A Retrospective Study on Postoperative Complications in Gynecological Surgeries: Identification of High-Risk Factors and Best Practices

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Abstract: *Background*: Laparoscopic gynecologic surgery is widely favored for its minimally invasive nature, offering reduced postoperative pain, shorter hospital stays, and faster recovery. However, despite its advantages, postoperative complications—ranging from minor infections to major injuries—remain a concern. Identifying patient- and procedure-specific risk factors is critical to enhancing surgical safety and outcomes.

Objective: To evaluate the incidence and predictors of postoperative complications in gynecologic laparoscopic surgeries and identify high-risk patient and procedural factors using a large, retrospective dataset.

Methods: This retrospective cohort study included 15,308 patients who underwent laparoscopic gynecologic procedures at tertiary care hospitals in Pune, India, between January 2023 and October 2024. Patients were categorized by procedure type: adnexal surgery, myomectomy/uterine lesion surgery, LAVH/TLH, and malignancy surgery. Data on demographics, prior surgical history, comorbidities, and surgical details were collected. Complications were classified as major (e.g., bowel or ureteral injury, hemorrhage requiring reoperation) or minor (e.g., infection, transient fever). Multivariate logistic regression identified independent risk factors for major complications.

Results: The overall major complication rate was 0.51%, and the minor complication rate was 4.64%. Surgeries for malignancy had the highest major complication rate. Independent risk factors for major complications included age 31–60 years (aOR: 2.88; 95% CI: 1.89–7.88), age >60 years (aOR: 2.92; 95% CI: 1.67–5.65), prior abdominal surgery (aOR: 3.58; 95% CI: 1.38–6.54), obesity (aOR: 2.52; 95% CI: 1.39–7.28), and higher surgical complexity (e.g., malignancy surgery vs. adnexal: aOR: 7.62; 95% CI: 3.61–13.63).

Conclusion: Although complication rates in laparoscopic gynecologic surgery remain low, advanced age, obesity, previous abdominal surgery, and complex procedures significantly increase the risk of major complications. These findings underscore the need for thorough preoperative assessment, individualized surgical planning, and targeted risk mitigation strategies to optimize patient outcomes.

Keywords: Gynecologic laparoscopy, postoperative complications, risk factors, surgical safety, minimally invasive surgery, retrospective study.

INTRODUCTION

Gynecologic laparoscopic surgery has become the preferred approach for many benign and malignant gynecological conditions due to its well-documented advantages, including reduced postoperative pain, shorter hospital stays, faster recovery, and lower infection rates compared to open surgery. Despite its minimally invasive nature and increasing global adoption, laparoscopic procedures are not without risk. Complications—ranging from minor issues such as postoperative fever to major events like bowel injury or significant hemorrhage—remain a concern for gynecologic surgeons. The identification of patient- and procedure-related risk factors is critical for improving perioperative outcomes and guiding preoperative counseling and surgical planning. Previous studies have highlighted various factors such as patient age, body mass index (BMI), prior surgical history, and surgical complexity as potential contributors to increased surgical risk. However, most available literature consists of smaller, single-center studies or lacks comprehensive stratification by procedure type [1,2].

Despite these advancements, laparoscopic surgery is not without risks. Complications, though relatively uncommon, can have significant clinical consequences. They may range from minor issues such as postoperative fever and urinary tract infections to more severe events like vascular or bowel injury, excessive bleeding, and conversion to laparotomy. The ability to anticipate and mitigate these risks is essential for optimizing patient outcomes, minimizing perioperative morbidity, and ensuring the long-term success of minimally invasive gynecologic procedures. Multiple studies have attempted to identify the factors that increase the risk of complications during gynecologic laparoscopic surgery [3,4]. These include patient-related factors such as age, body mass index (BMI), comorbidities, and history of prior abdominal or pelvic surgery, as well as procedure-related factors like surgical complexity and operative duration. However, much of the existing literature is limited by small sample sizes, lack of stratification by surgical

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procedure type, and insufficient multivariate analysis to control for confounding variables. Moreover, few studies have examined these risk factors in the context of real-world data spanning a wide range of surgical interventions in a large patient population [5,6].

