



Original Article

The Lived Experience of Operating Room Staff From Factors for Hypothermia in Patients Undergoing Laparoscopic Surgery: A Qualitative Study

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Abstract

Background: At body temperature below 36 °C, hypothermia occurs, causing severe problems for the patients. Hypothermia during laparoscopic surgery can negate the benefits of this method, thus proper control can reduce the associated complications, length of hospital stay, and costs. This study aimed to explain factors affecting hypothermia in patients undergoing laparoscopic surgery based on the lived experience of the operating room staff.

Methods: This qualitative study was performed as a contractual content analysis. Eight operating room nurses of the hospital of Hamadan University of Medical Sciences were selected by purposive sampling. Data collection tools were in-depth semi-structured interviews, observations, and library studies. The data were analyzed by using Graneheim and Lundman method.

Results: Data analysis led to ten sub-themes and five main themes, including non-optimal infusion of liquids, unfavorable gas insufflation, the need to be aware of hypothermia in laparoscopic surgery, improper covering of the patient's body, and non-optimal heating of the environment and the patient.

Conclusion: In patients undergoing laparoscopic surgery, hypothermia is an essential and dangerous complication; in this research, an attempt was made to identify factors affecting hypothermia and increase the awareness of the operating room staff to take a step toward the optimal control of the hypothermia complication.

Keywords: Hypothermia, Laparoscopic surgery, Operating room nurses, Qualitative study, Operating room



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Introduction

Hypothermia is a common and dangerous complication of anesthesia and surgery that plays a significant role in pre-, intra-, and post-operative care. Hypothermia occurs when the central body temperature falls below 36 °C (F8/96). More than 70% of surgery patients suffer from this complication (1). Laparoscopy is a method that uses narrow cameras to observe the space inside the abdominal cavity. Laparoscopic surgery has several advantages such as pain reduction, smaller incision sites, shorter hospital stays, lower costs, reduced recovery time, faster recovery, and minimal adhesion if it is performed correctly (2). Laparoscopic surgery using carbon dioxide (CO₂) at room temperature can adversely affect body temperature. However, most laparoscopic surgeries are performed without heating and moistening CO₂ (3).

Intraoperative hypothermia occurs in more than 25%-90% of patients as a common postoperative complication

with side effects such as chills, bleeding, coagulation disorder, surgical site infection, cardiac dysfunction, and delayed recovery in postoperative recovery (4). The skin may become white or edematous which occurs in the peripheral environment as the hands and feet and other exposed areas such as the ears, nose, and cheeks (5). The incidence of postoperative hypothermia is associated with old age, major or long-term anesthesia or surgery, preoperative body temperature, anesthetic technique, female, emergency surgery, higher American Society of Anesthesiology physical status, amount of intravenous or blood replaced, and operating room temperature (6).

Unwanted hypothermia can lead to increased respiratory distress, hypoxia, and delayed endotracheal exit. Measurement of the physiological indicators of vital signs is effective in assessing the patient's hypothermia. Thus, hypothermia stimulates the respiratory system and increases the number of breaths (1). CO₂ is the most



common gas used to blow into the abdomen because it is non-combustible, cheap, and highly soluble in water, and laparoscopy causes less direct damage due to gentle tissue displacement, precise hemostasis, continuous irrigation, the use of small surgical instruments, and a smaller operating field (7).

Hypothermia during laparoscopic surgery can negate the expected benefits of this procedure. Therefore, the prevention of temperature drop during laparoscopic surgery should be mandatory (8). Even warming the air with pressure for more than 30 minutes before the induction of anesthesia can increase the amount of heat in the peripheral tissue and reduce hypothermia during surgery. The penetration of hot and humid gas during laparoscopic surgery is also an active alternative to prevent hypothermia. However, using a device to heat and moisturize the gas may add to the cost (9). The rate of hypothermia in patients admitted to the intensive care unit (ICU) after surgery is high (17%-46%), thus maintaining the patient's natural body temperature before, during, and after surgery for patient safety, the expected outcome of surgery, and patient satisfaction is essential (10). It should be noted that hypothermia causes dangerous complications, and each of these complications has irreversible consequences for patients undergoing surgery. Moreover, laparoscopic surgeries in Iran have increased significantly, confirming the priority of this study more than before, and according to the available information, studies evaluating factors affecting the hypothermia of patients undergoing laparoscopic surgery in the operating room of Iran are insufficient. Therefore, a qualitative study was performed on factors affecting hypothermia in patients undergoing laparoscopic surgery.

