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Laparoscopic repair of complicated inguinal hernia: when to convert? evidence, surgical judgment, and patient safety

Abstract

Introduction: Laparoscopic inguinal hernia repair has evolved from a controversial and slowly adopted procedure to an established approach with recognized advantages. Increasing experience has progressively expanded its indications, including acute irreducible and strangulated groin hernias. However, although current guidelines support emergency laparoscopy in selected patients when appropriate expertise and resources are available, the evidence defining when a laparoscopic procedure should be abandoned and converted remains limited.

Objective: To review the historical evolution and current evidence regarding laparoscopic management of complicated inguinal hernia, with particular emphasis on the indications for conversion, and to propose a practical decision-making framework based on surgical judgment and patient safety.

Methods: A narrative review of international guidelines, systematic reviews, meta-analyses, and relevant observational studies on emergency laparoscopic groin hernia repair was performed, with particular attention to conversion, difficult reduction, bowel viability and resection, contamination, mesh use, and cognitive factors influencing intraoperative decision-making. A historical operative experience from the early laparoscopic era is used to illustrate the evolution of surgical judgment.

Findings: Current evidence supports laparoscopic repair as a feasible option in selected patients with complicated groin hernias, but the certainty of evidence is predominantly low or very low. No validated time limit, number of reduction attempts, conversion score, or other objective threshold defines when conversion should occur. Failure to achieve safe reduction is a documented reason for conversion, whereas bowel injury, necrosis, or the need for intestinal resection do not necessarily mandate conversion if they can be managed safely. Based on the available evidence and surgical safety principles, three conditions are proposed for continued laparoscopic management: adequate Vision, maintained Control, and meaningful Progress, all subordinated to Patient Safety. Cognitive biases, including overconfidence, fixation, and persistence with an unsuccessful strategy, may also influence the decision to convert.

Conclusion: Emergency laparoscopic repair is a reasonable option for selected complicated groin hernias, but the precise threshold for conversion remains insufficiently defined by current evidence. Loss of adequate vision, control, or meaningful progress should prompt reassessment, with patient safety as the overriding criterion. Conversion should be regarded as a safety strategy rather than technical failure.

Keywords: inguinal hernia; laparoscopy; TAPP; strangulated hernia; conversion; surgical judgment; patient safety; cognitive bias

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Alejandro Weber Sánchez
Department of General Surgery, Hospital Ángeles Lomas, México

Correspondence: Alejandro Weber Sánchez, MD, Vialidad de la Barranca s/n C410 Valle de las Palmas, Huixquilucan, Estado de México 52763, Mexico, Tel +52 55 5246 9527

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Introduction

Laparoscopic surgery profoundly transformed general surgery. Procedures that for decades had required large incisions were progressively replaced by minimally invasive approaches. However, this transition did not occur uniformly. Whereas laparoscopic cholecystectomy rapidly achieved nearly universal acceptance and other initially controversial procedures eventually entered routine surgical practice, laparoscopic inguinal hernia repair followed a much slower course.

In a 2021 editorial, we referred to laparoscopic inguinal hernia repair as "the usually dismissed" procedure because, almost four decades after its earliest descriptions, it remained proportionally less frequently adopted than many other laparoscopic operations. In a Mexican survey conducted in 2015 among 1,018 general surgeons, only 26.3% reported routinely performing endoscopic inguinal hernia repair, and lack of training and experience were among the principal reasons for not doing so.[1]

The situation has evolved. The HerniaSurge guidelines recognize that laparo-endoscopic techniques, when adequate expertise and resources are available, offer faster recovery and a lower risk of chronic pain than open repair in selected settings. They also emphasize that surgical services should be able to offer both anterior and posterior approaches because no single technique is optimal for every groin hernia.[2] The evolution has reached a point that would have been difficult to imagine during the early years: laparoscopy can now be considered even for selected acute complicated groin hernias.[3]

This change raises a new question. It is no longer enough to ask which hernias can be treated laparoscopically. We must also ask: how

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long should we continue laparoscopically, and when is conversion the more prudent option?

The objective of this article is to review the historical evolution and contemporary evidence regarding laparoscopic management of complicated inguinal hernia and to propose a practical framework for deciding when to convert, based on three elements - vision, control, and progress - all subordinated to a fundamental principle: patient safety. Finally, analyze the possible influence of cognitive biases, particularly overconfidence, fixation, and the difficulty of abandoning a strategy in which substantial time and effort have already been invested.

