
Risk Factors And Postoperative Complications In Laparotomy Under General Anesthesia: A Systematic Literature Review

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Abstract

Laparotomy is an abdominal surgery procedure that is still widely performed both in elective and emergency conditions. This procedure is often performed under general anesthesia and has a fairly high risk of postoperative complications, such as pulmonary complications, acute kidney injury (AKI), surgical wound infections, ileus, sepsis, and postoperative nausea and vomiting (PONV). The risk of complications may increase due to patient factors, intraoperative factors, and anesthesia factors. This study aims to identify and synthesize risk factors that contribute to postoperative complications in patients undergoing laparotomy surgery under general anesthesia. This study uses the Systematic Literature Review (SLR) method with the PRISMA approach and the PICO framework. Literature searches were conducted on PubMed, ScienceDirect, and Google Scholar databases with a publication range of 2015-2025. The included studies were quantitative studies with a Randomized Controlled Trial (RCT) design and a cohort study that discussed risk factors and postoperative complications in patients undergoing laparotomy surgery or open abdominal surgery under general anesthesia. Article quality assessment was carried out using the Joanna Briggs Institute (JBI) instrument. A total of 4,068 articles were identified in the early stages. After the duplicates were removed, 1,409 articles were obtained for filtering. A total of 238 articles passed the initial screening based on titles and abstracts, then 203 articles were removed because they did not meet the inclusion criteria. A total of 35 articles underwent full-text review, 26 articles were removed because they did not meet the criteria, so that 9 articles were eligible for analysis. The results of the synthesis showed that postoperative complications in laparotomy patients with general anesthesia were multifactorial. Patient factors include advanced age, comorbidities, high ASA status, and poor functional status. Intraoperative factors include hypotension, blood loss, organ perfusion disorders, duration of surgery, and fluid management. Anesthesia factors are primarily related to anesthesia techniques, the use of inhaling agents or TIVAs, and the prevention of PONV. The most commonly reported complications include PPCs, AKI, SSI, sepsis, ileus, and PONV. Postoperative complications in laparotomy surgery with general anesthesia are not caused by a single factor, but rather by an interaction between patient, intraoperative, and anesthesia factors. Preoperative risk assessment, intraoperative hemodynamic monitoring, fluid management based on patient needs, and selection of appropriate anesthesia techniques are necessary to lower the risk of complications and improve patient safety.

Keywords: Laparotomy, General Anesthesia, Postoperative Complications, Risk Factors, Systematic Literature Review.

INTRODUCTION

Laparotomy is an abdominal surgical procedure that is performed through an incision in the abdominal wall for diagnostic and therapeutic purposes. This procedure is still an important procedure in surgical practice, especially in cases of acute abdomen, trauma, obstruction, gastrointestinal perforation, peritonitis, intraabdominal tumors, as well as complex elective cases. Although the development of minimally invasive surgical techniques is becoming more widespread, laparotomy is still necessary in certain clinical situations because it provides direct and extensive access to the abdominal cavity (Oumer et al., 2021; Sincavage et al., 2021).

Patients undergoing laparotomy generally require general anesthesia to guarantee loss of consciousness, analgesia, muscle relaxation, and physiological stability during surgery. However, the combination of open abdominal surgery and general anesthesia can increase the risk of postoperative complications. These complications can be pulmonary complications such as pneumonia, atelectasis, respiratory failure, bronchospasm, and aspiration; kidney complications such as acute kidney injury; surgical wound infections; sepsis; ileus; hypothermia; cardiovascular disorders; and postoperative nausea and vomiting (PONV) (Sigona & Richman, 2023).

Postoperative complications not only reduce the quality of patient recovery, but also prolong the length of treatment, increase healthcare costs, and increase the risk of mortality. Some studies suggest that complications and mortality after laparotomy are still a major problem, especially in high-risk patients and in facilities with limited resources. Factors such as advanced age, anemia, high ASA status, comorbidities, intraoperative hypotension, long duration of anesthesia, organ perfusion disorders, and choice of anesthesia techniques can contribute to poor postoperative outcomes (Sincavage et al., 2021; Oumer et al., 2021).