Materials and Methods

Study Setting

Using a contractual content analysis approach, the present qualitative study was performed at the Hospital of Hamadan University of Medical Sciences.

Participants

Eight operating room nurses of Hamadan University of Medical Sciences, including four women and four men aged 27-45 years, were purposefully selected to review the data. The inclusion criteria were operating room nurses with at least four years of clinical experience and willingness to participate in the study. On the other hand, the exclusion criterion was an unwillingness to continue participating in the study for any reason (Table 1).

Data Collection

Data were collected through interviews, library studies, and observation. Several questions were pre-designed according to the research objectives. Here are some examples of interview questions: Are you aware of hypothermia and what causes hypothermia in patients undergoing laparoscopic surgery? What are the

Table 1. Characteristics of Participants

Participants' Number	Gender	Education Level	Age (y)	Work Experience (y)
P1	Male	BSN	33	8
P2	Female	MSc	27	4
P3	Female	BSN	40	15
P4	Male	BSN	36	9
P5	Female	BSN	45	17
P6	Female	MSc	30	5
P7	Male	MSc	35	7
P8	Male	BSN	39	10

Note. BSN: Bachelor's in nursing; MSc: Master's in nursing.

consequences of hypothermia for patients undergoing surgery? If you have experience in this field, please tell me. During the interview, more exploratory questions were asked, such as How? How about and if possible, give an example. The in-depth semi-structured interview was conducted individually (The researcher and interviewee) with ethical considerations. The duration of the interviews was variable and relied on the desire of the participants to continue the interview (20-40 minutes). At the beginning of each session, after stating the objectives for the participants, they were allowed to record the interview, and then each interview was implemented verbatim in less than 24 hours so that in the case of ambiguity, the researcher could follow up again. To ensure the accuracy of the questions and the interview process and to determine the next samples, the interviews were simultaneously conducted, along with coding and data analysis. Coding is the process by which data are analyzed, conceptualized, and put together in a new way, helping the researcher to be able to design other required questions and better guide the study path. Interviews were transcribed with Microsoft Word software and prepared for analysis. During the study, numbers (P1, P2, P3, etc.) were used instead of the names of the participants. Interviews were conducted with eight participants until data saturation.

Data Analysis

The following steps were carefully followed in the data analysis according to the proposed steps of Graneheim and Lundman. The recorded interviews were careful, word-for-word, implemented, and read several times by the researcher. Then, line by line, they were compared with the form of sessions prepared by the researcher, and significant sentences that were related to the main topic of the research were marked. The main concept of meaningful sentences was extracted as a code, and the classification of codes began accordingly. In this way, codes that had common concepts were placed in a category and named accordingly. With each new interview, the previous classes were reviewed and merged or a new class was created. Under the supervision of an observer with experience in qualitative data analysis, the work of classifying and naming classes was reviewed, and the content was

provided to the participants to ensure the accuracy of the researcher’s interpretation and understanding. In this way, the main themes of the study were extracted, and the relationship between classes was identified. In library studies, the studies of other researchers were used, and the researcher also collected the desired data through observation.

Rigor

Four criteria of validity, credibility, reliability, and transferability were used for the research rigor of Lincoln and Guba. For the reliability of the research, the researcher used triangulation methods, prolonged data engagement, member checks, and persistent observation. For validity, the researcher attempted to guarantee the validity of this research by preserving the documents related to different stages of research and reviewed by the supervisor. The research credibility was provided by such measures as participants’ reviews. For transferability, participants of different ages, both genders, and different levels of education and those with different work experiences participated in the study.

Results

In this study, data were collected through semi-structured in-depth interviews with eight (four females and four males) operating room nurses of Hamadan University of Medical Sciences, library studies, and observation of the researcher. After analyzing the data, ten sub-themes were extracted, which during the classification, finally became the five main themes, including non-optimal infusion of liquids, unfavorable gas insufflation, the need to be aware of hypothermia in laparoscopic surgery, improper covering of the patient’s body, and non-optimal heating of the environment and the patient (Table 2).

Non-optimal Infusion of Liquids

This theme included several sub-themes such as the use of cold serum and cold blood, lack of attention to serum temperature and its heating, and consumption of large volumes of serum.