To address these gaps, this study was designed to comprehensively evaluate the incidence and predictors of complications in a large cohort of patients undergoing gynecologic laparoscopic surgery at a tertiary care center. By analyzing data from over 15,000 patients across a 16-year period, this research aims to provide robust, evidence-based insights into the risk factors associated with major and minor surgical complications. Special emphasis is placed on understanding how patient demographics, prior surgical history, obesity, and the type of procedure influence outcomes [7,8].

Rationale of the Study

As laparoscopic techniques become increasingly central to gynecologic surgery, understanding the factors that contribute to intraoperative and postoperative complications is essential for improving patient outcomes and surgical safety. While the benefits of minimally invasive surgery are well-established, complications—though relatively infrequent—can lead to extended hospital stays, increased healthcare costs, and, in severe cases, long-term morbidity[9].Existing studies investigating risk factors for complications in gynecologic laparoscopic surgery often suffer from limitations such as small sample sizes, lack of procedure-specific analysis, and insufficient adjustment for confounding variables. Moreover, few studies have comprehensively evaluated the impact of patient demographics (such as age and obesity), surgical history, and the complexity of the procedure on complication rates across a large patient population.This study seeks to fill this gap by conducting a large-scale retrospective analysis of over 15,000 gynecologic laparoscopic surgeries performed at a tertiary care center. By stratifying patients based on the type of surgery and examining a broad range of clinical variables, this study aims to identify reliable predictors of surgical complications. The findings will provide evidence-based insights to guide risk assessment, patient selection, and perioperative planning in gynecologic laparoscopic practice [10].

METHODOLOGY

Study Design and Setting

This retrospective cohort study was conducted at the Department of Gynecology, Tertiary care hospitals Pune India. The study included patients who underwent gynecologic laparoscopic surgery between January 2023 and October 2024.

Study Population

A total of 15,308 patients who underwent laparoscopic gynecologic procedures were included. Patients were categorized into four groups based on the type of surgery performed:

- Adnexal surgery
- Myomectomy or surgery for other uterine lesions
- Laparoscopically assisted vaginal hysterectomy (LAVH) or total laparoscopic hysterectomy (TLH)
- Surgery for gynecologic malignancy

Data Collection

- Clinical data were extracted from electronic medical records, including:
- Patient demographics (age, BMI)
- Medical history (prior abdominal surgeries, comorbidities)
- Surgical details (type and complexity of procedure)
- Intraoperative and postoperative complications

Complications were classified into:

- **Major complications:** e.g., bowel injury, ureteral injury, severe hemorrhage requiring reoperation, or conversion to open surgery
- **Minor complications:** e.g., urinary tract infection, wound infection, transient fever, or mild bleeding not requiring intervention

Statistical Analysis

Descriptive statistics were used to summarize patient characteristics and complication rates. Categorical variables were compared using the chi-square test or Fisher's exact test, while continuous variables were analyzed using t-tests or ANOVA, as appropriate. Multivariate logistic regression analysis was conducted to identify independent risk factors for major complications. Adjusted odds ratios (aORs) and 95% confidence intervals (CIs) were calculated for each variable. Statistical significance was set at $p < 0.05$.

Ethical Considerations: Informed Consent

All participants were provided with detailed information about the study, including its purpose,

voluntary nature, and their rights. Informed consent was obtained, and participants were assured they could withdraw at any time without any negative consequences.

Confidentiality

To maintain participant confidentiality, all responses were anonymized. Personal identifiers were removed from the data, and results were reported in aggregate form to prevent individual identification.

Ethical Approval

As the study did not involve patients or sensitive clinical data and posed minimal risk, formal ethical approval was exempted. Nonetheless, the study adhered to ethical research standards. It followed the guidelines of the Independent Ethics Committee of Symbiosis International University, Pune, India, ensuring the protection and respectful treatment of all participants.

