

# The Effect of Perioperative Warming Measures for Major Abdominal Surgery on Postoperative Hypothermia

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## Abstract

**Aim of the study:** was to determine the effect of perioperative warming measures for major abdominal surgery on postoperative hypothermia.

**Setting:** The current study was conducted in operating room at Emergency Hospital of Menoufia University, Menoufia Governorate.

**Subjects:** A purposive sample consists of 100 adult patients undergoing major abdominal surgery were randomly divided and assigned alternatively into two equal groups; 50 for each group.

**Tools:** Three tools were used for data collection. Structured interview questionnaire: knowledge assessment sheet, perioperative assessment sheet, and shivering scale.

**Results:** There was a highly significant difference between study and control groups regarding mean perioperative temperature at all times of interval of measurements  $p < 0.001$ . Also there was a highly significant difference between study and control groups concerning postoperative shivering  $P < 0.001$ .

**Conclusions:** Usage of perioperative warming measures for major abdominal surgery has a positive effect on the prevention of postoperative hypothermia and shivering.

**Recommendations:** All staff of surgical nurses should be encouraged to be familiar with perioperative warming measures and use these measures in order to maintain perioperative normothermia and prevent postoperative hypothermia.

**Keywords:** Perioperative warming measures, Abdominal surgery, Hypothermia

## Introduction

Inadvertent perioperative hypothermia is a common complication of perioperative procedures and is defined as a core body temperature below 36°C (96.8°F). The hypothermic state ranges from mild to profound. Most people tolerate mild hypothermia (35.0°C to 35.9°C body temperature), which is not associated with significant morbidity or mortality. The mortality rate for patients with moderate

hypothermia (34.0°C to 34.9°C body temperature) has been estimated at 21.0 %, and is even higher in severe hypothermia (i.e., core temperature < 33.9°C). Despite hospital based treatment, mortality from moderate or severe hypothermia approaches 40 % [1,2].

The outcome for patients as a result of perioperative hypothermia is poorer, with an increase in surgical site infections, cardiac complications and bleeding a common complication. Patients' distress and discomfort as well as increased treatment costs and prolonged hospitalization are other consequences associated with

perioperative hypothermia [3-5].

The reported prevalence of perioperative hypothermia ranges from 50% to 90% of all surgical patients and results when the body's ability to maintain normothermia is diminished by absence of protective reflex's such as shivering and piloerection due to anaesthesia and loss of heat during surgery. Approximately 6 million patients undergo surgery in England each year, so the burden of related complications is likely to be significant [3,4]. In the United States hypothermia afflicts millions of U.S. surgical patients every year [5].

The total number of patients admitted with general surgery in Menoufia University Hospital from June 2014 to September 2015 was 3029. The major abdominal surgery estimated at this period was 9.71% from the total number of general surgery Statistical Records of Surgery, Menoufia University Hospital [6].

Inadvertent perioperative hypothermia is a common but preventable complication of perioperative procedures, which is associated with poor outcomes for patients. In 2007, the Association of Perioperative Registered Nurses (AORN) updated and published recommended practices to prevent and treat perioperative hypothermia throughout risk reduction strategies include assessing the patient for increased risk of hypothermia, monitoring temperature throughout the perioperative period that is (pre, intra, and postoperatively), using optimal temperature monitoring sites, and using active and/or passive warming measures as appropriate [7,8].

Regular measurement and recording temperature is the key to prompt identification and its management. The American Society of Anesthesiologist (ASA) considers the use of aggressive perioperative thermal management to maintain normothermia in the surgical patient is imperative to positive surgical outcomes. Management of this nursing and medical diagnosis requires the coordinated efforts of anaesthesia providers, surgeons, and perioperative, perianaesthesia, and critical care nurses [9].

### Significance of the study

It has been observed from clinical experience in operating room at Emergency Hospital of Menoufia University that the patients after major abdominal surgery have hypothermia and shivering subsequently that produce adverse physiological effect. It is the responsibility of the nurse to monitor temperature throughout the perioperative period using optimal temperature monitoring sites, and using active and/or passive warming measures as appropriate to prevent hypothermia and shivering. Therefore this study was conducted to determine the effect of perioperative warming measures for major abdominal surgery on postoperative hypothermia.

### Aim of the study

The aim of the study was to examine the effect of perioperative warming measures for major abdominal surgery on postoperative hypothermia.

### Operational definitions

**Major abdominal surgery:** It's defined as surgery pertaining to the contents of the abdominal cavity; its wall and orifices involving the more important, difficult and hazardous operations on the abdomen. This may include surgery on the stomach, gallbladder, small intestine, or large intestine (colon), liver, pancreas, spleen, and esophagus.  
**Perioperative warming measures:** It means using measures either

passive or/ active or using these measures together to maintain patients who are undergoing major abdominal surgery normothermic, exhibited no shivering, and discomfort.