Literature search strategy

A focused narrative literature search was conducted to identify current evidence relevant to laparoscopic management of complicated groin hernias and intraoperative conversion. The search included international clinical practice guidelines, systematic reviews, meta-analyses, and relevant observational studies addressing emergency laparoscopic groin hernia repair, TAPP, strangulated or acutely irreducible hernia, conversion to open surgery, difficult reduction, bowel viability and resection, contamination, and mesh use. Additional literature concerning cognitive biases and intraoperative surgical decision-making was also reviewed. References were selected according to their relevance to the specific clinical questions addressed in this article, with preference given to recent guidelines, systematic reviews, meta-analyses, and studies providing information on conversion or technical decision-making. Because the purpose of the article was to provide a narrative clinical review rather than a systematic review or meta-analysis, no formal quantitative synthesis was performed.

A different history

The origin of laparoscopic inguinal hernia repair differed from that of many other minimally invasive operations. Ralph Ger described closure of the peritoneal sac with staples in 1982, a proposal far removed from the principles of open repairs developed since Bassini and, later, from prosthetic techniques. The initial reaction of the surgical community was understandably cautious.[1] At the beginning of the 1990s, several approaches appeared almost simultaneously. Intraperitoneal onlay mesh (IPOM) raised concern because the prosthesis remained in contact with the viscera. Transabdominal preperitoneal (TAPP) repair and totally extraperitoneal (TEP) repair were subsequently developed. The coexistence of different techniques, each with advocates and detractors, paradoxically hindered early adoption of the laparoscopic approach.[1]

A further fundamental difference was anatomical. Surgeons accustomed to the anterior approach had to learn the posterior anatomy of the groin, which was less familiar. The learning curve was therefore not only technological, but anatomical and conceptual.[1] Early outcomes did not always favor acceptance. Limited dissection, missed lipomas, undersized prostheses, inadequate fixation, and lack of standardization contributed to recurrences during the learning curve. Specific complications, including neural, vascular, and visceral injuries, further reinforced resistance among some surgeons.[1]

Nevertheless, improved anatomical knowledge, standardization of TAPP and TEP, better prosthetic materials and instruments, and above all greater training progressively changed the results. Accumulated evidence confirmed important advantages, particularly faster recovery and less chronic pain in appropriately selected patients, while also confirming that the approach should be individualized according to the patient, the hernia, available expertise, and local resources.[2]

From elective surgery to complicated groin hernia

The maturity of a surgical technique may be measured not only by its use under ideal circumstances, but also by whether it can be safely extended to more complex situations.

The 2023 HerniaSurge update introduced more precise terminology. It recommends avoiding the ambiguous term "incarcerated hernia" and distinguishes an acutely irreducible hernia, which cannot be reduced despite having previously been reducible; a chronically irreducible hernia; and a strangulated hernia, in which vascular compromise is confirmed by imaging or intraoperative findings.[3] Manual reduction may be attempted in an acutely irreducible hernia without suspicion of ischemia; when reduction fails or strangulation is suspected, urgent surgery is recommended. If the patient's condition permits and appropriate expertise and resources are available, HerniaSurge suggests diagnostic laparoscopy and accepts that laparoscopic repair may be attempted. Importantly, but the guideline itself rates the evidence addressing acute groin hernia as low or very low.[3]

The 2025 Eastern Association for the Surgery of Trauma (EAST) guideline reinforced this trend. After screening 7,038 publications and including 34 studies, it conditionally recommended laparoscopic over open repair in adults requiring urgent surgery for acutely incarcerated or strangulated inguinal hernia. Laparoscopy was associated with lower recurrence (OR 0.75; 95% CI 0.58-0.99) and a hospital stay approximately three days shorter. However, the overall certainty of evidence was very low, largely because much of the literature was retrospective.[4] Also, a 2025 systematic review and meta-analysis including 13 studies and 38,659 patients likewise found shorter hospital stay and a lower risk of wound infection with laparoscopy. The pooled conversion rate, reported in only five studies, was 2.78% (95% CI 0.60-11.92).[5]

Another systematic review specifically addressing emergency TAPP repair included eight studies and 316 patients. Only three conversions were reported, while 25 visceral resections were performed, most extracorporeally. The authors concluded that TAPP appears feasible and safe in selected patients but emphasized the limited and heterogeneous evidence.[6]

Thus, the question has evolved from "Can it be done?" to "In whom, and under what circumstances, can it be done safely?" A third question remains much less studied: once a laparoscopic procedure has been started, when should it be abandoned and converted?