Use of Cold Serum and Cold Blood

Diagnostic procedures or surgery are performed in patients undergoing laparoscopic surgery without opening the abdomen. To examine the peritoneal cavity, the abdominal and pelvic organs are inserted into the abdomen by a camera after gas penetrates the abdominal wall, and surgery is performed accordingly. Therefore, serum at room temperature and even colder is used routinely. The use of cold serums for washing due to trauma to organs such as the gallbladder, ducts, and bile entering the abdomen, injection of cold fluids and cold blood due to the urgency of the patient’s condition, or lack of proper attention in the operating room nurses to this matter can lead to complications of hypothermia in patients undergoing laparoscopic surgery. For example, in this regard, one of the participants stated: *"...When the gallbladder separates from the liver bed or the bile duct is ligating, for whatever reason, when they are damaged, it often happens that the bile enters the abdominal cavity and needs to be rinsed. Although normal saline is colder than the room temperature that I say. In laparoscopy, we use serums that are available and cold..."* (P2). Another participant mentioned: *"...The serums that we inject into the patient are cold, which can cause hypothermia..."* (P4).

Lack of Attention to Serum Temperature and its Heating

Limited working space and not being routine to use hot serums in laparoscopic surgery, fatigue, impatience, and laziness in the heating serum have caused operating room nurses not to pay enough attention to heating serums. In this regard, one of the participants indicated: *"... Sometimes we are so tired and just want to start the operation sooner that it ends sooner..."* (P5). Another participant declared: *"... Because it is routine and the workspace is limited, it does not matter to use warm serum..."* (P7).

Use of a Large Volume of Serum

Irrigation and aspiration used during laparoscopic surgeries and the need for large-scale washing due to trauma to organs such as the gallbladder, duct, and bile entering the abdomen can lead to hypothermia in patients undergoing laparoscopic surgery. In this respect, one of

Table 2. The Main Themes and Sub-themes of Hypothermia in Patients Undergoing Laparoscopic Surgery

Main Themes	Sub-themes
• Non-optimal infusion of liquids	• Use of cold serum and cold blood
• Unfavorable gas insufflation	• Lack of attention to serum temperature and its heating
• The need to be aware of hypothermia in laparoscopic surgery	• Use of large-volume serum
• Improper covering of the patient’s body	• Continuous use of CO ₂ gas during laparoscopic surgery
• Non-optimal heating of the environment and the patient	• Blowing of cold and dry CO ₂ gas
	• Lack of knowledge about the appropriate temperature of CO ₂ gas
	• Wet draping of patient
	• Incorrect draping with inappropriate cloths
	• Low operating room temperature
	• Lack of using proper heating devices

the participants stated: "... Definitely, if the volume of our washing increases, this irrigation and aspiration will cause hypothermia in the patient..." (P6).

Unfavorable Gas Insufflation

This theme included several sub-themes such as the continuous use of CO₂ gas during laparoscopic surgery and the blowing of cold and dry CO₂ gas.

Continuous Use of CO₂ Gas During Laparoscopic Surgery

Hypothermia often occurs due to the use of CO₂ gas during laparoscopic surgery, which can offset the benefits of this procedure. Because CO₂ gas is non-combustible, absorbable in large volumes without severe side effects per minute, cheap, and highly soluble, reducing the risk of gas embolism; it can be used as a reliable gas for pneumoperitoneum in laparoscopic surgery. Considering that this gas enters the abdomen in large volumes and continuously flows during laparoscopic surgery, it is highly important to pay attention to it. In this regard, one of the participants indicated: "... Blowing CO₂ gas into the abdomen to create pneumoperitoneum can be the most important factor in causing hypothermia in laparoscopic surgery because we use this gas in a large volume and with the continuous flow during the operation until the end of the operation..." (P1).

Blowing Cold and Dry CO₂ Gas

Given that this gas enters the abdomen in large volumes and continuously flows during laparoscopic surgery, it is extremely important to pay attention to its temperature. In this regard, one of the participants mentioned: "...The gas we use has a low temperature and cold, which can be the most important cause of hypothermia in laparoscopy..." (P5).

The Need to Be Aware of Hypothermia in Laparoscopic Surgery

Lack of knowledge of operating room nurses about the appropriate temperature of CO₂ gas is the most important factor in causing hypothermia in patients undergoing laparoscopic surgery.

Lack of Knowledge About the Appropriate Temperature of CO₂ Gas

Operating room nurses' lack of attention to gas temperature, adjustment of the gas temperature according to the hospital routine, and lack of paying attention to the gas temperature due to not having enough information about the effect of CO₂ temperature on hypothermia in patients undergoing laparoscopic surgery have led to this complication. In this respect, one of the participants stated: "... the temperature of this gas should be checked because we are consuming routine and pay no attention to many things such as what the temperature of the gas is and how it can affect hypothermia ... " (P3).