**Passive warming:** It's the appropriate method to prevent or minimize heat loss throughout the operation by removal of cold, wet clothing, movement to a warm environment (minimum 20°C-24°C or 68°F-75°F), limited skin exposure by using two warm gown, socks, head covering, wrapped the lower extremities of patient from the feet to the lowered one third of the thigh, and the arm to forearm with cotton and gauze role.

**Active warming:** Active warming measures this method deliver heat to the body to prevent heat loss through active core rewarming (warmed intravenous fluids, and body cavity lavage).

**Postoperative hypothermia:** The patient exhibits sign and symptoms of hypothermia (core body temperature below 36°C, piloerection, and shivering) at Post Anaesthetic Care Unit (PACU).

### Research Hypothesis

The following research hypotheses were formulated in an attempt to achieve the aim of the study:

1. Patients who receives perioperative warming measures (study group I) will show perioperative normothermia when compared to patients who do not receive it (control group II).
2. Patients who receives perioperative warming measures (study group I) will show no postoperative shivering when compared to patients who do not receive it (control group II).

### Methods and Procedure

**Research design:** A clinical trial (quasi experimental) research design was utilized to fulfill the aim of this study.

**Research Setting:** The current study was conducted in the operating room at Emergency Hospital of Menoufia University, Menoufia Governorate, Egypt. The setting is considered representative for patients with major abdominal surgery.

### Subjects

**Sampling technique:** The subjects of our study were chosen from operating room at Emergency Hospital of Menoufia University. The sample size was determined and calculated using EPI info program at CI (coefficient interval) 95%.

**Sample:** A purposive sample consists of 100 adult patients undergoing major abdominal surgery.

- Patients were randomly divided and assigned alternatively into two equal groups; 50 for each group:
- ✓ **Study group (I):** was received perioperative warming measures to avoid postoperative hypothermia and shivering.
- ✓ **Control group (II):** was exposed to a routine hospital care.

### Inclusion criteria

- Conscious patients with major abdominal surgery their age ranged from 21 up to 60 years old.
- Free from any chronic disease such as diabetes mellitus, hypertension, heart disease, kidney disease, and thyroid disorder.
- The patients were on American Society of Anesthesiologists physical status 1 (ASA PS1) that means normally healthy patient e.g., no organic, physiologic, or psychiatric disturbance; and

healthy with good exercise tolerance American Society of Anesthesiologists [10].

### Exclusion Criteria

- The extreme age (very young and very old patients).
- The patient's temperature is below 36.0°C in the preoperative phase.
- Pregnant women
- Patients who have been treated with therapeutic hypothermia
- Patients with severe head injuries resulting in impaired temperature control.

**Tools of the study:** Based on the review of related literature three tools were used by the researcher for collecting the necessary data, these tools were:

**Tool I: Structured interview questionnaire:** Knowledge assessment sheet. It was developed by the researcher after reviewing of the related literature [11,12].

To assess the patient's sociodemographic data; past and present medical history and assess patient's knowledge about hypothermia. It was comprised of three parts:

**Part one: Sociodemographic data:** It was comprised of 5 questions included data related to patient's age, sex, education, occupation, and marital status.

**Part two: Medical history:** It was comprised of 11 questions regarding to patient's past and present medical history (chronic diseases), if yes what is it, are you smoker, if yes how many hours to stop smoking before day of surgery, chief complaints, diagnosis, and type of surgery, vital signs night the operation, weight, height, and body mass index (BMI).

**Part three: Patient's knowledge:** It was comprised of six questions related to patient's knowledge regarding to postoperative hypothermia such as definition of postoperative hypothermia, causes, complications, how to stay warm preoperative, how to stay warm postoperative and importance of stay warm.

**Scoring system:** Each question was given two marks if the subject reported completely correct answer, one mark if he/she reported incompletely correct answer, and zero if the answer was incorrect or don't know.

**Reliability of the tool I:** The test was reliability tested by the researcher using cronbach  $\alpha = 0.83$ .

**Tool II: Perioperative assessment sheet:** It was developed by the researcher based on the review of related literature [12-14].

To assess the effect of perioperative warming measures for major abdominal surgery on postoperative hypothermia. The tool was comprised of three parts.

**Part one: Preoperative assessment sheet:** It was comprised of 18 items concerning vital signs record (1 hour before leaving the ward, and immediately before induction of anaesthesia), O<sub>2</sub> saturation immediately before induction of anaesthesia, manifestations of hypothermia, ask the patient if he/she is cold to determine patient's thermal comfort level, taking premedication, types and time of

premedication, types of passive insulation was used (use socks, use head covering, limit skin exposure, warm blankets/ duvet, and wear slippers), wrapping upper and lower extremities, types of active insulation was used (warming IV fluids, warm irrigation fluids/ antiseptic solution), and ways of transfer to theater.