Research on postoperative complications of laparotomy often focuses on one type of complication, such as surgical wound infection or mortality, so a comprehensive picture of risk factors has not been comprehensive. In addition, some studies have not linked patient factors, intraoperative factors, and anesthesia factors together. Therefore, this systematic literature review is important to synthesize scientific evidence related to risk factors and postoperative complications in laparotomy surgery with general anesthesia.

RESEARCH METHODS

Study Design and Search Strategy

This study uses the Systematic Literature Review (SLR) method by following the guidelines of Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). The focus of the research was compiled using the Population, Intervention, Comparison, Outcome (PICO) approach. The population in this study was patients undergoing laparotomy surgery or open abdominal surgery; intervention/exposure are patient, intraoperative, and anesthesia risk factors; comparison is a variation of risk factors or perioperative management; and the outcome is postoperative complications.

Data Sources and Search Strategies

Literature searches were conducted on *PubMed*, *ScienceDirect*, and *Google Scholar* databases. The publication range used is 2015-2025. The keywords used included "Postoperative Complications", "Laparotomy", "Risk Factors", "Laparotomy Surgery", "General Anesthesia", "Abdominal Surgery", "Predictors", "Perioperative Risk", and "Postoperative Outcomes". Keywords are combined using the Boolean operators AND and OR to increase search scope.

Eligibility Criteria and Study Selection

Inclusion criteria include articles published in 2015-2025, discussing patients undergoing laparotomy surgery or open abdominal surgery under general anesthesia, focusing on risk factors and postoperative complications, using a quantitative design in the form of a randomized controlled trial or cohort study, and available in Indonesian or English. An article is issued if published before 2015, does not discuss general anesthesia and its complications, in the form of a non-systematic literature review, meta-analysis, case report, letter to the editor, or a non-scientific article.

Data Extraction and Bias Risk Assessment

Data extraction was carried out based on article title, author name and year of publication, study design, sample number and characteristics, risk factors studied, postoperative complications, and main outcomes. The methodological quality assessment was carried out using the Joanna Briggs Institute (JBI) Critical Appraisal Tools according to the study design. Articles with quality scores that meet the eligibility threshold are then categorized as include for further analysis.

Data Analysis

Data were analyzed descriptively using narrative synthesis because there were variations in study design, sample characteristics, type of risk factors, and reported complication outcomes. Results are presented in the form of a PRISMA diagram, study characteristics table, and narrative description to identify the patterns of risk factors as well as the most commonly reported types of complications.

RESULTS AND DISCUSSION

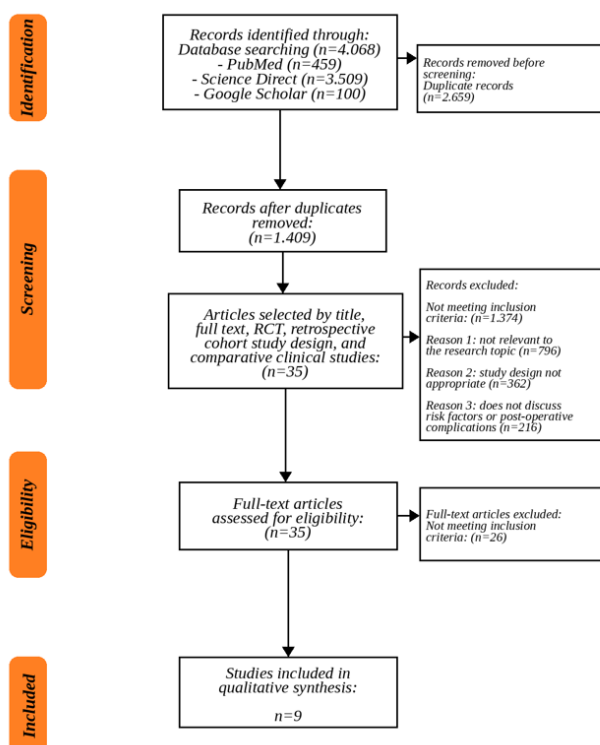


Figure 1. PRISMA Flow Diagram

Literature searches on PubMed, ScienceDirect, and Google Scholar yielded 4,068 articles, consisting of 459 articles from PubMed, 3,509 articles from ScienceDirect, and 100 articles from Google Scholar. After the removal of duplication, there are 1,409 articles left. Screening by title and abstract resulted in 238 articles that were relevant for the early stages. Of these, 203 articles were excluded because they did not meet the inclusion criteria, so 35 articles were reviewed in full-text. In the final stage, 26 articles were excluded because they did not meet the criteria, and 9 articles were eligible for analysis in this systematic literature review.

