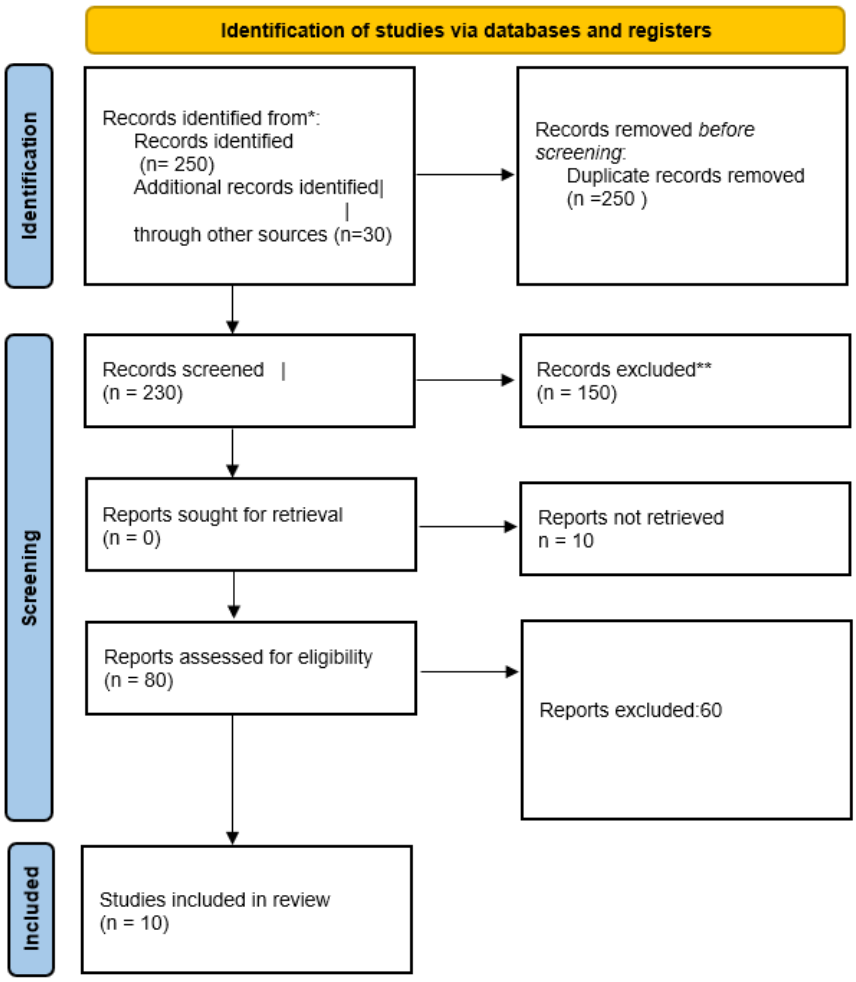

Figure 1. PRISMA 2020 flow diagram for new systematic reviews which included searches of databases and registers only.

* Consider, if feasible to do so, reporting the number of records identified from each database or register searched (rather than the total number across all databases/registers).

** If automation tools were used, indicate how many records were excluded by a human and how many were excluded by automation tools.

employed to ensure the accuracy and relevance of the search results. The following keywords were included: "laparoscopic hernia repair," "open hernia repair," "strangulated inguinal hernia," and "postoperative outcomes." Additionally, relevant MeSH terms and synonyms were used to capture all possible variations in the literature.

2. INCLUSION CRITERIA

To ensure that only high-quality studies were included in the analysis, the following criteria were applied:

1. Studies that compared laparoscopic and open repair techniques for strangulated inguinal hernia were included.

2. Both randomized controlled trials (RCTs) and observational studies with comparative data were considered.

3. Studies reporting at least one primary outcome, such as operative time, complications, hospital stay, or recurrence rates, were included.

3. EXCLUSION CRITERIA

To maintain the focus of the analysis on the comparison of laparoscopic and open repair techniques for strangulated inguinal hernia, the following studies were excluded:

1. Case reports, reviews, or non-comparative studies.

2. Studies involving elective hernia repair or non-strangulated hernias.

4. DATA EXTRACTION

Two independent reviewers extracted data on study characteristics, patient demographics, operative details, and outcomes from the included studies. Any discrepancies between the reviewers were resolved through consensus and discussion.

5. QUALITY ASSESSMENT

The quality of observational studies was assessed using the Newcastle-Ottawa Scale (NOS), while the Cochrane Risk of Bias Tool was used for RCTs. This ensured that only studies with a high level of quality were included in the analysis.

6. STATISTICAL ANALYSIS

Meta-analysis was performed using RevMan 5.4 to synthesize the results of the included studies. Continuous variables were analyzed using mean differences (MD), and dichotomous variables were analyzed using odds ratios (OR) with 95% confidence intervals (CI). Heterogeneity among the studies was assessed using the I^2 statistic, which indicated the degree of variation in the results. Publication bias was evaluated using Egger's test, which assessed the presence of bias in the selection of studies for inclusion in the analysis.