**Part two: Intraoperative assessment sheet:** It was comprised of 22 items related to ambient room temperature (passive warming measures), record vital signs every 15 minutes, record oxygen saturation every 1 hour, signs and symptoms of hypothermia, type/ amount of IV fluids and blood/ blood products, anaesthesia technique used (general anaesthesia and neuroaxial), type and dosage of anaesthetic drugs used during induction and maintenance of anaesthesia, warmth of IV fluids/ irrigation fluids, and blood (active warming measures). Also warmth of inhaled anaesthetic gases (active warming measures), Time taken for induction of anaesthesia, time taken to start surgery after induction of anaesthesia, duration of surgery/ minutes, and surgical drape if it dries or wet.

**Part three: Postoperative assessment sheet:** It was comprised of 6 items concerning ambient room temperature, number of blankets used for warming, vital signs record every 5 minutes and oxygen saturation every 15 minutes, manifestations of hypothermia, is the patient need oxygen, and time in recovery room.

**Reliability of the tool II:** The test was reliability tested by the researcher using cronbach  $\alpha = 0.90$ .

**Tool III: Shivering scale:** It was developed by Bilotta, Pietorpalo & Rosa [15]. Related to shivering scale, it was graded on a five point scale. The measurement graded from zero to four to rate the patient's severity level of shivering.

Grade 0 means: No shivering.

Grade 1 means: fasciculation of face and lips.

Grade 2 means: fasciculation of face and neck.

Grade 3 means: visible tremor involving more than one muscle group.

Grade 4 means: gross muscular activity involving the entire body.

Reliability of the tool III: The test was reliability tested by Bilotta, Pietorpalo & Rosa [15] using cronbach  $\alpha = 0.90$ .

### Method

1. **Written approval:** Permission to carry out the study was taken from responsible authorities of Menoufia University Hospitals after explanation of the purpose of the study.
2. **Tools development:** The first and second tools were developed by the researchers after extensive review of relevant literature, while third tool was developed by Bilotta et al., [15].
3. **Validity of the tools:** All tools were tested for face and content validity by a doing jury of 5 academic staff of various departments (two experts on Medical Surgical Nursing, Faculty of Nursing, Cairo University, two experts on Medical Surgical Nursing, Faculty of Nursing, Menoufia University and one expert on Community Health Nursing, Faculty of Nursing, Menoufia University). Necessary modifications were done to ascertain relevance and completeness. All tools were written in English.
4. **Reliability of the tools: Tool I:** Structured interview questionnaire: knowledge assessment sheet reliability was measured by the researchers using cronbach  $\alpha = 0.83$ . Tool

II: Perioperative assessment sheet reliability was measured by the researchers using cronbach  $\alpha = 0.90$ . Tool III: Shivering scale reliability was measured by Bilotta et al., using cronbach  $\alpha = 0.93$  [15].

5. **A pilot study:** It was conducted prior to data collection on 10% of study sample (10 patients) to evaluate the developed tools in order to test the clarity and the applicability of the tools and estimated the time needed to collect data. Necessary modifications were done. These patients were excluded from the sample.
  6. **Ethical consideration:** The patient's verbal and written consent for participation in the study were obtained after explanation of the purpose of the study. Confidentiality and anonymity of patients were assured. Patients were also informed that refusal to participate wouldn't affect their care. The study was conducted after reviewing and accrediting protocol by ethical committee at the faculty of nursing.
  7. **Data collection:** Data collection was extended from June 2014 to September 2015. Hundred adult patients with major abdominal surgery who fulfilled the inclusion criteria were selected randomly and divided alternatively into two groups.
    - **Study group (1):** were receive perioperative warming measures to prevent postoperative hypothermia and shivering.
    - **Control group (2):** exposed to a routine hospital care.
    - Each Patient who agreed to participate in the study and fulfilling the study inclusion criteria were interviewed individually by the researchers for both study and control groups.
    - All patients were on general anaesthesia, some of these patients were on Neuroaxial (Epidural) peripheral nerve block mainly usage for postoperative analgesia accompanied by general anaesthesia.
    - All patients were on drugs for induction of general anaesthesia (interval 500mg or deprevane 200mg plus fentanyl 100 mic, and loading dose of atracurium 30mg) for both studied group (study & control group).
    - All patients were on drugs for maintenance of anaesthesia (maintenance dose of atracurium 20mg, inhaled anaesthetic gases as isoflurane) for both studied group (study & control group).
    - Two interview were done for both study and control groups at Emergency Hospital of Menoufia University.
- The first interview was done the day before surgery in the surgical ward. This interview took about 1 hour for both studied groups (study & control groups).
- The second interview was started 1 hour before surgery in the surgical ward then the researchers accompanied the patient to operating room, this interview was extended until the patient discharged from recovery room. The second interview took about 5 to 6 hours (1 hour before surgery + time of the operation until discharged from recovery room).