The nine studies analyzed consisted of observational prospective cohort research and randomized controlled trials. The main focus of the study included postoperative pulmonary complications, acute kidney injury, surgical wound infection, PONV, as well as other systemic complications such as sepsis, ileus, cardiovascular disorders, and mortality. In general, recurrent risk factors were found to include advanced age, comorbidities, high ASA status, poor functional status, intraoperative hypotension, long duration of surgery, blood loss, organ perfusion disorders, fluid management, and anesthesia techniques.

Table 1. Characteristics of the Studies Analyzed

Title	Country	Author(s) & Year	Research Methodology	Sample Size & Characteristics	Risk Factors/Complications Studied	Primary Outcomes
<i>Incidence and trajectories of subclinical and KDIGO-defined postoperative acute kidney injury in patients undergoing major abdominal surgery</i>	Sweden	Zeuchner et al., 2024	Cohort prospektif observasional	n = 588; patients >50 years old, major abdominal surgery, without previous CKD	Age, comorbidities, duration of operation, intraoperative hypotension, blood loss, nephrotoxic drugs; Complications: SPO-AKI, PO-AKI, PO-AKD, CKD, 30-day mortality	Postoperative kidney injury is common and associated with mortality as well as long-term complications.
<i>Effect of sub-hypnotic dose of propofol on prevention of</i>	Ethiopia	Yimer et al., 2018	Cohort prospektif observasional	n = 72; ASA I-II patient, age ≥18 years, open abdominal	Age, gender, history of PONV, type of surgery, anesthesia factors, anxiety, obesity; Complications:	Propofol 30 mg IV lowered the incidence of PONV in the first

<i>postoperative nausea and vomiting as part of multimodal antiemetic in patients undergoing open abdominal surgery</i>				surgery under general anesthesia	PONV, dehydration, bleeding, wound dehiscence, pulmonary aspiration	6 hours and lowered the need for additional antiemetics.
<i>Maximal inspiratory diaphragmatic ultrasound predicts postoperative pulmonary complications after upper abdominal surgery</i>	China	Yan et al., 2025	Cohort prospektif observasional	n = 223; patients >=50 years, upper abdominal surgery under general anesthesia, 14-day follow-up	ASA, anemia, hypoxemia, duration of surgery, type of surgery, length of incision, diaphragmatic dysfunction; Complications: PPCs	The decrease in diaphragm index increases the risk of PPCs and strengthens the accuracy of the prediction when combined with ARISCAT.
<i>Cardiac index-guided therapy to maintain optimised postinduction cardiac index in high-risk patients having major open abdominal surgery (iPEGASUS trial)</i>	Germany and Spain	Funcke et al., 2024	Randomized Controlled Trial multicenter	n = 318; High-risk patients, elective open abdominal surgery, general anesthesia, duration >2 hours	Organ perfusion, intraoperative hemodynamics, fluid status, dobutamine, cardiac index variability; Complications: wound infections, pneumonia, ileus, hemorrhage, kidney failure, arrhythmias, mortality	Cardiac index-based therapy does not decrease complications and is not recommended as the primary strategy for preventing complications.
<i>Outcome of intraoperative goal-directed therapy using Vigileo/FloTrac in high-risk patients scheduled for major abdominal surgeries</i>	Egypt	Elgendy et al., 2017	Randomized Controlled Trial prospektif	n = 86; high-risk patients ASA II-III, major abdominal surgery >120 minutes	Hemodynamic status, fluid response, comorbidities, blood loss, tissue perfusion; Complications: bleeding, kidney failure, myocardial infarction, infection, delayed wound healing, mechanical ventilation	Goal-directed therapy reduced postoperative morbidity and ICU stay, but did not significantly reduce mortality.
<i>Gastrointestinal Surgical Outcomes Study (GISOS): a 30-day monocentric prospective cohort study in Ethiopia</i>	Ethiopia	Avedev & Asefa, 2024	30-day observational prospective cohort	n = 259; adult patients of elective and emergency gastrointestinal surgery with general anesthesia	Elderly, ASA III, ECOG III, comorbidities, malignancy, emergency surgery; complications: SSI, AKI, pneumonia, ileus, sepsis, mortality	High postoperative complications and mortality; The main risks include high ASA, poor functional status, comorbidities, malignancy, and emergency surgery.
<i>Goal-directed hemodynamic therapy versus restrictive normovolemic therapy in major open abdominal surgery: A randomized controlled trial</i>	Switzerland	Diaper et al., 2021	Randomized Controlled Trial	n = 401; Adult patients elective open abdominal surgery under general anesthesia, duration >=2 hours	Intraoperative fluid management, hemodynamic status, vasopressor/inotropic, fluid volume; Complications: pulmonary, cardiovascular, wound infections, kidney failure, delirium	There was no significant difference between GDHT and restrictive therapy against complications and mortality.
<i>Fluid therapy and pulmonary complications in abdominal surgeries: randomized controlled trial</i>	Brazil	Castro et al., 2024	Randomized Controlled Trial prospektif	n = 85; ASA I-III patients, elective laparotomy >=120 minutes under general anesthesia	Intraoperative fluid management, fluid volume, MAP, delta pulse pressure, fluid loss, hemodynamic conditions; Complications: PPC, wound infections, kidney failure, sepsis, mortality	GDFT lowered PPC significantly, but did not decrease mortality and length of hospitalization.
<i>Comparison of post-operative</i>	Iran	Amiri et al., 2020	Randomized Clinical Trial	n = 105; ages 18-65 years, ASA I-	Inhalation anesthesia technique vs TIVA, patient	TIVA lowers PONV compared

