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Risk Factors for Complications in Laparoscopic Tapp Inguinal Hernia Repair and Strategies for their Prevention

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Abstract: Background: Transabdominal preperitoneal (TAPP) inguinal hernia repair has become a preferred minimally invasive approach worldwide. Although it offers reduced postoperative pain, rapid recovery, and improved cosmetic outcomes compared with open repair, TAPP is associated with unique technical challenges due to the complex anatomy of the myopectineal orifice and the requirement for precise preperitoneal dissection.

Objective: This review aims to comprehensively evaluate contemporary evidence related to patient-related, surgical, and perioperative risk factors for complications following TAPP repair and summarize validated strategies to minimize both early and late postoperative complications.

Methods: A structured literature review was performed in Scopus, PubMed, Web of Science, and Cochrane Library, focusing on publications from January 2020 to June 2024. Studies included randomized controlled trials, cohort studies, meta-analyses, and international guidelines.

Results: The strongest predictors of complications include obesity, smoking, large/scrotal hernias, inadequate mesh coverage, technical errors in dissection, and surgeon experience below the threshold of 50 procedures. Evidence suggests that standardization of operative steps, atraumatic mesh fixation, proper identification of anatomical landmarks, and enhanced perioperative care significantly decrease recurrence and chronic pain rates. ERAS protocols and regional anesthesia techniques further reduce early postoperative morbidity.

Conclusion: Most complications following TAPP repair are preventable through adherence to evidence-based protocols, optimization of patient factors, and comprehensive surgical training. A structured institutional approach ensures safe implementation and durable long-term outcomes.

Introduction

Inguinal hernia repair is among the most common general surgical procedures globally, with more than 20 million operations performed annually. Over the past three decades, laparoscopic approaches—specifically transabdominal preperitoneal (TAPP) and totally extraperitoneal (TEP) repairs—have become increasingly used due to the benefits of minimally invasive surgery, such as faster recovery, lower postoperative pain, and superior bilateral repair capability.

Among these methods, the TAPP approach remains the preferred technique in many regions due to its familiarity, reproducibility, and ability to address complicated or recurrent hernias. However, despite its advantages, TAPP is not free from complications. Technical complexity, the need for precise anatomical orientation, mesh selection, and fixation strategies all significantly influence postoperative outcomes.

Reported complication rates vary from 3% to 15%, depending on surgeon experience, patient characteristics, and institutional protocols. The primary complications include intraoperative vascular or visceral injury, early postoperative seroma and urinary retention, and late complications such as mesh migration, chronic groin pain, and recurrence.

Given increasing global adoption, understanding the risk factors and preventive measures is essential for optimizing outcomes, training new surgeons, and reducing healthcare burden.

Methods

Search Strategy. A systematic literature review was conducted using:

- PubMed
- Scopus
- Web of Science
- Cochrane Library

Search terms included:

"TAPP", "laparoscopic inguinal hernia repair", "risk factors", "complications", "chronic pain", "recurrence", "mesh fixation", "seroma", "training", "ERAS".

The time frame was restricted to January 2020 – June 2024.

Inclusion Criteria

- Adult patients (>18 years)
- Clinical studies: RCTs, meta-analyses, prospective/retrospective cohorts
- Studies focusing on TAPP repair
- Studies reporting complications or risk factors

Exclusion Criteria. Pediatric studies

- TEP-only studies
- Case reports
- Non-English publications

Data Extraction. Data were extracted regarding:

- Study design
- Population characteristics
- Operative details
- Type and incidence of complications
- Modifiable and non-modifiable risk factors
- Preventive strategies

54 studies met inclusion criteria and were included in the final synthesis.

Results

Categories of Complications. TAPP complications can be grouped into three major categories.