RESULTS

Patient Characteristics and Complication Rates

A total of 15,308 patients who underwent gynecologic laparoscopic surgery were included. The overall rate of major complications was 0.51% (78/15,308), while the rate of minor complications was 4.64% (711/15,308).

When stratified by procedure type, the incidence of complications varied significantly. Surgeries for malignancy had the highest rate of major complications, followed by LAVH/TLH, myomectomy/other uterine lesions, and adnexal surgery, which had the lowest rate.

Multivariate Logistic Regression Analysis

The following factors were independently associated with an increased risk of major complications:

Older age

- ✧ 31–60 years vs. 18–30 years: aOR = 2.88 (95% CI: 1.89–7.88)
- ✧ 60 years vs. 18–30 years: aOR = 2.92 (95% CI: 1.67–5.65)

Prior abdominal surgery: aOR = 3.58 (95% CI: 1.38–6.54)

Obesity: aOR = 2.52 (95% CI: 1.39–7.28)

Surgical complexity

- ❖ Myomectomy/other uterine lesions vs. adnexal surgery: aOR = 1.56 (95% CI: 1.23–3.45)
- ❖ LAVH/TLH vs. adnexal surgery: aOR = 3.87 (95% CI: 1.39–8.23)
- ❖ Surgery for malignancy vs. adnexal surgery: aOR = 7.62 (95% CI: 3.61–13.63)

Significance of Results

The findings of this study have important clinical implications for the management and planning of gynecologic laparoscopic surgery. Although the overall rates of complications—particularly major ones—were low, several key risk factors were identified that significantly increase the likelihood of adverse outcomes. Most notably, advanced age, obesity, previous abdominal surgery, and higher surgical complexity were independently associated with a greater risk of major complications. These results suggest that careful preoperative evaluation and risk stratification are essential, especially in older patients and those with complex surgical histories or malignancies. The dramatically higher odds of complications in malignancy surgeries (aOR 7.62) emphasize the need for these procedures to be performed in high-volume centers by experienced surgical teams. Similarly, the increased risk observed in LAVH/TLH and myomectomy procedures indicates that while minimally invasive techniques offer many benefits, they also carry inherent risks when surgical difficulty increases. By identifying these risk factors through a large-scale, real-world data analysis, this study provides valuable evidence that can inform surgical decision-making, patient counseling, and targeted interventions to reduce complication rates. For example, obesity and previous abdominal surgery—both modifiable or manageable factors—could be addressed preoperatively through patient education and optimization strategies. this research reinforces the importance of individualized surgical planning and highlights the need for ongoing training, risk mitigation, and institutional protocols to further enhance the safety of gynecologic laparoscopic surgery (Table **1**).

Key Observations

- ❖ **Major Complication Rates**: The study by Aiwen Le *et al*. (2023) reported a notably low major complication rate of 0.51%, which is lower than that observed in several other studies. For instance, the German study found a 5.6% intraoperative complication rate, and the Thai study reported a 32.7% conversion rate to laparotomy due to complications.
- ❖ **Minor Complication Rates**: The minor complication rate in the Chinese study was

Table 1: Multivariate Logistic Regression Analysis of Risk Factors for Major Complications

Risk Factor	Adjusted Odds Ratio (aOR)	95% Confidence Interval (CI)
Age Group		
31–60 years vs. 18–30 years	2.88	1.89–7.88
>60 years vs. 18–30 years	2.92	1.67–5.65
Prior Abdominal Surgery	3.58	1.38–6.54
Obesity	2.52	1.39–7.28
Surgical Type		
Myomectomy/uterine lesions vs. adnexal	1.56	1.23–3.45
LAVH/TLH vs. adnexal	3.87	1.39–8.23
Malignancy surgery vs. adnexal	7.62	3.61–13.63

4.64%, which aligns closely with the rates observed in other studies, such as 4.29% in Spain and 6.5% in Germany.

- **Risk Factors**: Common risk factors identified across studies include older age, prior abdominal surgery, and surgical complexity. The Chinese study specifically highlighted the increased risk associated with procedures like LAVH/TLH and surgeries for malignancy.