**Study group (1):** The study was conducted in four consecutive phases. These phases were: assessment, planning, implementation, and evaluation.

#### Assessment phase

The first interview was conducted in the surgical ward the day before surgery where the patient individually was interviewed. It

took about 1 hour for both studied groups (study & control groups). The aim of this phase was to assess patient's health status and knowledge by using tool I: knowledge assessment sheet such as sociodemographic data, medical history and patient's knowledge related to hypothermia. Also the researchers distributed the prepared booklet for every patient of study group one and informed them about definition of hypothermia, causes, serious complications of hypothermia, how to conserve body temperature during preoperative phase and postoperative phase. The patients were asked to bring one of his/ her family members to attend the information session.

The second interview was conducted 1 hour before surgery in the surgical ward for both studied groups (study & control groups). This phase aimed to assess patient's post knowledge by using tool I section three: patients' knowledge. In addition to assess patient's vital signs, premedication, type of passive and active warming method used by using tool II section one: preoperative assessment sheet.

**Planning phase:** Based on assessment phase the plan of perioperative warming measures was developed based on extensive literature review of current related literature for each patient of the study group.

**Implementation phase:** It was started 1 hour before induction of anaesthesia where the patient was prepared for surgery on the ward and ended by the patient's transfer from Post Anaesthetic Care Unit (PACU). The aim of this phase was provide each patient in the study group with perioperative warming measures through perioperative phases. It includes:

- **Preoperative phase:** 1 hour before induction of anaesthesia, during which patient is prepared for surgery on the ward. The preoperative warming measures for the study group include the following measures:
  - Record patient's vital signs and oxygen saturation.
  - Patient's temperature was measured from tympanic membrane and documented one hour before patients leave the ward.
  - The patient's wear additional clothes and wear slippers to maintain patients stayed warm before surgery.
  - Minimizing skin exposure by using duvet.
  - The patient was encouraged to walk to the theater.
  - Passive insulation such as (socks, head covering, 2 warm gown, and limit skin exposure).
  - Then the researcher was accompanied the patient from ward to the operating room, the patient was stayed in the waiting room from 15 to 30 minutes before entering the operating room.
  - All patients were applied elastic bandage at operating room.
  - The ambient room temperature was regulated at 26°C (passive insulation).
  - Active insulation such as warming IV infusion at 38°C was used.
  - The researcher in the operating room wrapped the lower extremities of patient from the feet to the lowered one third of the thigh, and the arm to forearm with cotton and gauze role. It was maintained until discharged from Post Anaesthetic Care Unit (PACU) to limit skin exposure and to conserve heat.

■ **Intraoperative phase:** total anaesthesia time, from the first anaesthetic intervention through the patient transfer to the recovery area of the theater suite. The intraoperative warming measures for the study group include the following measures:

- Record patient's vital signs and oxygen saturation.

- o Patient's temperature was measured from tympanic membrane and documented immediately before induction of anaesthesia, after induction of anaesthesia, and every 15 minutes until the end of surgery.
- o In the theater suite: the ambient temperature was at 26°C (passive insulation).
- o After induction of anaesthesia the doctor was disinfected the skin by warmed antiseptic solutions to 38°C (active insulation). The doctor were draped patients with towels and linen which covering the neck and shoulders to limit skin exposure. All IV infusion was warmed along the operation at 38°C (active insulation).
- o Active insulation such as warming IV infusion at 38°C was used.
- o Wrapping upper and lower extremities was maintained during intraoperative phase until discharged from Post Anaesthetic Care Unit (PACU) to limit skin exposure and to conserve heat.
- **Postoperative phase:** The 24 hours after the patient has entered the recovery area of the theater suite. Warming measures that was implemented in (PACU) postoperatively for the study group includes the following measures:
  - o The patient's vital signs & oxygen saturation was measured and documented immediately at recovery room and vital signs was taken every 5 minutes while oxygen saturation every 15 minutes.
  - o Patient's temperature was measured from tympanic membrane.
  - o The patient was adequately covered by two blankets (passive insulation) throughout the postoperative phase to conserve heat.
  - o Active insulation such as warming IV infusion at 38°C was used.
  - o Wrapping upper and lower extremities was maintained until discharged from Post Anaesthetic Care Unit (PACU) to limit skin exposure and to conserve heat.
  - o The temperature of Post Anaesthetic Care Unit (PACU) was regulated at 26 °C (passive insulation).

## Control group 2

### Routine hospital care:

#### Preoperative care:

- o Patient's temperature wasn't measured/or documented one hour before patients leave the ward.
- o The patient's wear light clothes.
- o The ambient room temperature was 18-20°C.
- o Didn't use passive insulation such as (socks, wrapping upper and lower extremities, sometimes use overhead, use one gown only).
- o Unlimited skin exposure.
- o Didn't use any active insulation such as warming IV infusion.