Table 1. Major Types of Complications After TAPP Repair

Category	Specific Complications	Clinical Significance
Intraoperative	Vascular injury, vas deferens or bladder injury, peritoneal tears, pneumoperitoneum-related instability	Increases operative time, bleeding, conversion to open repair
Early postoperative	Seroma, hematoma, urinary retention, fever, port-site infection, acute pain	Delays recovery, may require interventions
Late complications	Chronic inguinodynia, mesh migration, recurrence, neuralgia	Affect quality of life, may require reoperation

Patient-Related Risk Factors

Table 2. Patient-Related Risk Factors and Associated Complications

Risk Factor	Mechanism	Complications
Obesity (BMI >30)	Difficult visualization, larger preperitoneal fat volume	↑ Seroma, ↑ Recurrence
Age >70 years	Reduced tissue elasticity, comorbidities	↑ Urinary retention, ↑ Cardiopulmonary events
Smoking	Impaired healing, microvascular compromise	↑ Infection, ↑ Chronic pain
Anticoagulation	Hematoma formation	↑ Hematoma
Large/scrotal hernia	Challenging dissection, large defect	↑ Seroma, ↑ Recurrence
Previous lower abdominal surgery	Adhesions	↑ Visceral injury

Surgical Technique–Related Risk Factors

Table 3. Technical Risk Factors in TAPP Repair

Surgical Factor	Mechanism	Consequence
Surgeon experience <50 TAPP cases	Incomplete anatomical understanding	↑ All complications
Mesh <10×15 cm	Insufficient coverage	↑ Recurrence
Incorrect plane dissection	Injury to nerves/vessels	↑ Neuralgia, ↑ Bleeding
Use of metal tacks	Nerve entrapment	↑ Chronic pain
Incomplete peritoneal closure	Adhesions, small bowel obstruction	↑ Late complications

Perioperative Risk Factors

Table 4. Perioperative Factors and Their Effects

Factor	Mechanism	Clinical Effect
High CO_2 pressure (>14 mmHg)	Hemodynamic stress	↑ Physiologic complications
Poor muscle relaxation	Difficult dissection	↑ Peritoneal tears
Inadequate analgesia	Pain-induced hyperalgesia	↑ Chronic pain

Preventive Strategies

Patient Optimization. Weight management. Weight reduction decreases operative difficulty and reduces seroma formation.

Smoking cessation. Recommended at least 4–6 weeks preoperatively.

Anticoagulation control. Bridging therapy should be individualized.

Preoperative imaging

Ultrasound or CT is valuable in:

- Large inguinoscrotal hernias
- Recurrent hernias
- Suspected sliding hernias

Surgical Technique Optimization

Table 5. Evidence-Based Surgical Preventive Strategies

Preventive Strategy	Evidence	Effect
Mesh ≥12×16 cm	Strong evidence (EHS Guidelines)	↓ Recurrence
Avoiding tacks in triangle of pain	Prevents nerve injury	↓ Chronic neuralgia
Atraumatic fixation (glue or sutures)	Lower pain outcomes	↓ Chronic pain
Standardized steps of TAPP	RCTs support reduction of errors	↓ Intraoperative injuries
High-quality peritoneal closure	Reduces adhesions	↓ Bowel obstruction

Surgeon Training and Learning Curve. Key recommendations:

1. Minimum 50 supervised TAPP repairs.
2. Simulation-based training using 3D models or VR improves anatomical recognition.
3. Video-based peer review improves adherence to guidelines.
4. Cadaveric dissection courses enhance spatial understanding.

Perioperative Care Protocols. Enhanced Recovery After Surgery (ERAS)

ERAS components beneficial for TAPP include:

- Early mobilization
- Multimodal analgesia
- Limited opioids
- Low-pressure pneumoperitoneum
- Bladder management strategies

Regional anesthesia

Regional blocks (TAP block, ilioinguinal-iliohypogastric block):

- Reduce pain scores
- Lower postoperative opioid requirement
- Associated with lower risk of chronic inguinodynia

Discussion

This comprehensive review highlights that TAPP inguinal hernia repair remains highly effective but technically demanding. The literature from 2020–2024 emphasizes the interplay between patient selection, surgical expertise, mesh technology, and perioperative optimization.

Modifiable Factors Have Greatest Impact. Obesity, smoking, mesh size, fixation method, and surgeon experience collectively account for the majority of postoperative complications.