Improper Covering of the Patient's Body

This theme encompassed sub-themes such as wet draping of patients and incorrect draping with inappropriate clothes.

Wet Draping of Patients

Wetting the cloths on the patient's body with cold liquids due to negligence and haste of operating room nurses and surgeons and placing wet instruments and wet gauze on the clothes and body of patients can lead to hypothermia in patients. In this regard, one of the participants stated: "... It often happens that we put wet gauze on the patient's clothes or even on the body of the patient. Or we pour the serum on the cloths that we put on the patient's body and wet them..." (P8).

Incorrect Draping With Inappropriate Clothes

We can mention the non-use of disposable cloths in hospitals due to their high cost and limited number, the use of reusable cloths, and the inaccuracy in covering the patient correctly and completely with the cloths, which is effective in causing hypothermia in patients. In this regard, one of the participants declared: "... Sometimes when we cover the patient's body with cloths, the patient's foot comes out without a cover..." (P6). Another participant mentioned: "... In our hospital, disposable cloths are used for orthopedic surgeries because they are expensive, and we have to use reusable cloths, which are usually cold, and we put them on the patient and body temperature drops..." (P4).

Non-optimal Heating of the Environment and the Patient

This theme consisted of sub-themes such as low operating room temperature and lack of using proper heating devices that can lead to hypothermia in patients.

Low Operating Room Temperature

Some factors can cause hypothermia in patients, including maintaining the operating room temperature approximately at less than 25 degrees, using a cooler and a fan in the operating room for the comfort of operating room nurses and surgeons during the surgery, and exposing the patient's body to cold weather. In this regard, one of the participants stated: "...The surgical team feels hot and uncomfortable because of the sterile gown they wear during the surgery, so the fan is on until they can do their job better ... " (P2).

Lack of Using Proper Heating Devices

Not using blankets, sheets, and warmers after the surgery to warm the patient can be effective in the occurrence of hypothermia in patients. In this regard, one of the participants indicated: "...When coming to the bed to transport the patient, the servant does not bring a blanket to put on the patient after the surgery..." (P7). Another participant mentioned: "... We did not always see a warmer used for the patient in recovery unless the patient had

chills..." (P3).

Discussion

Based on the findings of the research, ten sub-themes were extracted, which finally turned into five main themes during the categorization. The experience of the study participants showed that the non-optimal infusion of liquids, unfavorable gas insufflation, the need to be aware of hypothermia in laparoscopic surgery, improper covering of the patient's body, and non-optimal heating of the environment and the patient can be effective in the occurrence of hypothermia in patients undergoing laparoscopic surgery. In this study, the first main theme of the non-optimal infusion of liquids included the sub-themes of using cold serum and cold blood, lack of attention to the serum temperature and its heating, and use of the large-volume serum. Based on the experience of the operating room nurses, several important factors can lead to the occurrence of hypothermia in patients undergoing laparoscopic surgery, including the use of serum and cold blood due to the traumas inflicted on the target organs. The other factors were a lack of attention to serum temperature and its heating due to the lack of routine and the limited field of work and the use of serum with volume following irrigation and aspiration during laparoscopic surgeries. In the study of Oshvandi et al, 62 women undergoing elective cesarean section with general anesthesia were randomly divided into two intervention and control groups. The intervention group received pre-warmed (37 °C) serum, while the control group received serum at room temperature (25.5 °C). The core body temperature and some hemodynamic parameters of the participants were examined during the operation, representing that the injection of pre-warmed serum (37 °C) prevented intraoperative hypothermia and improved nursing care (11). Likewise, in the study of Behdad et al, the administration of warm liquids could reduce the side effects of hypothermia, including shivering (2). The second main theme of unfavorable gas insufflation included the continuous use of CO₂ gas during laparoscopic surgery and blowing cold and dry CO₂ gas. In the study of Binda, it was also shown that blowing dry and cold CO₂ into the abdominal cavity causes peritoneal damage, postoperative pain, hypothermia, and the formation of adhesions after the operation, thus the use of hot and humid gas can completely prevent hypothermia and postoperative pain (7).