#### Intraoperative care:

- o Patient's temperature wasn't measured/ or documented
- o The ambient room temperature was between 18- 20°C.
- o Didn't use any active insulation such as warming IV infusion while the nurses in the operating room immersed the IV fluids in the container contain hot water which affected by cooling system(air condition).
- o Antiseptic solution wasn't warmed.
- o Didn't use passive insulation such as (socks, wrapping upper and lower extremities, sometimes use overhead, use one gown only).

#### Postoperative care:

- o Patient's temperature wasn't measured/ or documented
- o The ambient room temperature was between 18- 20°C.
- o Didn't use any active insulation such as warming IV infusion.
- o Didn't use passive insulation such as (socks, wrapping upper and lower extremities, sometimes use overhead, use one gown only).
- o Use only one blanket at recovery room (PACU).

#### Statistical analysis

Data were collected, tabulated, statistically analyzed using an IBM personal computer with Statistical Package of Social (SPSS) version 20 where the following statistics were applied.

- a) **Descriptive statistics.** In which quantitative data were presented in the form of mean  $\bar{X}$ , standard deviation (SD), and qualitative data were presented in the form numbers and percentage (%).
- b) **Analytical statistics.** The used tests of significance included:
  - **Chi-squared test ( $\chi^2$ ):** was used to study association between qualitative variables.
  - **Student t- test:** is a test of significance used for comparison between two groups having quantitative variables.
  - **Paired t-test:** is a test of significance used comparison between two related groups having quantitative variables.
  - **Pearson correlation (r):** is a test used to measure the association between two quantitative variables.
  - **Spearman's correlation:** for studying the correlation in condition of qualitative and quantitative.
    - P value of >0.05 was considered statistically non-significant.
    - P value of <0.05 was considered statistically significant.
    - P value of <0.001 was considered statistically highly significant.

#### Results

Table (1) illustrated that the mean age was 54.3±6.37 years & 51.5±8.76 years for both study and control groups respectively, 50.0 % & 52.0% respectively were male, regarding level of education 42.0% & 46.0% respectively had secondary education, 46.0% of study group were house wife & 44.0% of control group were employee, and 86.0% & 88.0% of both groups respectively were married. There were no statistical significant differences between both studied groups in relation to their sociodemographic characteristics.

Figure (1) illustrated that, there was no statistical significant difference between study and control groups regarding pretest total knowledge score while on the other hand there was significant improvement posttest of total knowledge score for study group rather than control group.

Table (2) showed that there was a highly statistical significant difference concerning active insulation used (warm IV fluid, and warm antiseptic solution) among study and control groups P value <0.001. While 100% of study and control groups had warm irrigation fluid.

Table 3: Cleared that the mean temperature was 36.86± 0.05, 36.49± 0.09 at preoperative, 36.33± 0.10, 36.02± 0.14 immediately after inductions of anesthesia, and 36.85±0.14, 32.96±0.51 immediately after recovery for both study and control groups respectively. Moreover, there was a highly statistical significant difference regarding mean temperature in p1 (preoperative temperature,

and immediately after induction of anesthesia) for both study and control groups. Also, there was a highly statistical significant in p2 (preoperative temperature, and immediately after recovery) for control group only P value <0.001.

Figure 2: showed that, the mean temperature immediately at recovery room was 36.9, 33.0 for both study and control groups respectively which reached to 37.0, 34.4 after 30 minutes for both study and control groups respectively. There was a highly statistical significant difference concerning mean temperature among study and control groups.

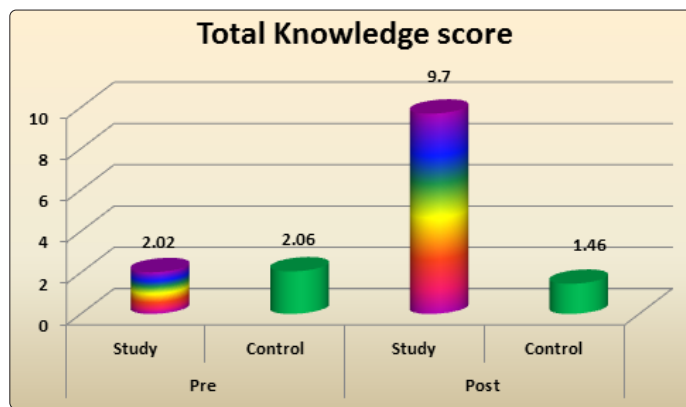
Table 4: illustrated that 100% of study group hadn't manifestations of hypothermia intraoperative, and postoperative compared to control group 100%, 98.0% had manifestation of hypothermia intraoperative, and postoperative respectively. Also this table showed that 54.0%, of control group had intraoperative cold extremities, while 60.0% had piloerection and cold extremities postoperative. Moreover, there was a highly statistical significant difference among study and control groups concerning manifestations of hypothermia intraoperative, and postoperative.

