Libyan Med J. 2026;18(4):145-150
https://doi.org/10.69667/lmj.26401
Libyan Medical Journal
https://lmj.ly/index.php/ojs/index *eISSN: 3107-0426*

Original article

Investigating The Incidence of Intraoperative Hypothermia and Associated Risk Factors in Laparoscopic Cholecystectomy Patients: A Pilot Prospective Cohort Study

Moaad Abuhallala[1,2], Ibtesam Salem[1,2], Heba Bin Iemayrah[1,2], Adnan Shareif[1,2*]

Faculty of Medicine, University of Tripoli, Libya.
General Surgery Department, Mitiga Military Hospital, Tripoli, Libya
Correspondence email. *dr.shareif@gmail.com*

Keywords.
Intraoperative Hypothermia, Laparoscopic Cholecystectomy, Risk Factors, Body Temperature, Libya, Surgery.

A B S T R A C T
Intraoperative hypothermia is a frequent and preventable complication during surgery. Despite international evidence, data from Libya remain scarce, especially for laparoscopic procedures. This study was conducted to assess the incidence of intraoperative hypothermia and identify associated risk factors in patients undergoing laparoscopic cholecystectomy. A prospective cohort study was conducted at a single hospital in Libya from October to December 2024. Twenty-seven adult patients undergoing elective laparoscopic cholecystectomy were enrolled. Intraoperative core temperature was recorded every 15 minutes. Demographic and clinical data were analyzed using appropriate statistical methods, including logistic regression. Hypothermia occurred in 77.8% of patients. Risk factors significantly associated with hypothermia included older age, lower BMI, greater intravenous fluid volume, lower operating room temperature, and longer surgery duration. Sex, ASA score, and fasting duration were not significantly associated. Intraoperative hypothermia is highly prevalent among laparoscopic cholecystectomy patients in Libya. Several modifiable risk factors were identified. Preventive measures should be implemented to reduce its occurrence and improve patient outcomes.

Introduction

Maintaining a constant body temperature is critical for proper physiological processes such as metabolism. It is also a crucial vital indicator [1]. Body temperature below 36°C (96.8°F), which is defined as hypothermia (a healthy person's normal core temperature is between 36.5 and 37.5°C [2,3]. According to previous studies, the prevalence of hypothermia during surgery varies from 40.13% to 75.06% [4,5]. Even modest hypothermia puts patients at risk for problems such as surgical site infection, cardiovascular events [6], decreased blood coagulation [7], longer recovery from anesthesia [8], and a higher death rate [9]. Furthermore, a higher infection rate may result in a longer hospital stay, thereby lengthening the patient's recovery period and increasing medical costs [10]. When these variables are taken into account, it becomes evident that preserving a normal body temperature during surgery is crucial to obtaining the best possible results for patients and lowering the possibility of complications afterward.

A previous study revealed that age, body mass index, baseline body temperature, the amount of irrigation fluid utilized, and the duration of the procedure are all associated with the risk of intraoperative hypothermia in patients undergoing laparoscopic abdominal procedures [10]. Laparoscopic cholecystectomy is a minimally invasive procedure used to remove a diseased gallbladder. For routine gallbladder removal procedures, this technique has essentially replaced the open method since the early 1990s [12]. Although there are many benefits to this minimally invasive procedure, there are also some unique difficulties, especially in controlling the patient's body temperature. However, the majority of recent studies on intraoperative hypothermia have mostly examined open surgical techniques. On the other hand, little study has been done, particularly in the context of laparoscopic surgery, to forecast and manage the risk of hypothermia [12,14].

As far as we are aware, no such study has ever been carried out in Libya. Furthermore, no study has been conducted specifically on laparoscopic cholecystectomy; instead, previous studies have usually involved a combination of several laparoscopic surgical techniques. We hypothesize that the advancements in laparoscopic surgery and the associated increase in operation times have heightened concerns regarding intraoperative hypothermia and its postoperative complications. This emerging challenge in clinical practice is due to a variety of risk factors.