<p><i>nausea and vomiting with intravenous versus inhalational anesthesia in laparotomic abdominal surgery: a randomized clinical trial</i></p>			<p>prospektif single-blind</p>	<p>II, elective laparotomy with general anesthesia</p>	<p>characteristics, duration of surgery, history of PONV; Complications: PONV, nausea, vomiting, need for antiemetics</p>	<p>to inhalation and reduces the need for antiemetics and the severity of nausea.</p>
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Study Characteristics

The included studies were published between 2017 and 2025 and included patients undergoing open abdominal surgery or laparotomy under general anesthesia. Four studies used a randomized controlled trial design, while the other five used an observational prospective cohort design. The number of samples varied from 72 to 588 patients. The most studied outcomes were pulmonary complications, PONV, acute kidney injury, surgical wound infections, postoperative morbidity, and mortality.

Risk of Bias Assessment

Quality assessment using JBI Critical Appraisal shows that the entire final article is worth analysis. Article quality scores range from 77% to 100%, so most studies have good methodological quality. The limitations that are still found include differences in study design, variations in sample sizes, heterogeneity of abdominal surgery types, and differences in complication outcomes measured in each study.

Discussion

The results of this systematic literature review show that postoperative complications in laparotomy patients with general anesthesia are still relatively high and have a multifactorial character. Complications found in various studies include pulmonary complications, acute kidney injury, surgical wound infection, sepsis, ileus, cardiovascular disorders, hemorrhage, delayed wound healing, and PONV. The variation in the incidence of complications is influenced by the patient's characteristics, type of surgery, anesthesia technique, duration of surgery, and intraoperative management strategies.

Patient factors are an important component in increasing the risk of complications. Old age can lower the physiological reserves of organs, making it more difficult for the body to adapt to surgical stress, anesthesia, bleeding, and hemodynamic changes. The study of Zeuchner et al. (2024) showed that postoperative acute kidney injury and subclinical postoperative acute kidney injury in major abdominal surgery were associated with adverse outcomes, including 30-day mortality and adverse renal events. This suggests that organ function, particularly kidneys, needs to be a major concern in elderly adult patients undergoing laparotomy.

Comorbidities, high ASA status, and poor functional status also consistently emerged as important risk factors. The GISOS study by Awedew and Asefa (2024) showed that patients with ASA III, ECOG III, comorbidities, malignancy, and emergency surgery had a higher risk of complications and mortality. This condition shows that a preoperative risk assessment is not enough to assess the type of surgery, but also to consider the patient's physiological capacity, comorbidities, and functional status before the procedure.