Table 5: revealed that 100% of study group hadn't shivering at recovery room compared to 82.0% of control group had shivering at recovery room. Control group showed different percentage as 18.0%, 34.0%, 6.0%, 24.0%, and 18.0% for each grade of shivering 0, 1, 2, 3, and 4 respectively. There was a highly statistical significant difference among study and control groups regarding shivering at recovery room.

**Table 1: Sociodemographic characteristics for both study and control groups**

Sociodemographic Characteristics	Study (N=50)		Control (N=50)		$\chi^2$ p value
	No.	%	No.	%	
Age / years ( $\bar{X} \pm SD$ )	54.3±6.37		51.5±8.76		1.77* 0.079
<b>Gender</b>					
Male	25	50.0	26	52.0	0.040
Female	25	50.0	24	48.0	0.841
<b>Level of education</b>					
Illiterate	14	28.0	7	14.0	
Primary education	7	14.0	8	16.0	3.29
Secondary education	21	42.0	23	46.0	0.349
Higher education	8	16.0	12	24.0	
<b>Marital state</b>					
Single	3	6.0	2	4.0	
Married	43	86.0	44	88.0	2.87
Widow	2	4.0	0	0.0	0.411
Divorced	2	4.0	4	8.0	
<b>Occupation</b>					
Manual	11	22.0	4	8.0	
Employee	14	28.0	22	44.0	5.92
House wife	23	46.0	20	40.0	0.116
No work	2	4.0	4	8.0	

\*t-test



**Figure 1: Mean of pre and postoperative total knowledge score for both study and control groups**

**Table 2: Distribution of both study and control groups regarding type of active insulation used**

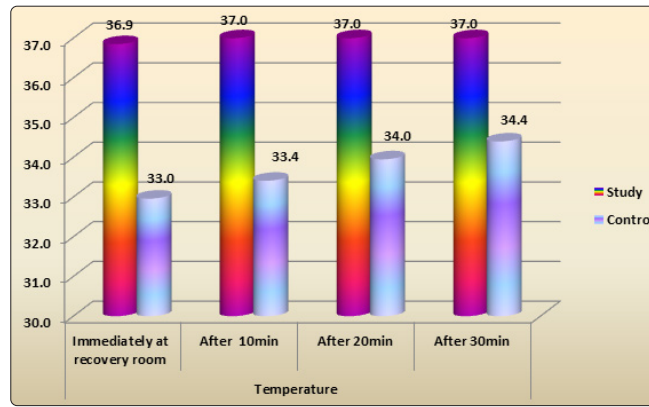
Types of active insulation used	Study (N=50)		Control (N=50)		$\chi^2$ p value
	No.	%	No.	%	
<b>Warm IV fluid</b>					
Yes	50	100	0	0.0	100
No	0	0.0	50	100	0.001**
<b>Warm irrigation fluid</b>					
Yes	50	100	50	100	-
<b>Warm antiseptic solution</b>					
Yes	50	100	0	0.0	100
No	0	0.0	50	100	0.001**

**Table 3: Mean & standard deviation of perioperative temperature among study and control groups**

Time of temperature	Study	Control	t-test p value
	X ±SD	X ±SD	
<b>Preoperative</b>	36.86±0.05	36.49±0.09	22.6 0.001**
<b>Immediately after induction of anesthesia</b>	36.33±0.10	36.02±0.14	11.9 0.001**
<b>Immediately after recovery</b>	36.85±0.14	32.96±0.51	54.23 0.001**
<b>Paired t-test</b>	47.5 <b>P1:0.001**</b>	33.1 <b>P1:0.001**</b>	
<b>P value</b>	0.774 P2:443	49.9 <b>P2:0.001**</b>	

P1: between preoperative temperature and immediately after induction of anesthesia

P2: between preoperative temperature and immediately after recovery



**Figure 2:** Postoperative temperature at recovery room for both study and control groups

**Table 4:** Comparison between study and control groups regarding intra and postoperative manifestations of hypothermia

Manifestation of hypothermia	Intraoperative				$\chi^2$ p value	Postoperative				$\chi^2$ p value
	Study (N=50)		Control (N=50)			Study (N=50)		Control (N=50)		
	No.	%	No.	%		No.	%	No.	%	
<b>Presence of manifestations</b>										
Yes	0	0.0	50	100	100	0	0	49	98.0	96.1
No	50	100	0	0.0	0.001**	50	100	1	2.0	0.001**
<b>Manifestations are</b>										
Shivering	0	0.0	0	0.0		0	0.0	2	4.0	
Piloerection	0	0.0	0	0.0		0	0.0	2	4.0	
Cold extremities	0	0.0	27	54.0		0	0.0	16	32.0	
Piloerection and cold extremities	0	0.0	3	6.0		0	0.0	30	60.0	
All of the above	0	0.0	20	40.0		0	0.0	0.0	0.0	