1991: a decision before the evidence

A personal experience from the early years of laparoscopic surgery illustrates this problem. In 1991, during an international congress of general surgery, I was invited as a faculty member in a laparoscopic surgery course. As part of the program, I was scheduled to perform a laparoscopic inguinal hernia repair transmitted live to the audience. At that time, laparoscopic inguinal repair was among the most controversial applications of the new approach.

The 60-year-old patient had a right indirect inguinal hernia and a history of appendectomy. On entering the abdomen, the cecum was found pexied and firmly adherent to the abdominal wall close to the hernia. To gain adequate access to the inguinal region, it had to be mobilized. During dissection, the cecum was inadvertently opened.

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The injury was immediately recognized and repaired laparoscopically. Technically, it was possible to attempt completion of the hernia repair laparoscopically. Nevertheless, I chose to repair the intestinal injury laparoscopically and complete the inguinal repair through an open approach. The audience, which had expected to observe a laparoscopic inguinal hernia repair, ultimately witnessed something perhaps more educational: the occurrence of a complication and the decision to modify the operative strategy to resolve it safely.

Thirty-five years later, the question remains relevant: was conversion necessary, and could a similar operation today be completed laparoscopically? Probably yes, under selected circumstances. But that is not the fundamental question. The fact that something can be done laparoscopically does not necessarily mean that it should be.

Conversion: a question without high-level evidence

Contemporary literature provides considerably more information about the feasibility of emergency laparoscopy than about the criteria for abandoning it. There is currently no validated operative time beyond which conversion is recommended, no validated maximum number of reduction attempts, no defined amount of blood loss, and no validated score integrating anatomical difficulty, bowel distension, ischemia, contamination, and operative progress.

Conversion rates are also heterogeneous. Lai et al. reported a pooled rate of 2.78%, but only five studies contributed conversion data and the confidence interval was wide.[5] A 2026 study is particularly illustrative. Among 62 patients with strangulated inguinal hernia initially approached by TAPP, 11 (17.7%) required conversion to open repair. In every converted case, the reason was inability to achieve laparoscopic reduction. Two of these patients required bowel resection. Among the 51 patients in whom TAPP was completed, five (9.8%) required bowel resection.[7]

These findings support two important concepts. First, failure to achieve safe laparoscopic reduction is a concrete and documented reason for conversion. Second, the need for bowel resection is not, by itself, an obligatory indication for conversion.

Reduction, bowel viability, and resection

In strangulated hernia, a particular advantage of the transabdominal approach is the ability to inspect the abdominal cavity, reduce the herniated contents, and directly assess bowel viability. When reduction cannot be achieved with gentle traction and external compression, controlled release of the constricting structure should be considered before increasing traction on the bowel. Persistent inability to achieve reduction, or the need for potentially traumatic manipulation, should clearly lower the threshold for conversion. After reduction, abnormal bowel color does not necessarily imply irreversible necrosis. Releasing the constriction may allow perfusion to recover, and viability can be reassessed before deciding on resection.

When resection is necessary, several alternatives are available: a completely laparoscopic resection, laparoscopic-assisted resection, exteriorization through a small incision, or formal open conversion. The choice depends on the extent of injury, bowel distension, contamination, physiological stability, and the team's experience. The emergency TAPP systematic review confirms that visceral resection can be performed without necessarily converting the entire procedure to an open operation.[6] Therefore, bowel necrosis does not automatically equal conversion. Conversion is indicated when the problem cannot be resolved safely with the current approach.