The research question of this study is: What is the incidence of intraoperative hypothermia in patients having laparoscopic cholecystectomy, and what are the risk factors for it? The null hypothesis (Ho) of this

Received: *26-01-2026* - ***Accepted***: *24-03-2026* - ***Published***: *01-04-2026*

Libyan Med J. 2026;18(4):145-150
https://doi.org/10.69667/lmj.26401
Libyan Medical Journal
https://lmj.ly/index.php/ojs/index *eISSN: 3107-0426*

study is that there is no significant risk of hypothermia during a laparoscopic cholecystectomy procedure, and certain factors like a lower body mass index (BMI), longer surgery time, different types of general anesthesia, and the operating room's temperature are not linked to a higher risk of hypothermia during these procedures, while the alternative hypothesis (H1) is that there is a significant risk of hypothermia during a laparoscopic cholecystectomy procedures, and certain factors like a lower body mass index (BMI), longer surgery time, different types of general anesthesia, and the operating room's temperature are linked to a higher risk of hypothermia during these procedures. This study aims to determine the incidence of intraoperative hypothermia in patients undergoing laparoscopic cholecystectomy. The objective of this study is to examine in detail the variables that could lead to hypothermia in patients from Libya undergoing laparoscopic cholecystectomy procedures.

Methods

Study design, setting, and duration

We conducted a pilot prospective cohort study in one hospital in Libya that regularly performs laparoscopic cholecystectomy surgeries within the period from 1 October 2024 to 31 December 2024.

Participants

Individuals meeting the following criteria were included in the study: Age ≥ 18, Preoperative body temperature ≥ 36°C, elective laparoscopic cholecystectomy surgery, and patients agreed to participate in the study. We excluded all laparoscopic procedures that had been switched to open procedures, and individuals with a history of thyroid disease or any metabolic disorder, and with preoperative body temperature below 36°C or above 38°C.

Data variables

The following data items were collected from each participant: Age, Sex, Body mass index (BMI), Volume of intravenous fluid, Duration of surgery, operating room temperature, and Preoperative fasting duration.

Data collection methods

A combination of clinical observations, direct measurements, and patient records was used for collecting data. Demographic data were collected from the patient's medical records. Throughout the surgical operation, infrared thermometers were used to measure the patient's temperature. As soon as the patient entered the operating room, the baseline temperature was taken. Up to the end of the procedure, temperature readings were taken every 15 minutes. Clinical data were collected from the surgical and anesthesia teams.

Sample size and power calculation

Twenty-seven patients from the participating hospital undergoing laparoscopic cholecystectomy were part of the pilot study. We gathered information on patient demographics, clinical characteristics, and the incidence of intraoperative hypothermia throughout this period.

Operating procedure information

The surgeries took place in operating rooms equipped with laminar airflow. The ambient temperature was maintained between 20 and 25°C. All patients in the study received general anesthesia, initiated through intravenous induction with propofol and rocuronium. Tracheal intubation was performed to allow patients to breathe independently during anesthesia, which was maintained using intravenous anesthesia with propofol and sevoflurane.

Statistical analysis plan

Data of categorical variables, such as sex and ASA, were summarized as frequencies and percentages. Data of the quantitative variables, such as age, BMI, baseline body temperature, ASA, volume of intravenous fluid, duration of Anesthesia, duration of surgery, operation room temperature, were summarized as mean and standard deviation (SD) if normally distributed or median and interquartile ranges (IQR) if not normally distributed. To test data normality, we used the Shapiro-Wilk test.

We used the Pearson's chi-square test to compare the categorical variables between hypothermic and normothermic groups, and the unpaired t-test for continuous variables that are normally distributed, and the Mann-Whitney U test for ordinal or continuous variables that are not normally distributed to compare between the two groups. A binomial logistic regression analysis was conducted to determine the risk factors for hypothermia by including all possible variables.

Statistical analysis was done by the Jamovi software, version 2.5 for Windows. A P value <0.05 was considered statistically significant.

Received*: 26-01-2026 -* ***Accepted****: 24-03-2026 -* ***Published****: 01-04-2026*

Libyan Med J. 2026;18(4):145-150
https://doi.org/10.69667/lmj.26401
Libyan Medical Journal
https://lmj.ly/index.php/ojs/index *eISSN: 3107-0426*

Ethical considerations
Risks to the patients
This study did not expose the participants to any risks.

Benefits to the patients
The study does not present direct benefits to the participants; however, there is an indirect benefit because this study will contribute to improving the management of intraoperative hypothermia, decreasing its incidence, and preventing the emergence of potential risk factors.

IRB or ethical approval
We obtained IRB/ethical approval from the ethical committee of the hospital.

Informed consent form
Written informed consent was obtained from each participant prior to enrolment in the study.