**Table 5:** Distribution of postoperative shivering among study and control groups

Postoperative assessment	Study (N=50)		Control (N=50)		$\chi^2$ p value
	No.	%	No.	%	
<b>Shivering at recovery room</b>					
Yes	0	0.0	41	82.0	
No	50	100	9	18.0	
<b>If yes grade of shivering is</b>					
Grade 0	50	100	9	18.0	69.5
Grade 1	0	0.0	17	34.0	0.001**
Grade 2	0	0.0	3	6.0	
Grade 3	0	0.0	12	24.0	
Grade 4	0	0.0	9	18.0	

\*significant\*\*highly significant

## Discussion

Inadvertent perioperative hypothermia (IPH) can be observed in 50%-90% of all the patients undergoing surgical procedures in operating room and postanesthetic care unit (PACU) [16,17]. There is evidence that hypothermia is associated with systemic complications

and alters the pharmacokinetics and pharmacodynamics of anesthetic agents. It is associated with a high potential for complications including decreased metabolic rate, morbid cardiac events such myocardial ischemia, metabolic acidosis, prolongation of muscle relaxants, increased blood loss, compromised healing and surgical

wound infection, postoperative shivering may also lead to increased oxygen consumption, norepinephrine release and higher mortality [18,19].

**Regarding sociodemographic characteristics of the studied sample** our study showed that there was no statistical significant difference between studied groups in their sociodemographic characteristics and this is consistent with **Kiekkas, Pouloupoulou, Papahatzi & Souleles** [20]. Who study effects of hypothermia & shivering on standard PACU monitoring of patients reported that there was no statistical significant difference between study and control groups.

**Regarding age:** Our study revealed that, the mean age of the studied groups was above 50 years old this finding consistent with **Poveda and Galvão**, who observed that the mean age of their study and control groups was above 50 years [21]. Furthermore, **Páscoa** (2012) who found that the mean age of study group was 55.6, 16.0. Also **Danczuk, Nascimento, Silveira, Hermida, Raisa**, stated that average age was 45.4 years  $\pm$  9.3 [22]. But our results were contradicted with the results of **Belayneh, Gebeyehu&Abdissa** [22]. Who mentioned that (52.5%) patients with hypothermia were more frequently in age of 25-50 years.

**Concerning sex:** Our results showed slight increase in male percentage over female in accordance with the present study **Páscoa** who found that half of their studied sample was male [24]. On the other hand **Luís et al.** mentioned that 57% of sample was female [25]. Also, **Poveda and Galvão** reported that 65.7% of hypothermic patients were female and this in the same line with the result of **Danczuk, Nascimento, Silveira, Hermida&Raisa** who showed female sex were 69% of sample [21,22].

**In relation to patient's knowledge about hypothermia:** The current study showed that there was no statistically significant difference between studied groups regarding their knowledge before informed about hypothermia and most of them had poor knowledge score, but there was significant improvement in study group than control group post informed. This result was consistent with **Harper et al.** who stated that informed patient preoperatively about hypothermia resulted in an increase in patients' knowledge post information compared with control group. From the researcher point of view significant knowledge score improved in study group due to effective information that was provided about hypothermia through illustrative colored booklet.

**Regarding pre and intraoperative temperature** the current study hypothesized that subjects who receive perioperative warming measures study group will show perioperative normothermia when compared to subjects who do not receive it. The findings of the current study revealed that there was a highly statistical significant difference between studied groups regarding mean intraoperative temperature which showed normothermia in study group at all intervals of measurement with  $P < 0.001$ .

This finding is in the line with **Poveda and Galvão & Horosz and Milewska** who studied passive warming measures (cooling system remaining off until begin of operation; cover in the regions of thorax, wrapping of the body parts with cotton) and active warming measures heating measures (heated fluids for irrigation of abdominal cavity; heated fluid for venous therapy and heated by forced air) used

in the prevention of hypothermia in the interoperation of elective abdominal surgery with visceral exposure [21,26]. They concluded that there was no severe hypothermia with the heating method utilized. However, there were more efficient methods that prevent mild and moderate hypothermia.

In addition, our results inconsistent with the results of **Moyses, Trettene, Navarro, Ayres** who suggested that passive heating measures are not efficient in the maintaining temperature in the perioperative, since they merely reduce the loss of heat [27]. From the researcher point of view this may be related to prevention or minimizing perioperative heat loss via convection, conduction, radiation, and evaporation when passive warming measures used on the other hand active warming measures deliver heat to the patient body.