Intraoperative factors also play a big role in postoperative complications. Hypotension, blood loss, organ perfusion disorders, and fluid imbalances can lead to impaired tissue oxygenation and worsen organ function. Elgendy et al. (2017) showed that intraoperative therapy based on hemodynamic targets was able to reduce postoperative morbidity and shorten the length of ICU stay in high-risk patients. However, other studies such as Diaper et al. (2021) and Funcke et al. (2024) show that certain hemodynamic strategies do not necessarily significantly lower complications. These differences in results suggest that hemodynamic management needs to be tailored to the patient's condition, rather than uniformly applied to all cases.

Fluid management is one of the important intraoperative aspects. Excessive fluid administration can increase the risk of tissue edema, gas exchange disorders, and lung complications,

while too restrictive fluids can decrease organ perfusion. Castro et al. (2024) showed that goal-directed fluid therapy can reduce postoperative lung complications compared to standard fluid therapy. These findings support the importance of monitoring fluids that are individualized and based on the patient's physiological response during open abdominal surgery.

The anesthesia factor is mainly related to anesthesia techniques and the use of anesthesia drugs. PONV is a complication that often occurs after general anesthesia and can slow recovery, interfere with oral intake, increase the risk of aspiration, and increase the need for antiemetics. Amiri et al. (2020) showed that inhaled anesthesia causes higher PONV than TIVA, while Yimer et al. (2018) showed that subhypnotic dose of propofol may lower the incidence of PONV in the early postoperative period. Thus, the selection of anesthesia techniques based on patient risk is an important part of the prevention of complications.

Pulmonary complications are a prominent outlier in patients with upper abdominal surgery and laparotomy. Yan et al. (2025) showed that decreased diaphragmatic function is associated with increased postoperative pulmonary complications. This condition can be exacerbated by postoperative pain, immobilization, long duration of anesthesia, and ventilation disorders. Therefore, prevention of pulmonary complications needs to include evaluation of respiratory function, adequate analgesia, early mobilization, breathing exercises, and postoperative oxygenation monitoring.

Surgical wound infections remain an important complication because they can prolong the length of treatment, increase the risk of sepsis, and worsen the patient's quality of life. The studies analyzed showed that SSIs often appear alongside other systemic complications, especially in patients with comorbidities and emergency surgery. Infection prevention must begin from the preoperative phase through optimization of patient conditions, appropriate antibiotic prophylaxis, aseptic techniques, glucose control, and postoperative wound monitoring.

Overall, these SLR findings confirm that postoperative complications in laparotomy with general anesthesia cannot be explained by a single factor. The interaction between patient, intraoperative, and anesthesia factors determines the patient's final risk. The clinical implication is the need for a comprehensive perioperative approach, ranging from preoperative risk stratification to comorbidity optimization, selection of anesthesia techniques, hemodynamic monitoring, fluid management, infection prevention, to early detection of postoperative complications.

CONCLUSION

Based on the results of the Systematic Literature Review of 9 articles that met the inclusion criteria, it can be concluded that postoperative complications in patients undergoing laparotomy under general anesthesia are still quite high. The most common complications found include postoperative pulmonary complications, acute kidney injury, surgical wound infection, sepsis, ileus, cardiovascular disorders, bleeding, delayed wound healing, and postoperative nausea and vomiting.

The risk factors that contribute to complications are multifactorial and can be grouped into patient factors, intraoperative factors, and anesthesia factors. Patient factors include advanced age, comorbidities, high ASA status, poor functional status, malignancy, and emergency surgery. Intraoperative factors include the duration of surgery, hypotension, blood loss, organ perfusion disorders, and suboptimal fluid management. Anesthesia factors include anesthesia techniques and the selection of anesthetic agents, especially in relation to the incidence of PONV.

The most rational approach to lowering the risk of complications is a thorough risk evaluation from preoperative, optimization of the patient's condition, individual monitoring of hemodynamics and fluids during surgery, selection of appropriate anesthesia techniques, and close monitoring in the postoperative phase. This strategy is important to improve patient safety and improve postoperative outcomes in laparotomy surgery under general anesthesia.

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