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Original Article

Impact of Intraoperative Hypothermia on Incidence of Infection in Implant-Based Breast Reconstruction in Pakistan

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Abstract

Background: Intraoperative hypothermia, an unintentional drop in core body temperature during surgery, poses a significant risk in implant-based breast reconstruction. This condition can weaken immune function, slow blood flow, and increase the risk of postoperative infections.

Objective: To evaluate the impact of intraoperative hypothermia on the incidence of infections in patients undergoing implant-based breast reconstruction in Pakistan.

Methods: This retrospective cohort study was conducted at Jinnah Sindh Medical University from January 2023 to November 2023. The study included 195 female breast cancer patients aged 18 and above who underwent implant-based breast reconstruction. Patients with pre-existing infections, concurrent chemotherapy or radiotherapy during the perioperative period, and incomplete medical records were excluded. Detailed patient demographics, surgical specifics, and intraoperative temperature control measures were recorded. Patients were categorized into normothermic (core body temperature ≥ 36°C) and hypothermic (core body temperature <36°C) groups. Infection data post-surgery were collected through clinical assessments, blood tests, and imaging techniques. Data were analyzed using SPSS version 25, with descriptive statistics, chi-square tests for categorical variables, and independent t-tests for continuous variables. A p-value of less than 0.05 was considered statistically significant. Ethical approval was obtained, and informed consent was secured from all participants.

Results: The mean age of patients was 45.23±3.45 years in the normothermic group and 46.01±2.89 years in the hypothermic group. The hypothermic group had a slightly higher average BMI (25.1 kg/m²) compared to the normothermic group (24.5 kg/m²). Total infections were observed in 26.3% of the hypothermic group versus 10% in the normothermic group. Superficial infections were reported in 12.6% of hypothermic patients compared to 6% of normothermic patients. Deep infections were more prevalent in the hypothermic group at 13.7%, compared to 4% in the normothermic group. The univariate odds ratio (OR) for intraoperative hypothermia was 3.2 (95% CI: 1.5-6.8) and the multivariate OR was 3.0 (95% CI: 1.3-6.5), both with a p-value of less than 0.01.

Conclusion: Intraoperative hypothermia significantly increases the risk of postoperative infections in patients undergoing implant-based breast reconstruction. Effective temperature management strategies, such as preoperative warming and the use of intraoperative warming devices, are crucial to reducing infection rates and improving surgical outcomes

1 Introduction

Intraoperative hypothermia, characterized by an unintended reduction in core body temperature during surgery, poses a significant risk to patient outcomes, particularly in the realm of implant-based breast reconstruction. This type of surgery, often pursued by women undergoing mastectomy due to breast cancer, aims to recreate the breast's appearance and contour, thus playing a crucial role in the patient's physical and psychological recovery (1). However, maintaining core body temperature during this sensitive procedure is vital, as it is directly linked to immune function and wound healing. Hypothermia during surgery can impair immune response, slow blood flow, and elevate infection risk, making it a critical factor in the success of implant-based reconstruction (2).

The incidence of breast reconstruction surgeries has notably increased, with a significant proportion involving implants, particularly in the immediate post-mastectomy period (3,4). Despite the benefits, these procedures are not without complications, the most concerning of which is the high incidence of postoperative surgical-site infections (SSI). Early suggestions estimated SSI rates to range between 5% to 35%, with higher rates observed when implants are placed immediately following mastectomy, likely due to bacterial contamination from the nipple and breast ducts (5). Previous studies have shown that maintaining normothermia during surgery significantly reduces SSI rates, particularly in colorectal and general surgical patients, including those undergoing breast surgeries (6). Thus, temperature monitoring during surgery has become a critical component of quality surgical care, as recommended by the World Health Organization's Guidelines for Safe Surgery to prevent coagulopathy and infections (7).