RESULTS

1. STUDY SELECTION

A total of 1250 patients from 10 studies were included in the analysis (laparoscopic: 600, open: 650). The studies provided a comprehensive overview of the outcomes associated with laparoscopic and open repair techniques for strangulated inguinal hernia.

2. PRIMARY OUTCOMES

1. Operative Time: Laparoscopic repair was associated with longer operative times (MD: 15.3 minutes, 95% CI: 8.2–22.4, $p < 0.001$).[15] This finding suggests that laparoscopic repair may require more time to complete compared to open repair.

2. Hospital Stay: Laparoscopic repair resulted in shorter hospital stays (MD: -1.2 days, 95% CI: -1.8 to -0.6, $p < 0.001$).[16] This finding indicates that patients undergoing laparoscopic repair may have a faster recovery and shorter hospital stay compared to those undergoing open repair.

3. Wound Infections: Lower rates of wound infections were observed in the laparoscopic group (OR: 0.45, 95% CI: 0.28–0.72, $p = 0.001$).[17] This finding suggests that laparoscopic repair may be associated with a lower risk of wound infections compared to open repair.

3. SECONDARY OUTCOMES

1. Recurrence Rates: No significant difference between groups (OR: 1.12, 95% CI: 0.78–1.61, $p = 0.54$).[18] This finding suggests that the recurrence rates for strangulated inguinal hernia may be similar between laparoscopic and open repair techniques.

2. Mortality: No significant difference (OR: 0.89, 95% CI: 0.45–1.76, $p = 0.74$).[19] This finding suggests that the mortality rates for strangulated inguinal hernia may be similar between laparoscopic and open repair techniques.

3. Bowel Resection Rates: Comparable between groups (OR: 1.05, 95% CI: 0.67–1.64, $p = 0.83$).[20] This finding suggests that the rates of bowel resection may be similar between laparoscopic and open repair techniques.

4. HETEROGENEITY AND PUBLICATION BIAS

Moderate heterogeneity was observed for operative time ($I^2 = 45\%$) and hospital stay ($I^2 = 50\%$). Egger's test indicated no significant publication bias ($p = 0.12$).

Table 1. Results laparoscopic and open inguinal hernia repair for strnagulated inguinal hernia.

Outcomes	Open Repair	Laparoscopic Repair	Mean Difference (MD)	Odds Ratio (OR)	95% Confidence Interval (CI)	*p*-value
Operative Time (minutes)	60.2 ± 15.1	75.5 ± 18.3	15.3	-	8.2-22.4	<0.001
Hospital Stay (days)	4.5 ± 1.9	3.3 ± 1.5	-1.2	-	-1.8 to -0.6	<0.001
Wound Infections (%)	12.1%	5.5%	-	0.45	0.28-0.72	0.001
Recurrence Rates (%)	8.5%	9.5%	-	1.12	0.78-1.61	0.54
Mortality (%)	2.1%	1.9%	-	0.89	0.45-1.76	0.74
Bowel Resection Rates (%)	10.3%	10.9%	-	1.05	0.67-1.64	0.83
Postoperative Pain (VAS)	6.2 ± 2.1	4.8 ± 2.3	-1.4	-	-2.1 to -0.7	<0.001
Return to Work (days)	21.5 ± 10.2	14.9 ± 8.5	-6.6	-	-10.1 to -3.1	<0.001
Complications (%)	25.6%	18.3%	-	0.67	0.45-1.01	0.056

Interpretation:

- Operative time was significantly longer in the laparoscopic group ($p < 0.001$).
- Hospital stay was significantly shorter in the laparoscopic group ($p < 0.001$).
- Wound infections were significantly less common in the laparoscopic group ($p = 0.001$).
- Recurrence rates, mortality, and bowel resection rates were similar between the two groups.
- Postoperative pain was significantly lower in the laparoscopic group ($p < 0.001$).
- Return to work was significantly faster in the laparoscopic group ($p < 0.001$).
- Complications were slightly less common in the laparoscopic group, but the difference was not statistically significant ($p = 0.056$).

Limitations:

- This table is based on a systematic review and meta-analysis of existing studies, and the results may be influenced by the quality and heterogeneity of the included studies.
- The outcomes may vary depending on the specific patient population, surgeon experience, and hospital setting.

Future Directions:

- Further studies are needed to confirm these findings and to explore the long-term outcomes of open and laparoscopic repair for strangulated inguinal hernias.
- The development of new technologies and techniques, such as robotic-assisted laparoscopic surgery, may improve the outcomes of laparoscopic repair and should be investigated in future studies.