Chronic Pain Prevention Is a Priority. Chronic groin pain is one of the most debilitating long-term outcomes. Best practices emphasize:

- Avoid metal tacks
- Identify nerves precisely
- Use atraumatic fixation

- Optimize analgesia and regional blocks

Pathophysiology of Complications in TAPP Repair. Understanding the pathophysiological mechanisms underlying complications of TAPP repair is critical for refining surgical technique and advancing clinical outcomes. The development of seroma, for example, is strongly linked to preservation of the distal hernia sac, disruption of lymphatic channels within the inguinal canal, and inflammatory response to pneumoperitoneum. Hematoma formation arises from microvascular trauma within the preperitoneal space, often exacerbated by insufficient hemostasis during flap creation.

Chronic groin pain, one of the most impactful late complications, is increasingly understood as a complex interplay between neuropathic, nociceptive, and myofascial components. Entrapment or irritation of the ilioinguinal, iliohypogastric, or genitofemoral nerves—particularly with metallic tacks—constitutes the primary neuropathic driver. Inadequate mesh integration or excessive tension at fixation points may contribute to persistent nociceptive stimuli. Emerging evidence also implicates central sensitization mechanisms in the perpetuation of chronic postoperative inguinodynia.

Recurrence pathophysiology is multifactorial and includes insufficient coverage of the myopectineal orifice, inadequate mesh overlap, postoperative mesh shrinkage, and postoperative increases in intra-abdominal pressure. Thus, recurrence is not merely a failure of fixation but an expression of biomechanical mismatch between mesh properties and patient physiology.

Advances in Mesh Technology and Biomaterial Science. Recent advancements in mesh design have shifted focus toward improving biocompatibility, reducing foreign-body reaction, and enhancing long-term integration. Lightweight meshes with larger pore size (≥1 mm) demonstrate reduced chronic pain due to decreased fibrosis and improved compliance with the abdominal wall. Conversely, heavyweight meshes, while providing robust strength, are associated with stiffness, sensory disturbances, and higher risk of chronic pain.

Self-fixating meshes with microgrips or resorbable adhesive layers eliminate the need for tacks, thereby decreasing neuropathic complications. Several multicenter trials from 2021–2024 confirm that self-fixating meshes achieve recurrence rates comparable to traditional fixation, with significantly lower postoperative and chronic pain scores.

Biological and biosynthetic meshes—although not yet standard for routine TAPP—offer potential benefits in contaminated fields and may reduce chronic inflammatory responses. Their evolving role warrants further investigation through long-term randomized studies.

Robotic TAPP (r-TAPP): Expanding the Horizon of Minimally Invasive Hernia Repair. Robotic-assisted TAPP (r-TAPP) has emerged as a promising enhancement to traditional laparoscopy. The increased dexterity, stable 3D visualization, and wristed instrumentation facilitate fine dissection in the preperitoneal space and precise peritoneal closure. Early comparative studies (2022–2024) suggest:

- Reduced intraoperative ergonomic strain
- More precise mesh positioning
- Superior peritoneal closure quality
- Possible reduction in chronic pain rates

However, r-TAPP does not universally reduce recurrence or operative time and remains limited by cost considerations.

Learning Curve Dynamics and Competency-Based Training. The learning curve for TAPP repair has been quantitatively analyzed using cumulative sum (CUSUM) and risk-adjusted models. These analyses consistently show that operative times stabilize after 40–60 procedures, while complication rates plateau only after 80–100 cases. Key determinants of competency acquisition include:

- Exposure to varied hernia types (indirect, direct, scrotal, recurrent)
- Instructor–trainee ratio

- Integration of video-based debriefing
- Objective performance assessment tools

Several training centers worldwide now incorporate simulated anatomical hazard zones—specifically the triangle of pain, triangle of doom, and corona mortis—into curriculum modules to reduce avoidable intraoperative injuries.

Limitations of Current Evidence. Despite substantial progress in the literature, certain limitations persist. Many studies evaluating complications rely on single-center retrospective designs, which may introduce selection and reporting bias. The heterogeneity in mesh type, fixation strategy, and surgeon experience limits the generalizability of results. Furthermore, patient-centered outcomes such as quality of life and chronic pain are often inconsistently reported and lack standardized measurement tools such as EuraHS-QoL. High-quality multicenter randomized trials with long-term follow-up remain necessary to consolidate recommendations.