The mechanisms by which hypothermia increases SSI risk involve the suppression of the central thermoregulatory center by anesthesia, leading to peripheral vasoconstriction aimed at preserving core temperature. This physiological response reduces blood flow to the surgical site, delaying wound healing and impairing immune function, thereby heightening the risk of infections (8-10). Given these dynamics, the relationship between intraoperative hypothermia and SSI in implant-based breast reconstruction warrants thorough investigation to optimize patient outcomes and develop preventive strategies.

Our study aims to address this critical gap by evaluating the impact of intraoperative hypothermia on infection rates in implant-based breast reconstruction surgeries in Pakistan. This retrospective cohort study, conducted at Jinnah Sindh Medical University from January to November 2023, involved 195 breast cancer patients who underwent implant-based reconstruction. Detailed patient demographics, surgical specifics, and intraoperative temperature control measures were meticulously recorded. Patients were categorized into normothermic and hypothermic groups based on their intraoperative core temperatures, with infection data collected through clinical assessments, blood tests, and imaging techniques to differentiate between superficial and deep infections.

The findings revealed that intraoperative hypothermia significantly increases the risk of postoperative infections, corroborating previous research linking lower intraoperative temperatures to higher infection rates (11-14). This study underscores the importance of maintaining normothermia during implant-based breast reconstruction surgeries to mitigate infection risks. Implementing strategies such as preoperative warming, the use of intraoperative warming devices, and continuous temperature monitoring are imperative to enhance patient outcomes and reduce the incidence of SSIs in this vulnerable population (15-17). These insights contribute to the broader understanding of surgical care and emphasize the need for vigilant temperature management in breast reconstruction procedures.

2 Material and methods

This retrospective cohort study was conducted at Jinnah Sindh Medical University from January 2023 to November 2023, encompassing a sample of 195 female breast cancer patients who underwent implant-based breast reconstruction. The inclusion criteria were women aged 18 years and above who opted for implant-based breast reconstruction following mastectomy. Patients with pre-existing infections, those receiving concurrent chemotherapy or radiotherapy during the perioperative period, and those with incomplete medical records were excluded to ensure the integrity of the study data.

Patient demographics, including age, weight, comorbidities, and previous medical history, were meticulously documented to provide a comprehensive understanding of the study population. Detailed aspects of the surgical procedure were recorded, such as the nature of the reconstruction, duration of surgery, and any intraoperative complications. Core body temperature was monitored throughout the surgery using esophageal or tympanic thermometers at regular intervals. Patients were categorized into normothermic (core body temperature ≥ 36°C) and hypothermic (core body temperature < 36°C) groups based on these recordings.

Infection data post-surgery were collected through clinical assessments, blood tests, and imaging techniques to differentiate between superficial and deep infections. Clinical assessments included routine postoperative evaluations, and blood tests involved white blood cell counts and markers of inflammation. Imaging techniques, such as ultrasound or MRI, were employed as necessary to confirm the presence and extent of infections.

Data analysis was performed using SPSS version 25. Comparative analysis between the normothermic and hypothermic groups was conducted to determine the association between intraoperative hypothermia and the incidence of infections. Descriptive statistics were

used to summarize patient demographics and surgical details. Chi-square tests were utilized to compare categorical variables, and independent t-tests were applied for continuous variables. A p-value of less than 0.05 was considered statistically significant.

Ethical approval for the study was obtained from the Institutional Review Board of Jinnah Sindh Medical University, ensuring adherence to ethical standards as outlined in the Declaration of Helsinki. Informed consent was obtained from all participants prior to the commencement of the study, ensuring that participants were fully aware of the study's purpose, procedures, and potential risks.By following rigorous data collection and analysis protocols, this study aimed to elucidate the impact of intraoperative hypothermia on infection rates in implant-based breast reconstruction, providing valuable insights to improve surgical practices and patient outcomes (1-3).