DISCUSSION

The comparative analysis of laparoscopic versus open surgical repair for strangulated inguinal hernias reveals important insights into the efficacy and safety of these surgical approaches. Our systematic review and meta-analysis included a comprehensive array of studies that collectively involved 1250 patients. The findings suggest that while laparoscopic repair is associated with longer operative times, it offers significant advantages in terms of postoperative recovery, as evidenced by shorter hospital stays and lower rates of wound infections.[21]

1. OPERATIVE TIME

The longer operative time observed in laparoscopic repair (MD: 15.3 minutes) may be attributed to the technical complexities associated with minimally invasive procedures.[22] Surgeons typically require additional time to navigate the instruments within the confined space of the abdomen and to perform the repair without direct visualization of the hernia sac. This is significant, especially in emergency settings where time is often of the essence. However, this extended operative time does not negate the benefits presented in postoperative outcomes, especially in a condition as critical as strangulated hernia.

2. HOSPITAL STAY

Notably, the reduction in hospital stay by 1.2 days for patients undergoing laparoscopic repair underscores the potential for enhanced recovery protocols.[23] Shorter hospitalizations not only improve patient satisfaction but also reduce healthcare costs and resource utilization. The benefits of laparoscopic surgery in promoting quicker recovery are further supported by recent studies that highlight accelerated postoperative rehabilitation and the ability for patients to return to their daily activities sooner, a critical factor considering the demographic often affected by inguinal hernias—working-age adults.

3. INFECTION RATES

The significantly lower incidence of wound infections in the laparoscopic cohort (OR: 0.45) aligns with the established advantages of minimally invasive surgery.[24] The reduced rate

of wound infections can be attributed to smaller incisions, decreased tissue trauma, and less exposure of internal tissues to external contaminants. This finding is particularly relevant given the increasing focus on reducing surgical site infections in the current healthcare landscape, which can lead to longer recovery times and increased healthcare costs.

4. RECURRENCE AND BOWEL RESECTION RATES

While recurrence rates and the need for bowel resections were comparable between the two surgical approaches, these outcomes already indicate the successful management of hernias with both techniques. The lack of significant difference in recurrence (OR: 1.12) reassures clinicians that the laparoscopic method does not compromise the long-term efficacy of the repair.[25] Additionally, the similar rates of bowel resections (OR: 1.05) indicate that both surgical interventions are equally adept at addressing complications arising from strangulation.[26]

5. RECENT RESEARCH CONTEXT

In the context of recent research, several studies have continued to explore the outcomes and advancements in laparoscopic techniques for emergency inguinal hernia repairs.[27] For example, newer techniques, such as robotic-assisted laparoscopic surgery, are showing promise in further minimizing risks associated with both operative time and complication rates. Studies have suggested that robotic assistance may enhance precision and possibly further reduce the incidence of infections and other complications.

Moreover, the importance of surgical training and experience is emphasized in the literature, indicating that outcomes can significantly vary based on the surgeon's proficiency with laparoscopic techniques.[28] This highlights the need for continued education and training in advanced laparoscopic techniques to optimize patient outcomes.

CONCLUSION

In conclusion, our systematic review and meta-analysis suggest that laparoscopic repair for strangulated inguinal hernia offers significant postoperative advantages over traditional open repair, particularly in terms of reduced hospital stays and lower rates of postoperative wound infections. Although laparoscopic repair is associated with longer operative times, the overall benefits may outweigh these initial concerns, especially in the context of rapid recovery protocols and enhanced patient satisfaction.

As the field evolves with ongoing research and technological advancements, it will be crucial to continue assessing the long-term outcomes of both surgical approaches. Future studies should aim to incorporate larger sample sizes and diverse populations, potentially including more contemporary techniques and technologies. Ultimately, our findings contribute to the growing body of evidence suggesting that laparoscopic repair is a viable and beneficial approach in the management of strangulated inguinal hernias, warranting consideration in clinical decision-making processes.

ETHICAL DISCLOSURES

Conflicts of Interest: The authors have no conflicts of interest to declare.
Financial Support: This work has not received any contribution grant or scholarship.
Provenance and Peer Review: Not commissioned; externally peer-reviewed.

RESPONSABILIDADES ÉTICAS

Conflitos de Interesse: Os autores declaram a inexistência de conflitos de interesse.
Apoio Financeiro: Este trabalho não recebeu qualquer subsídio, bolsa ou financiamento.
Proveniência e Revisão por Pares: Não solicitado; revisão externa por pares.

CONTRIBUTORSHIP STATEMENT

Authours contributed substantially to the conception and planning, preparation of the draft, critical revision of the content of the manuscript and approved the final version of the manuscript to be published.

DECLARAÇÃO DE CONTRIBUIÇÃO

Os autores contribuíram substancialmente na conceção e planeamento, preparação do rascunho, revisão crítica do conteúdo do manuscrito e aprovaram a versão final do manuscrito a ser publicada.

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