Contamination and mesh use

Ischemia or bowel resection also raises the question of prosthetic repair. HerniaSurge states that in patients with strangulation and/or bowel resection in a clean-contaminated field, mesh repair may be used, with a tendency toward macroporous mesh. This is, however, a weak recommendation supported by very low-certainty evidence.[3] A 2023 Cochrane review included 15 trials and 1,241 patients and rated the certainty of all outcomes as very low. It could not establish firm conclusions regarding infection, mortality, or recurrence with mesh versus non-mesh repair; mesh removal was reported in some contaminated or dirty fields.[8] Another meta-analysis, including 24 studies and 12,402 patients, found lower overall recurrence with mesh (OR 0.36; 95% CI 0.19-0.67) without an overall increase in infection. However, among patients undergoing bowel resection, mesh repair was associated with a higher risk of surgical site infection (OR 1.74; 95% CI 1.04-2.91).[9]

An absolute rule is therefore inappropriate. Bowel resection does not automatically contraindicate mesh, but the degree of contamination must be incorporated into the decision. This distinction also helps reinterpret the 1991 case: an enterotomy immediately recognized and repaired with minimal or no contamination is very different from perforation with substantial enteric spillage. Contemporary evidence might permit a more conservative attitude toward conversion in the former situation, but it does not oblige the surgeon to continue laparoscopically.

When to convert? A practical framework

In the absence of validated criteria, a practical decision framework is proposed that is not intended to constitute a scoring system or to replace surgical judgment. It is based on three conditions required for safe continuation: vision, control, and progress.

Vision

The surgeon must be able to identify the anatomy unequivocally and maintain exposure that permits further work without producing additional injury. Severe bowel distension, edema, inflammation, bleeding, dense adhesions, or loss of anatomical planes can transform a technically possible operation into an unnecessarily hazardous one. The question is therefore not simply whether the surgeon can see, but whether visualization is adequate to continue safely.

Control

Control over the course of the operation must be maintained. Bleeding that cannot be managed rapidly and reliably, a visceral injury that cannot be safely repaired laparoscopically, contamination that is difficult to control, or physiological deterioration should lower the threshold for conversion. The occurrence of a complication does not automatically mandate conversion; the decisive issue is whether control can be recovered and maintained.

Progress

A difficult operation may require time, and time alone is not an indication for conversion. However, there is a fundamental difference between slow progress and repeatedly performing maneuvers that are not solving the problem. When the same attempts at reduction, dissection, or exposure are repeated without meaningful advancement, the appropriateness of the strategy should be reconsidered. In particular, inadequate exposure should not be replaced by increasing traction on the bowel. The relevant question is whether the operation is progressing toward resolution or whether persistence has become unproductive.

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Patient safety above the three criteria

Vision, control, and progress are not independent goals. All three are subordinate to a higher principle: patient safety. Figure 1 summarizes the proposed practical algorithm for decision-making in complex or complicated groin hernia.