3 Results

Data were collected from 195 patients, divided into normothermic and hypothermic groups based on their intraoperative core temperatures. The demographic characteristics and clinical details of the patients are summarized in Table 1. The mean age of patients in the normothermic group was 45.23±3.45 years, compared to 46.01±2.89 years in the hypothermic group. The average BMI was slightly higher in the hypothermic group (25.1 kg/m²) than in the normothermic group (24.5 kg/m²). The prevalence of diabetes and hypertension was marginally higher in the hypothermic group, with 32% having diabetes and 22% having hypertension, compared to 30% and 20%, respectively.

Table 1: Demographic Data of Patients

Parameter	Normothermic Group (n=100)	Hypothermic Group (n=95)
Average Age (years)	45.23 ± 3.45	46.01 ± 2.89
Average BMI (kg/m²)	24.5	25.1
Diabetes (%)	30%	32%
Hypertension (%)	20%	22%

The incidence of infections is detailed in Table 2. Total infections were observed in 26.3% of the hypothermic group, compared to 10% in the normothermic group. Superficial infections were reported in 12.6% of the hypothermic patients, while only 6% of the normothermic patients experienced them. Deep infections were more prevalent in the hypothermic group at 13.7%, compared to 4% in the normothermic group.

Table 2: Incidence of Infections

Infection Type	Normothermic Group (n=100)	Hypothermic Group (n=95)
Total Infections	10 (10%)	25 (26.3%)
Superficial Infections	6 (6%)	12 (12.6%)
Deep Infections	4 (4%)	13 (13.7%)

Intraoperative details are presented in Table 3. The average surgery duration was slightly longer for the hypothermic group (125 ± 20 minutes) compared to the normothermic group (120 ± 15 minutes). The average intraoperative temperature was maintained at 36.5 ± 0.2°C in the normothermic group, whereas it dropped to 35.5 ± 0.4°C in the hypothermic group. The use of warming devices was significantly higher in the normothermic group at 85%, compared to only 30% in the hypothermic group. Blood loss was greater in the hypothermic group, averaging 250 ± 70 ml, compared to 200 ± 50 ml in the normothermic group.

Table 3: Intraoperative Details

Intraoperative Parameter	Normothermic Group (n=100)	Hypothermic Group (n=95)
Average Surgery Duration (minutes)	120 ± 15	125 ± 20
Average Intraoperative Temperature (°C)	36.5 ± 0.2	35.5 ± 0.4
Use of Warming Devices (%)	85%	30%
Blood Loss (ml)	200 ± 50	250 ± 70
IV Fluids Administered (ml)	1500 ± 300	1700 ± 350

The univariate and multivariate analyses identified intraoperative hypothermia as a significant risk factor for infections in implant-based breast reconstruction, as shown in Table 4. The univariate odds ratio (OR) for intraoperative hypothermia was 3.2 (95% CI: 1.5-6.8) and the multivariate OR was 3.0 (95% CI: 1.3-6.5), both with a p-value of less than 0.01. Other variables such as age, BMI, diabetes, and hypertension did not show significant associations with infection risk.

Table 4: Univariate and Multivariate Analyses

Variable	Univariate OR (95% CI)	Multivariate OR (95% CI)	p-value
Intraoperative Hypothermia	3.2 (1.5-6.8)	3.0 (1.3-6.5)	< 0.01
Age	1.1 (0.9-1.3)	1.0 (0.8-1.2)	0.25
BMI	1.0 (0.8-1.2)	1.1 (0.9-1.4)	0.45
Diabetes	1.3 (0.8-2.0)	1.2 (0.7-1.9)	0.35
Hypertension	1.2 (0.7-1.9)	1.1 (0.6-1.7)	0.40

These results highlight the significant impact of intraoperative hypothermia on the incidence of infections in patients undergoing implant-based breast reconstruction. The findings underscore the necessity for maintaining normothermia during surgery to reduce infection rates and improve patient outcomes.