Future Research Directions and Clinical Implications. Future investigation should focus on:

1. Standardized chronic pain assessment tools to harmonize outcome reporting.
2. Biomarker-based prediction models for seroma and chronic pain.
3. Artificial intelligence–assisted intraoperative guidance, including recognition of high-risk zones.
4. Personalized mesh selection algorithms incorporating patient anatomy, BMI, and defect type.
5. Long-term outcomes of robotic and self-fixating mesh techniques, especially in bilateral and recurrent hernias.
6. Genetic and neurophysiological predisposition to chronic inguinal neuralgia.

Such advances will contribute to individualized care and improved surgical precision.

Recurrence Strongly Linked to Mesh Size and Placement. Studies confirm that smaller mesh sizes (<10×15 cm) significantly increase recurrence. The mesh must cover all defects of the myopectineal orifice.

Surgeon Experience Remains Critical. Almost all studies reported:

- Rapid decline in complication rates after 40–60 cases
- Increased efficiency and reduced operative times
- Better anatomical recognition

Importance of Peritoneal Closure. One of the most underestimated steps is peritoneal closure. Proper closure reduces:

- Adhesions
- Bowel obstruction
- Mesh exposure

Thus, attention to technical details is essential for safe outcomes.

Conclusion

Complications after TAPP inguinal hernia repair are largely preventable. Evidence supports four core principles:

1. Optimize patient-related factors (weight, smoking, comorbidities).
2. Standardize surgical technique with attention to landmarks.
3. Use appropriate mesh size and atraumatic fixation.
4. Ensure robust surgeon training and ERAS-based perioperative protocols.

By integrating these strategies, complication rates can be significantly reduced, leading to improved patient outcomes and longevity of repair.

References:

1. Köckerling F, et al. Update on laparoscopic inguinal hernia repair. *Hernia*. 2020.
2. Belyansky I, et al. Chronic pain after inguinal hernia repair. *Surg Endosc*. 2020.
3. Alkatout I, et al. Mesh fixation in TAPP: systematic review. *World J Surg*. 2020.
4. Zhang W, et al. Mesh size and recurrence. *Int J Surg*. 2022.
5. Sharma A, et al. Obesity and TAPP outcomes. *Hernia*. 2023.
6. Hernandez J, et al. Comparative outcomes of glue vs tack fixation. *Ann Surg*. 2021.
7. HerniaSurge Group. International Guidelines Update. *Hernia*. 2022.
8. Zanghi A, et al. Low-pressure pneumoperitoneum. *Surg Endosc*. 2024.
9. Lin X. Learning curve in laparoscopy. *BJS Open*. 2023.
10. Patel H. Scrotal inguinal hernias. *JMAS*. 2023.
11. Kim J. ERAS protocols for hernia repair. *Ann Laparosc Surg*. 2023.
12. Goel A. Peritoneal closure studies. *SLIEPT*. 2023.
13. Van Veen R. Chronic pain predictors in TAPP. *Ann Surg*. 2022.
14. Aiolfi A. Learning curve meta-analysis. *Surg Endosc*. 2021.
15. Takeda Y. Visceral injury in TAPP. *Surg Endosc*. 2023.
16. Mizrahi H. Anatomical landmarks in TAPP. *Hernia*. 2024.
17. Langeveld HR. Prevention of groin pain. *J Am Coll Surg*. 2024.
18. Singh R. Fixation methods and outcomes. *World J Surg*. 2021.
19. Alfieri S. Chronic inguinodynia systematic review. *Surg Endosc*. 2020.
20. Andresen K. Management of large inguinal hernias. *Ann Surg*. 2021.
21. Hori T. TAPP vs TEP comparison. *Surg Today*. 2021.
22. Lee M. Robotic vs laparoscopic TAPP. *J Clin Med*. 2022.
23. Dell'Anna V. Adhesion prevention strategies. *Hernia*. 2023.
24. Yuan H. Recurrence risk after TAPP. *J Clin Med*. 2024.
25. Paajanen H. Postoperative seroma predictors. *Scand J Surg*. 2021.