Results

A total of 27 patients who underwent laparoscopic cholecystectomy were included in this study. Overall, 21 of the 27 (77.8%, 95% CI: 275%–91%) patients experienced hypothermia. The overall median (IQR) age of the population was 40 (8) years, and the median (IQR) duration of surgery was 77 (35) min (Table 1). Patients with hypothermia were older (P < 0.001), received greater volumes of intravenous fluids (P < 0.001), had lower BMI (Figure 1), and had longer surgery durations (P < 0.001) compared to the normothermic group (Table 1).

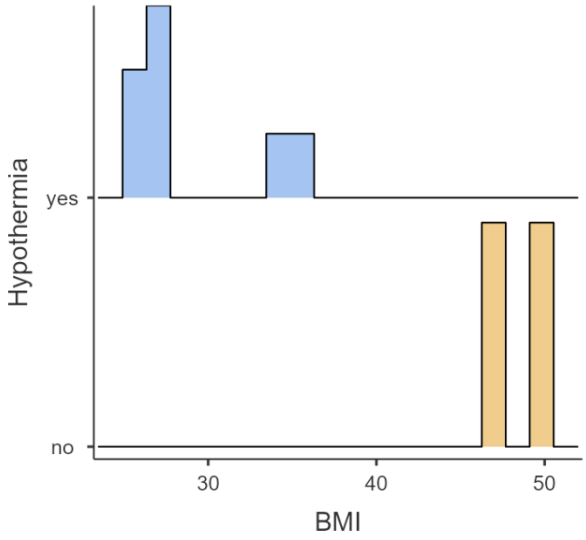

Figure 1. Distribution of BMI in patients with and without intraoperative hypothermia.

Table 1. Comparison of demographic and intraoperative variables between hypothermic and normothermic groups

Demographics	Hypothermia	Normothermic	P value
Age	40 (8)	40.5 (9)	< 0.001
Sex	21 (77.8%)	6 (22.2%)	0.443
BMI	26.9 (7.6)	48.45 (2.9)	< 0.001
Fasting duration	12 (2.5)	12.75 (3.5)	0.440
Duration of surgery	77 (37)	67.5 (55)	< 0.001
Operating room temperature	22 (5)	23 (0)	< 0.001
IVF volume	1000 (300)	350 (500)	< 0.001

Binomial logistic regression analysis revealed that age (OR = 1.017, 95% CI: 1.000–1.034, P = 0.050), intravenous fluid volume, operating room temperature (OR = 1.011, 95% CI: 1.000–1.018), and longer surgery duration (OR = 1.010, 95% CI: 1.006–1.015, P < 0.001) were associated with an increased risk of hypothermia. Conversely, a higher BMI (OR = 0.938, 95% CI: 0.880–1.000, P = 0.049) reduced the likelihood of developing hypothermia during laparoscopic cholecystectomy. No significant association was found with ASA physical status.

Received*: 26-01-2026 -* ***Accepted****: 24-03-2026 -* ***Published****: 01-04-2026*

Libyan Med J. 2026;18(4):145-150
https://doi.org/10.69667/lmj.26401
Libyan Medical Journal
https://lmj.ly/index.php/ojs/index *eISSN: 3107-0426*

Discussion

In our study, hypothermia occurred in 77.8% of the entire population. This study identified age, BMI, intravenous fluid volume, and surgery duration as factors linked to hypothermia in patients undergoing laparoscopic cholecystectomy. The logistic regression analysis in this study identified age as a risk factor for hypothermia, consistent with findings from previous research. The reduced metabolic rate in older individuals impairs their ability to regulate body temperature, making them more prone to hypothermia.

Our findings align with several large-scale studies that have investigated intraoperative hypothermia incidence and risk factors. Vural et al. [21] reported a similar incidence of intraoperative hypothermia at 74.30% in their study of 144 patients undergoing various surgical procedures. This consistency across different surgical populations suggests that intraoperative hypothermia remains a prevalent perioperative complication despite advances in temperature monitoring and warming technologies. The variability in hypothermia incidence reported in the literature, ranging from 11.7% to 94.4% [15], may be attributed to differences in surgical procedures, patient populations, temperature monitoring protocols, and preventive measures implemented across different healthcare institutions.