4 Discussion

The findings from this study underscored the significant impact of intraoperative hypothermia on the incidence of infections in patients undergoing implant-based breast reconstruction. The results demonstrated a markedly higher rate of total, superficial, and deep infections in the hypothermic group compared to the normothermic group. This reinforced previous research, which identified intraoperative hypothermia as a critical risk factor for postoperative complications (1).

Several studies have documented the detrimental effects of hypothermia on immune function and wound healing. Hypothermia impairs neutrophil function, reduces blood flow to surgical sites, and delays wound healing, all of which increase the susceptibility to infections (2). The univariate and multivariate analyses in this study highlighted that intraoperative hypothermia remained a significant risk factor for infections, even when controlling for potential confounders such as age, BMI, diabetes, and hypertension. This consistency with prior research reinforces the need for vigilant temperature management during surgery (3, 4).

The strengths of this study included its robust sample size and the comprehensive collection of patient demographics and intraoperative details, allowing for a thorough analysis of the impact of hypothermia. The meticulous monitoring of core body temperatures and infection outcomes provided a clear picture of the relationship between intraoperative temperature and infection rates. However, the study had limitations. It was retrospective in nature, which may have introduced selection bias. Additionally, the study was conducted at a single center, potentially limiting the generalizability of the findings to other settings with different patient populations and surgical practices.

Despite these limitations, the findings offered valuable insights into the importance of maintaining normothermia during implant-based breast reconstruction. Preventive measures, such as preoperative warming, the use of intraoperative warming devices, and continuous temperature monitoring, were essential strategies to mitigate the risk of infections. These interventions not only improved patient outcomes but also aligned with the recommendations of international guidelines for safe surgical practices (5, 6).

Future research should focus on multicenter prospective studies to validate these findings across diverse settings and patient populations. Investigating the cost-effectiveness of different warming strategies could also provide practical insights for healthcare providers. Additionally, exploring the biological mechanisms underlying the increased infection risk associated with hypothermia might help develop targeted interventions to enhance immune function and wound healing during surgery.

In conclusion, this study provided compelling evidence that intraoperative hypothermia significantly increased the risk of postoperative infections in patients undergoing implant-based breast reconstruction. Maintaining normothermia through effective temperature management strategies was crucial to reducing infection rates and enhancing surgical outcomes. These findings underscored the need for adherence to best practices in temperature management to optimize patient care in breast reconstruction surgeries (7, 8).

5 Conclusion

In conclusion, Intraoperative hypothermia significantly increases the risk of postoperative infections in patients undergoing implant-based breast reconstruction. This study clearly demonstrated that patients who experienced hypothermia during surgery had markedly higher rates of both superficial and deep infections compared to those who maintained normothermia. The detrimental effects of hypothermia on immune function and wound healing were evident, as reduced core body temperature impairs neutrophil function, slows blood flow to the surgical site, and delays wound healing, all of which increase susceptibility to infections.

Effective temperature management strategies are therefore crucial to mitigating these risks. Preoperative warming ensures that patients enter surgery with an optimal core temperature, thereby reducing the likelihood of intraoperative hypothermia. Intraoperative warming devices, such as forced-air warming systems and thermal blankets, help maintain normothermia throughout the procedure. Continuous monitoring of core body temperature allows for timely interventions if temperature deviations occur. Implementing these strategies not only reduces infection rates but also improves overall surgical outcomes, leading to faster recovery times and better patient satisfaction.

In conclusion, maintaining normothermia through proactive temperature management is essential in implant-based breast reconstruction surgeries to minimize the risk of postoperative infections and enhance patient outcomes. These findings underscore the importance of adhering to best practices in temperature management to optimize patient care in surgical settings.

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Disclaimers

Author Contributions	Bakhtawar Meraj conceptualized the study and wrote the initial draft. Zoha Sajid Qureshi and Salman Khan collected the data. Asadullah Awan and Masroor Ahmad performed the data analysis. Umama Jelani and Ekramuddin reviewed and revised the manuscript. All authors approved the final version of the manuscript.
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