The third main theme was the need to be aware of hypothermia in laparoscopic surgery, including the sub-theme of lack of knowledge about the appropriate temperature of CO₂ gas. In addition, the operating room nurses' experience of not paying attention to the temperature of the gas used due to not having enough information about the proper temperature of CO₂ gas and adjusting the gas temperature according to the hospital routine can be effective in the occurrence of hypothermia in patients undergoing laparoscopic surgery. Binda also

found that it is clear that humidified gas should be used during laparoscopic surgery, but one question remains unanswered: at what temperature should the humidified gas be blown in the belly to achieve the greatest clinical benefit for the patient? To solve this question, more clinical trials are necessary (7). The fourth main theme of improper covering of the patient's body included the sub-themes of wet draping of the patient and incorrect draping with inappropriate clothes. In addition to the experience of nurses in the operating room, who found the wetting of the cloths on the patient's body with cold liquids due to haste and carelessness, not using disposable cloths, incomplete and incorrect covering of the patient are effective in the occurrence of hypothermia. In their study, Rutala and Weber pointed out that the gowns should be selected in such a way that they are protected against the infiltration of fluids for anticipated pressures and bleeding (12). The fifth main theme of non-optimal heating of the environment and the patient included the sub-themes of low operating room temperature and lack of using proper heating devices. The lived experience of the operating room staff revealed that the cold temperature of the operating room environment, the use of cooling devices during the surgery, and the lack of proper warming of the patient's body during and after the surgery can play a role in the occurrence of hypothermia. Sultan et al also reported that active heating for elective cesarean section reduces intraoperative temperature, hypothermia, and shivering, and forced air heating or heated liquid should be used accordingly (13). In the study of Becerra et al, pre-warming 5-15 and 15-30 minutes before urological laparoscopic surgery could reduce hypothermia during the operation period and in the first hour after the surgery (8). It is hoped that by explaining the effective factors of hypothermia, we will help in the optimal control of hypothermia in patients undergoing laparoscopic surgery.

Conclusion

Studies conducted in this field confirmed that hypothermia in patients undergoing surgery, especially laparoscopy, is known as an important and dangerous complication. Therefore, in this research, it was attempted to take a step in this field. Based on the experience of operating room nurses, lack of paying attention to the temperature of injected fluids such as serum and blood to patients due to fatigue, the haste of the surgical team, and the lack of routine heating of serums and sometimes frequent washes with large volumes caused hypothermia in patients. Providing appropriate and correct infusion using serum and warm blood with appropriate volumes can be effective in the optimal control of hypothermia in patients undergoing laparoscopic surgery. Further, the findings demonstrated that the continuous use of CO₂ gas during laparoscopic surgery and the blowing of cold CO₂ gas can contribute to the occurrence of hypothermia. Hence, in laparoscopic surgery, special attention should be paid to the optimal insufflation of

CO₂ gas into the abdomen, and the use of warm and moist CO₂ gas with appropriate pressure and volume can be highly effective in the optimal control of hypothermia in patients undergoing laparoscopic surgery. The lack of sufficient knowledge of operating room personnel about hypothermia and its complications in patients undergoing laparoscopic surgery has caused them to not pay enough attention to the temperature of the consumed gas and liquids. Accordingly, preparing a comprehensive training program to raise awareness among operating room personnel about hypothermia and its causes can play a role in controlling hypothermia. Improper covering of the patient, which includes the incorrect drape of the patient with reusable fabric cloths instead of disposable cloths that keep the patient's body warm and the waterproof properties of disposable cloths that prevent getting wet and lower the patient's body temperature, it leads to hypothermia in patients. Thus, sufficient care and attention to the correct drape of the patient and the use of warm and disposable cloths in the drape of the patient can be effective in the optimal control of hypothermia in patients undergoing laparoscopic surgery. Maintaining a low temperature in the operating room to reduce infection and using coolers and fans during surgery and not using proper heating devices to warm patients after surgery in the recovery environment led to hypothermia in patients. Therefore, the use of blankets, warmers, mattresses with a water circulation system, and heating systems with air pressure can control hypothermia in patients undergoing laparoscopic surgery. Hence, it is suggested that the recommendations for the optimal control of patients' hypothermia should be followed as much as possible according to the policies of each hospital to minimize the occurrence of hypothermia in surgeries, especially laparoscopy. It is also recommended to perform more and more comprehensive investigations in many hospitals on the effective factors of hypothermia, including the effect of anesthetic drugs, and to find comprehensive solutions for the optimal control of hypothermia in patients undergoing laparoscopic surgery.

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Competing Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Ethical Approval

The present study was approved by the Ethics Committee of Hamadan University of Medical Sciences (UMSHA) - Iran, with the ethics code of IR.UMSHA.REC.1400.378. Conscious written consent was obtained from participants to participate in the study. The confidentiality of information, anonymity, and right of withdrawal were considered during the study. This study complies with the Standards for Reporting Qualitative Research.

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