The identification of age as a significant risk factor in our study is well-supported by existing literature. Chen et al. [10] in their prospective cohort study of 1,168 patients undergoing laparoscopic surgery found that older age was significantly associated with increased risk of intraoperative hypothermia (OR = 0.902, $p < 0.001$). This association is physiologically plausible, as aging is associated with decreased metabolic rate, reduced muscle mass, impaired thermoregulatory responses, and altered peripheral circulation, all of which contribute to increased susceptibility to heat loss during surgical procedures [20].

Body mass index (BMI) emerged as another significant risk factor in our analysis, which is consistent with findings from multiple studies in the laparoscopic surgery literature. Shen and He [21] reported that patients with BMI ≤ 23 kg/m² had a significantly higher incidence of hypothermia during laparoscopic surgery (52.78%). The relationship between low BMI and increased hypothermia risk can be explained by the reduced subcutaneous fat layer, which serves as insulation against heat loss. Patients with lower BMI have less thermal mass and reduced capacity to maintain core body temperature when exposed to the cold operating room environment and the cooling effects of anesthetic agents [22].

This study found that a longer surgery duration heightened the risk of hypothermia, aligning with the findings of most studies on surgical populations. Heat loss starts during surgical skin preparation and continues for the first hour after anesthesia induction. Extended surgery duration increases the time the patient is exposed to the surrounding temperature and leads to more intravenous fluid administration, both of which contribute to a decrease in core temperature.

The relationship between surgery duration and hypothermia risk has been consistently demonstrated across multiple surgical specialties. Wang et al. [23] in their systematic review and meta-analysis of laparoscopic surgery found that operation time greater than 120 minutes was a significant risk factor for hypothermia. Similarly, Zhao et al. [12] reported that surgery time exceeding 60 minutes was associated with an increased risk of hypothermia in pediatric patients (OR = 3.743, $p < 0.001$). The prolonged exposure to the cold operating room environment, increased heat loss through the surgical site, and the cumulative effects of anesthetic agents on thermoregulation contribute to this time-dependent relationship [25].

The volume of intravenous fluids administered during surgery represents another modifiable risk factor identified in our study. This finding is supported by extensive research demonstrating that the administration of room-temperature or cold intravenous fluids contributes significantly to perioperative heat loss. Peixoto et al. [15] identified the administration of cold venous infusions as one of the key factors associated with intraoperative hypothermia. The infusion of large volumes of fluid at temperatures below body temperature creates a significant heat sink, requiring the patient's metabolic processes to warm the administered fluids to core body temperature, thereby contributing to overall heat loss [21].

Specific to laparoscopic cholecystectomy, our findings are particularly relevant given the unique thermal challenges associated with this procedure. The insufflation of carbon dioxide gas at room temperature into the peritoneal cavity creates an additional cooling effect that is specific to laparoscopic procedures. Previous studies have shown that the temperature of insufflated CO_2 can significantly impact patient core temperature, with warmed and humidified CO_2 demonstrating protective effects against hypothermia development [22]. The clinical implications of our findings extend beyond the immediate perioperative period. Intraoperative hypothermia has been associated with numerous adverse outcomes, including increased surgical site infection rates, prolonged hospital stays, increased blood loss, cardiac arrhythmias, and delayed wound healing [23]. The economic burden of hypothermia-related complications is substantial, with studies demonstrating cost reductions of approximately AU$689,659 when comprehensive hypothermia prevention protocols are implemented [15].

Our study's identification of specific risk factors provides valuable information for developing targeted prevention strategies. Preoperative risk stratification based on age, BMI, anticipated surgery duration, and

Received*: 26-01-2026 -* ***Accepted****: 24-03-2026 -* ***Published****: 01-04-2026*

Libyan Med J. 2026;18(4):145-150
https://doi.org/10.69667/lmj.26401
Libyan Medical Journal
https://lmj.ly/index.php/ojs/index *eISSN: 3107-0426*

planned fluid administration can guide the implementation of appropriate warming measures. Active warming devices, warmed intravenous fluids, and environmental temperature control represent evidence-based interventions that can significantly reduce hypothermia incidence [29].

The comparison of our results with international studies reveals both similarities and differences in hypothermia incidence rates. While our 77.8% incidence is higher than some reported rates, it falls within the range observed in similar populations. Wongyingsinn and Pookprayoon [30] reported a 73.5% incidence of intraoperative hypothermia in their Thai population, while studies from China reported lower rates of 39.90% [14]. These variations likely reflect differences in ambient temperature, patient characteristics, surgical techniques, and institutional protocols for temperature management.