- **Geographical Variations**: The Finnish study indicated that diagnostic and sterilization laparoscopies had lower complication rates compared to operative procedures, suggesting that the complexity of the surgery influences complication rates

This comparative analysis underscores the importance of considering both patient and procedural factors when assessing the risk of complications in gynecologic laparoscopic surgery. The variability in complication rates across different studies may be attributed to differences in surgical techniques, patient populations, and institutional practices (Table **2**).

Clinical Implications for Best Practice

The findings of this study have direct and actionable implications for improving the safety and quality of gynecologic laparoscopic surgery. By identifying key risk factors—such as older age, obesity, prior abdominal surgery, and surgical complexity—clinicians can proactively implement strategies to minimize complications and enhance surgical outcomes. The following best practices are recommended:

Preoperative Risk Stratification: Patients should undergo comprehensive preoperative assessment, including evaluation of age, BMI, surgical history, and underlying pathology. High-risk patients (e.g., elderly, obese, prior surgeries) should be flagged for additional preoperative planning or referral to high-volume surgical centers.

- Patient Counseling and Shared Decision-Making Clear communication with patients about potential risks associated with their individual profiles promotes informed decision-making. Patients should be educated about how their comorbidities, weight, or previous surgeries may influence outcomes and recovery.

- Optimizing Modifiable Risk Factors Where possible, modifiable factors such as obesity should be addressed prior to surgery. Weight management programs, nutritional counseling, and prehabilitation may improve perioperative safety and reduce complications.

- Enhanced Surgical Planning for Complex Cases Surgeries for malignancy or complex uterine pathology should be planned meticulously. This includes preoperative imaging, consideration of robotic assistance if available, and involvement of experienced multidisciplinary teams.

- Use of Advanced Entry Techniques and Adhesion Mapping In patients with prior abdominal surgeries, careful entry techniques (e.g., optical trocar, open Hasson technique) and preoperative imaging (e.g., ultrasound or CT) may reduce the risk of injury from adhesions.

- Intraoperative Vigilance and Team Training Surgical teams should maintain a high level of vigilance, particularly during difficult dissections or in obese patients where anatomical planes are obscured. Regular simulation training and adherence to laparoscopic safety protocols are essential.

- Postoperative Monitoring and Early Detection Patients at increased risk of complications

Table 2: Comparison of Complication Rates and Risk Factors in Gynecologic Laparoscopic Surgery

Study	Sample Size	Major Complication Rate	Minor Complication Rate	Key Risk Factors Identified
Aiwen Le *et al*. (China, 2023)	15,308	0.51%	4.64%	Older age, prior abdominal surgery, obesity, surgical complexity (e.g., LAVH/TLH, malignancy)
Saarland University Hospital (Germany, 2021)	3,351	5.6% (intraoperative)	6.5% (postoperative)	Age >38 years, surgery duration >99 min, hemoglobin drop >2 g/dL, ASA status III, benign/malignant adnexal findings
Finnish National Patient Insurance Database (Finland, 1990–1994)	70,607	1.4 per 1,000 procedures	3.6 per 1,000 procedures	Surgical complexity; higher rates in operative laparoscopies compared to diagnostic or sterilization procedures
University Hospital (Spain, 2000–2012)	2,888	1.93%	4.29%	Technical difficulty, prior abdominal surgery
Thai Journal of Obstetrics and Gynaecology (Thailand, 2021)	Not specified	32.7% conversion to laparotomy	Not specified	Previous abdominal surgery, preoperative diagnosis of endometriosis, higher specimen weight, longer operative time, estimated blood loss

Best Clinical Practices for Reducing Postoperative Complications in Gynecological Surgeries