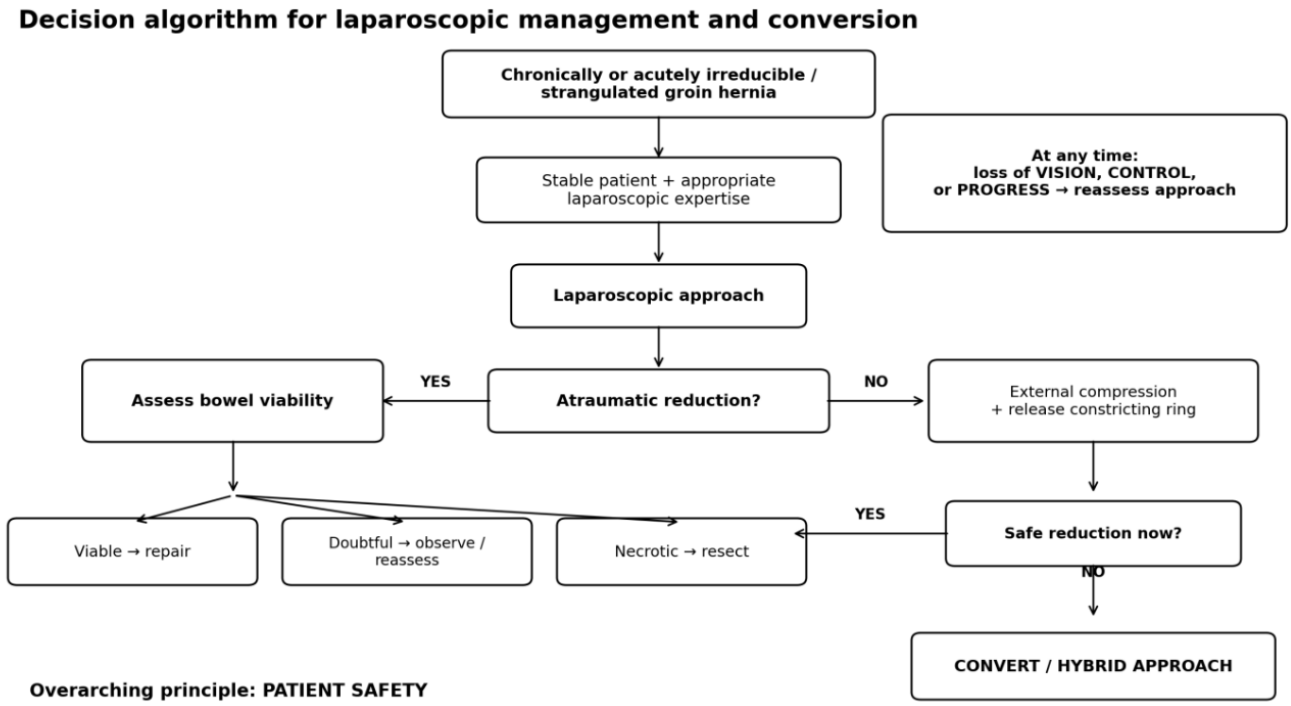

Figure 1 Practical decision algorithm for laparoscopic management and conversion in complex or complicated groin hernia.

When the problem is not only anatomical

Another component of conversion receives less attention: the surgeon. Intraoperative decisions are made under pressure, uncertainty, and cognitive load. A systematic review of 39 studies including 6,514 surgeons and more than 200,000 patients, identified 31 types of cognitive bias. Overconfidence, anchoring, and confirmation bias were the most frequent, and some were associated with actual patient harm.[10]

A more recent systematic review again identified confirmation bias, anchoring, risk aversion, and overconfidence among the most represented biases in surgical settings.[11] Several mechanisms may operate during a complex laparoscopic procedure. Overconfidence may lead the surgeon to overestimate the ability to resolve a difficult situation. Fixation may keep attention focused on a single strategy despite the availability of alternatives. Confirmation bias may favor interpreting small signs of progress as evidence that the chosen approach should be continued. In addition, the more time and effort already invested in completing a laparoscopic operation, the more difficult it may become psychologically to abandon it. From a decision-theory perspective, effort already spent should not alter the assessment of future risk, yet it may do so.

Live surgery adds another dimension. In the 1991 case, the demonstration was being transmitted to an audience expecting to observe a laparoscopic inguinal hernia repair. Continuing might have demonstrated technical ability; conversion, particularly in those early years, might have been interpreted as inability to complete the new procedure. However, the patient should not assume additional risk in order to demonstrate the surgeon's laparoscopic ability. During a difficult operation, a deliberate reflective question may therefore be useful: am I continuing because this remains the safest approach for the patient, or because I want to finish the operation laparoscopically?

Conversion is not failure

During the early years of laparoscopic surgery, conversion rate was often treated as an indicator of technical success. This concept can be misleading. Conversion is an available operative strategy, not necessarily a complication; timely conversion may prevent one. Nor should the choice be viewed simply as laparoscopy versus laparotomy. Intermediate strategies include enlarging an access site, extracorporeal resection, a mini-incision, or a hybrid procedure. The goal is not to preserve the label "laparoscopic" at all costs, but to solve the surgical problem with the least possible harm. The maturity of minimally invasive surgery may therefore be better measured not by the percentage of operations completed laparoscopically, but by the ability to select appropriately when to start, when to continue, and when to stop.

Conclusion

Emergency laparoscopic repair is a reasonable option for selected complicated groin hernias, but the evidence defining the precise moment for conversion remains limited. Loss of adequate vision, control, or meaningful progress should prompt reassessment, always with patient safety as the overriding criterion. Conversion is not technical failure; delayed conversion may expose the patient to avoidable harm.

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Conflicts of interest

The author declares no conflicts of interest.

Use of artificial intelligence

Artificial intelligence-assisted tools were used for language translation, stylistic refinement, and manuscript formatting. The intellectual content, clinical interpretation, and authorship of the manuscript remain entirely the author's responsibility.

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