The prospective design of our study and the specific focus on laparoscopic cholecystectomy provide valuable insights into this common surgical procedure. However, our findings should be interpreted within the context of our study's limitations and the broader literature on perioperative hypothermia prevention. To the best of our knowledge, this is the first report on intraoperative hypothermia occurring during laparoscopic cholecystectomy in a Libyan population. However, several limitations should be acknowledged. First, the incidence of hypothermia may have been underestimated due to the 20-minute interval for core temperature measurements; reducing this to 5-minute intervals could have revealed a higher incidence, as suggested by studies using continuous temperature monitoring [26]. Second, as an observational study, potential confounding factors and biases might not have been fully accounted for. The relatively small sample size of 27 patients, while appropriate for a pilot study, limits the generalizability of our findings and the power to detect smaller effect sizes for some risk factors.

Lastly, since this was a single-center study, caution should be taken when generalizing our findings to other populations, particularly given the potential influence of institutional practices, equipment availability, and local climate conditions on hypothermia incidence. Future research should focus on developing and validating prediction models for intraoperative hypothermia risk in laparoscopic procedures, evaluating the effectiveness of targeted warming interventions, and investigating the long-term outcomes associated with perioperative hypothermia in this patient population. Multi-center studies with larger sample sizes would provide more robust evidence for risk factor identification and enable the development of evidence-based prevention protocols specific to laparoscopic cholecystectomy.

Conclusion

Intraoperative hypothermia was frequently observed in patients undergoing laparoscopic cholecystectomy. During the procedure, the core temperature generally decreased, and the incidence of hypothermia rose over time. Factors such as age, BMI, baseline body temperature, fasting duration, and surgery duration were found to be significantly associated with the occurrence of hypothermia.

Conflict of interest. Nil

References

1. Szymusiak R. Body temperature and sleep. Handb Clin Neurol. 2018;156:341-51. PMID: 30454623.
2. National Institute for Health and Clinical Excellence (UK). The management of inadvertent perioperative hypothermia in adults. London: National Institute for Health and Clinical Excellence (UK); 2008 Apr 24 [cited 2018 Sep 12]. (NICE Clinical Guidelines, No. 65). Available from: https://www.nice.org.uk/guidance/cg65
3. Chisholm TA, Andersen ES, Juan HY, Lele S, Coots LB, Mountziaris PM. Impact of intraoperative hypothermia on autologous breast reconstruction. Ann Plast Surg. 2023 Jun 1;40(6):11-14.
4. Li L, Yan Y, Xin F. [Construction and verification of risk prediction model of intraoperative hypothermia in patients undergoing laparoscopic surgery]. Chin J Nurs. 2022;57(4):6-9. Chinese.
5. Yan Y, Ting X. [Analysis of risk factors and preventive measures of intraoperative hypothermia in patients undergoing laparoscopic surgery for rectal cancer]. General Nursing. 2022;22(14):20-4. Chinese.
6. Frank SM, Fleisher LA, Breslow MJ, Higgins MS, Olson KF, Kelly S, Beattie C. Perioperative maintenance of normothermia reduces the incidence of morbid cardiac events. A randomized clinical trial. JAMA. 1997 Apr 9;277(14):1127-34. PMID: 9087467.
7. Cavallini M, Baruffaldi Preis FW, Casati A. Effects of mild hypothermia on blood coagulation in patients undergoing elective plastic surgery. Plast Reconstr Surg. 2005 Jul;116(1):316-21; discussion 322-3. PMID: 15988282.
8. Tanaka M, Nagasaki G, Nishikawa T. Moderate hypothermia depresses arterial baroreflex control of heart rate during, and delays its recovery after, general anesthesia in humans. Anesthesiology. 2001 Jul;95(1):51-5. PMID: 11465583.
9. Billeter AT, Hohmann SF, Druen D, Cannon R, Polk HC Jr. Unintentional perioperative hypothermia is associated with severe complications and high mortality in elective operations. Surgery. 2014 Nov;156(5):1245-52. PMID: 25231730.