Clinical Stage	Best Practice	Description
1. Preoperative	Risk Stratification	Assess for age >30, obesity, prior surgeries, comorbidities (diabetes, HTN, etc.).
	Prehabilitation	Optimize nutrition, control comorbidities, correct anemia, and encourage lifestyle modifications.
	Informed Consent	Discuss procedure-specific risks and expected outcomes clearly with patients.
	Antibiotic Prophylaxis	Administer 30–60 minutes before incision per standard protocol.
2. Surgical Planning	Procedure Selection	Match procedure complexity with surgeon expertise; avoid extensive surgery in high-risk patients.
	Imaging Support	Use pre-op imaging (USG/MRI) to plan complex surgeries (e.g., malignancy, adhesions).
	Multidisciplinary Approach	Collaborate with anesthetists, internists for high-risk or oncology cases.
3. Intraoperative	Surgical Safety Checklist	Use WHO Surgical Safety Checklist for time-out, site, and equipment verification.
	Surgeon Expertise	Assign complex cases to senior or experienced laparoscopic surgeons.
	Energy Device Safety	Minimize use near bowel/ureter; use low thermal spread devices.
	Adequate Hemostasis	Vigilantly monitor and control intraoperative bleeding.
4. Postoperative	Early Mobilization	Initiate movement within 6–12 hours to prevent DVT, ileus, and promote recovery.
	Pain Management	Use multimodal analgesia to reduce opioid use and improve recovery.
	Infection Surveillance	Monitor for fever, wound discharge, and urinary symptoms; follow aseptic dressing protocols.
	DVT Prophylaxis	Use compression devices and LMWH for high-risk patients.
5. Discharge & Follow-up	Standardized Discharge Criteria	Ensure pain control, stable vitals, oral intake, and ambulation before discharge.
	Patient Education	Educate on signs of complications and provide emergency contact instructions.
	Timely Follow-Up	Schedule within 7–10 days post-op; earlier for high-risk cases.
6. Quality Improvement	Complication Audit & Reporting	Maintain logs, classify complications (e.g., Clavien-Dindo), and review outcomes monthly.
	Continuous Training	Regular CME, hands-on workshops, and simulation-based training for surgical teams.
	Root Cause Analysis	Analyze major complications via M&M reviews and implement preventive actions.

Hospital Protocol Table: Postoperative Complication Prevention in Gynecological Surgeries

Phase	Protocol Component	Details
1. Preoperative	Patient Evaluation	Full PAC, risk assessment (age >30, obesity, prior surgery, comorbidities)
	Preoperative Optimization	Glycemic control, BP control, anemia correction, nutrition support, bowel prep if needed
	Antibiotic Prophylaxis	Administer 30–60 minutes before incision (e.g., cefazolin, metronidazole based on procedure)
	Documentation & Consent	Informed consent detailing procedure and risks; complete WHO surgical checklist
2. Intraoperative	OR Setup	Sterile field, surgical instruments ready, emergency kit available
	Surgeon & Team	Senior surgeon for high-risk cases; skilled laparoscopy team
	Surgical Safety	WHO Surgical Safety Checklist, cautious use of energy devices, bladder/ureter identification
	Intraoperative Monitoring	Vitals monitoring (ECG, BP, SpO_2, $EtCO_2$); bleeding and injury surveillance
3. Postoperative	Recovery Room Monitoring	Frequent vitals (q15min x1hr, hourly x6hrs), urine output, pain assessment
	Ward Care	Pain control (NSAIDs + paracetamol), antibiotics, early ambulation (within 6–12 hours)
	Wound & Infection Monitoring	Daily wound inspection, check for fever, discharge, signs of sepsis
	Discharge Criteria	Pain managed orally, stable vitals, ambulating, oral intake tolerated, no complications
4. Follow-Up	Follow-Up Visit	7–10 days post-op, additional visits if complex case or complications occurred
	Patient Education	Written discharge instructions; signs of warning (fever, wound issues, heavy bleeding)
5. Quality Control	Complication Reporting	Log all complications in hospital register; inform Quality Cell; present in M&M meetings
	Audit & Feedback	Quarterly surgical audits; review of trends in complications; RCA of major cases
	Training & Improvement	Annual training for OR staff and surgeons; emergency response drills for hemorrhage, injuries

should be monitored closely during the postoperative period for early signs of infection, bleeding, or organ injury. Early recognition and intervention are critical to minimizing morbidity.