Received: *26-01-2026* - ***Accepted***: *24-03-2026* - ***Published***: *01-04-2026*

10. Chen HY, Su LJ, Wu HZ, Zou H, Yang R, Zhu YX. Risk factors for inadvertent intraoperative hypothermia in patients undergoing laparoscopic surgery: A prospective cohort study. PLoS One. 2021 Sep 30;16(9):e0257816. PMID: 34591882.
11. Kapoor T, Wrenn SM, Callas PW, Abu-Jaish W. Cost analysis and supply utilization of laparoscopic cholecystectomy. Minim Invasive Surg. 2018 Apr 18;2018:7838103. PMID: 29850017.
12. Zhao J, Le Z, Chu L, Gao Y, Zhang M, Fan J, Zhang H, Li Q. Risk factors and outcomes of intraoperative hypothermia in neonatal and infant patients undergoing general anesthesia and surgery. Front Pediatr. 2023 Feb 9;11:1113627. PMID: 36846160.
13. Yan L, Tan J, Chen H, Xiao H, Zhang Y, Yao Q, Li J, Wang Y. A nomogram for predicting unplanned intraoperative hypothermia in patients with colorectal cancer undergoing laparoscopic colorectal procedures. AORN J. 2023 Jan;117(1):e1-e12. PMID: 36562615.
14. Vural F, Çelik B, Deveci Z, Yasak K. Investigation of inadvertent hypothermia incidence and risk factors. Turk J Surg. 2018 Dec 1;34(4):300-305. PMID: 30664428.
15. Peixoto CA, Ferreira MBG, Felix MMS, Pereira CBM, Cândido JV, Rocha LA, Silva R. Factors contributing to intraoperative hypothermia in patients undergoing elective surgery. Perioper Care Oper Room Manag. 2021 Mar;22:100150.
16. Collins S, Budds M, Raines C, Hooper V. Risk factors for perioperative hypothermia: A literature review. J Perianesth Nurs. 2019 Apr;34(2):338-346. PMID: 30366776.
17. Shen C, He Y. Intraoperative hypothermia in patients with laparoscopic surgery: Influencing factors and prevention strategies. Heliyon. 2024 Jun 15;10(11):e31479. PMID: 38845978.
18. Akers JL, Dupnick AC, Hillman EL, Bauer AG, Armstrong JH. Inadvertent perioperative hypothermia risks and postoperative complications: A retrospective study. AORN J. 2019 Jun;109(6):741-747. PMID: 31155710.
19. Wang H, Wang A, Song X, Luo J, Zhang P. Risk factors for intraoperative hypothermia during laparoscopic surgery: A systematic review and meta-analysis. PLoS One. 2025 Jul 1;20(7):e0328282.
20. Macario A, Dexter F. What are the most important risk factors for a patient's developing intraoperative hypothermia? Anesth Analg. 2002 Jan;94(1):215-20, table of contents. PMID: 11772839.
21. Kasai T, Hirose M, Yaegashi K, Matsukawa T, Takamata A, Tanaka Y. Preoperative risk factors of intraoperative hypothermia in major surgery under general anesthesia. Anesth Analg. 2002 Nov;95(5):1381-3, table of contents. PMID: 12401637.
22. Wang M, Jiang Y, Han W, Jiang L, Mao C. Summary of the best evidence for the prevention of intraoperative unplanned hypothermia in patients undergoing laparoscopic surgery. Gland Surg. 2021 Oct;10(10):2946-2958. PMID: 34804880.
23. Hu Z, Li W, Liang C, Li K. Risk factors and prediction model for inadvertent intraoperative hypothermia in patients undergoing robotic surgery: a retrospective analysis. Sci Rep. 2023 Mar 2;13(1):3575. PMID: 36864080.
24. Pu J, Zhao W, Xie X, Huang H. A Systematic Review and Meta-Analysis of Risk Factors for Unplanned Intraoperative Hypothermia Among Adult Surgical Patients. J Perianesth Nurs. 2022 Feb;37(1):135-143. PMID: 34583838.
25. Wongyingsinn M, Pookprayoon V. Incidence and associated factors of perioperative hypothermia in adult patients at a university-based, tertiary care hospital in Thailand. BMC Anesthesiol. 2023 Apr 17;23(1):134. PMID: 37069529.
26. Cho SA, Lee SJ, Yoon S, Park SH, Koo CH, Hong JY, Ryu JH. Risk factors for postoperative hypothermia in patients undergoing robot-assisted gynecological surgery: a retrospective cohort study. Int J Med Sci. 2022 May 9;19(8):1147-1154. PMID: 35922917.

Received*: 26-01-2026 -* ***Accepted****: 24-03-2026 -* ***Published****: 01-04-2026*