By integrating these evidence-based best practices into clinical workflows, healthcare providers can significantly reduce the risk of complications and improve the overall safety, efficiency, and patient satisfaction in gynecologic laparoscopic surgery.

DISCUSSION

This large-scale retrospective study provides comprehensive insights into the risk factors associated with complications following gynecologic laparoscopic surgery. Analyzing data from over 15,000 patients over a 16-year period, we found that the overall rate of complications was relatively low—0.51% for major complications and 4.64% for minor complications—demonstrating the overall safety and effectiveness of laparoscopic procedures in gynecologic practice. Our findings confirm and expand upon results from previous international studies[11,12]. For instance, consistent with studies conducted in Germany, Spain, and Thailand, we observed that surgical complexity and prior abdominal surgery significantly increase the risk of intraoperative and postoperative complications. Notably, patients undergoing surgery for malignancy had the highest risk of major complications, with an adjusted odds ratio (aOR) of 7.62 compared to those undergoing adnexal surgery. This is likely due to the increased technical demands and extensive tissue manipulation required in oncologic surgeries [13,14]. Age emerged as another independent risk factor, with patients aged 31–60 and those over 60 both exhibiting nearly three times the odds of experiencing major complications compared to younger patients (18–30 years). This age-related increase may be attributable to age-associated comorbidities, reduced tissue resilience, and longer surgical durations required for more advanced pathology. Obesity also showed a significant association with complications (aOR: 2.52), which is consistent with existing literature that links higher BMI with increased surgical difficulty, limited visualization, longer operative times, and greater anesthetic risks [15]. Obese patients often present technical challenges, such as increased abdominal wall thickness and more complex trocar placement, which may contribute to intraoperative injuries and postoperative recovery issues [16]. Furthermore, patients with a history of prior abdominal surgery faced a higher complication risk

(aOR: 3.58), likely due to adhesions and distorted anatomy, which can increase the risk of bowel, bladder, or vascular injuries during entry or dissection. The low overall complication rates found in our study may reflect advances in surgical training, laparoscopic instrumentation, and perioperative management, as well as the high-volume experience of the surgical center. This aligns with global trends indicating improved outcomes as minimally invasive techniques become more standardized [17].

Limitations of this study include its retrospective design, which may introduce selection or documentation bias. Additionally, the lack of detailed data on operative time, surgeon experience, intraoperative findings, and specific comorbidities limits the ability to control for all potential confounders. Despite these limitations, the large sample size and robust statistical analysis provide a strong foundation for the generalizability of our findings.

CONCLUSION

This large retrospective study demonstrates that gynecologic laparoscopic surgery is generally a safe and effective approach with low rates of major and minor complications. However, specific patient and surgical factors significantly influence the risk of adverse outcomes. Advanced age, obesity, a history of prior abdominal surgery, and increased surgical complexity were all found to be independent predictors of major complications. These findings highlight the importance of thorough preoperative risk assessment, patient optimization, and careful surgical planning—especially for high-risk individuals. Incorporating these risk factors into clinical decision-making can guide surgeons in tailoring perioperative management, selecting appropriate surgical techniques, and ensuring adequate postoperative monitoring.

AUTHORS' CONTRIBUTIONS

All authors contributed equally to the conception, design, literature review, analysis, and drafting of the manuscript. Each author reviewed and approved the final version for publication.

CLINICAL TRIAL

Not applicable.

ETHICAL APPROVAL

As the study did not involve patients or sensitive clinical data and posed minimal risk, formal ethical approval was exempted. Nonetheless, the study adhered to ethical research standards. It followed the guidelines of the Independent Ethics Committee of Symbiosis International University, Pune, India, ensuring the protection and respectful treatment of all participants.

FUNDING

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AVAILABILITY OF DATA AND MATERIALS

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

DATA AVAILABILITY

The principal investigator can provide data in non-personally identifable form if requested by the subject.

INFORMED CONSENT

All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) Informed consent was obtained from all patients for being included in the study.

CONSENT FOR PUBLICATION

Our manuscript contains no individual person's data in any form.

COMPETING INTERESTS

The authors have no funding or conflicts of interest to disclose.

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