#### **Passive warming measures**

**Concerning limit skin exposure:** The findings of the current study revealed presence of perioperative normothermia this finding was matched by **Hooper et al.** who concluded a single layer of most any passive insulator reduces heat loss [28]. Also **Burger and Fitzpatrick** agree with us as they concluded that minimizing skin exposure, providing adequate bed linen for transfer to theatre and educating patients about the importance of keeping warm perioperatively are all extremely important to minimize heat loss [29].

**Regarding wrapping lower and upper extremities:** Our results showed presence perioperative normothermia which comes in accordance with **Muhd, Hassan & Zaini** who demonstrated that a passive warming device, the heat band, if used appropriately, was effective as an active warming device [30].

In addition, **Shao et al.** agreed with our results as they emphasized that the most effective method of warming was a combination of body wraps, warming of the surgical rinse fluid [31]. The mean temperature of patients was  $37 \pm 0.33^\circ\text{C}$ , which was a statistically significant difference compared to that of control groups. Also, **Thomassen et al.** mentioned that wrapping is the most efficient to prevent heat loss, as shown by increased skin temperatures, lower metabolic rate and better thermal comfort [32]. From researcher point of view this accordance may be due to reduce radiating, convection heat loss via the skin.

But our results contradicted with the results of **Poveda and Galvão** who cleared that the passive cutaneous warming method was used (lower limb bandaging), is not the most effective to maintain patients' normothermia [21].

Also **Mohamed** illustrated that there was no significant difference as regard hypothermia or shivering as leg wrapping can't prevent them [33]. From researcher point of view this incongruence may be due to the bandage applied on cooling environment.

**Concerning double gown:** Our results showed presence of perioperative normothermia which comes in accordance with **Wasfie and Barber** who concluded that patients who wear double gown more likely to report normal body temperatures, and less likely to ask for additional blankets [19]. Heat loss through the skin reduced by passive insulation. These results can be interpreted by **Horosz and Milewska** who stated that a single layer of most any passive insulator reduces cutaneous heat loss by roughly 30% which sufficient to



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restore thermal steady state [34].

**In relation to ambient room temperature (Cutaneous warming measures):** The current study hypothesized that subject who receives perioperative warming measures will show perioperative normothermia when compared to subjects who do not receive it. The findings of the current study revealed that there were statistically significant differences among the study and control groups regarding intraoperative temperature. This result was consistent with **Poveda, Galvão & Dantas** who concluded that there was statistically significant difference and positive correlation between patients' core body temperature and mean operating room temperature [35].

In addition, **El Gamal, El Kassabany & Frank** found that increasing the ambient OR temperature to 26°C (79°F) has been found to reduce the incidence of core hypothermia in younger and older patient populations [36]. This in my opinion may be related to vulnerability of young and old age. Also American Society **Perianesthesia** Nurses systemic review revealed that maintaining OR ambient room temperature between 68 °F and 77 °F (20°C - 25°C) was sufficient to prevent hypothermia [37].

Furthermore, the result of the present study was in accordance with **Feinstein and Miskiewicz** who stated that increasing ambient temperatures in the operating room is a just method that can significantly decrease the occurrence of hypothermia within the surgical arena [38]. From researcher point of view this accordance may be related to the room temperature is the most critical factor in preventing perioperative heat loss by radiation and convection from the skin and by evaporation from within surgical incisions.

But, our results were contradicted with results of **Rowley et al.** found that room temperature adjustment interventions were not more effective than current practice in preventing perioperative hypothermia [39]. From researcher point of view this incongruence may be due to the temperature of operating room only at 23 degree wasn't enough to maintain normothermia and needed to additional warming measures in order to maintain rather normal body temperature.

**As regard warming IV fluid/ irrigation fluid (active warming measure):** Our results showed that there was significant intraoperative normothermia among study group this was supported by **Moola and Lockwood** who concluded that intravenous fluids, if warmed (38-40°C) to a temperature higher than operating room's there is a proved beneficial to patients in terms of hemodynamic stability, and for the development of a higher core temperature (T<sub>c</sub>) [40]. Also, **Fadzlina, Nazaruddin & Hardy** showed that warmed IV and irrigation fluids resulted in a significantly higher mean core body temperature [41].

Furthermore, the result of the present study was in accordance with **Andrzejowski, Turnbull, Nadakumar, Gowthaman & Eapen** reported that intraoperative warming of infusions and blood products given at infusion rates above 500 mL/h is very effective [42]. Also, **Esnaola and Cole** found that intraoperative usage of warmed IV fluids may help in reducing the risk of fluid induced hypothermia, thereby improving normothermia [43].

Moreover, **National Collaborating Center for Nursing and Supportive Care** concluded that warmed IV fluids 1.3 to 1.8 liters

versus usual care for general anaesthesia had significantly higher core temperatures at 15, 30 and 60 minutes intraoperatively [44]. Also Sessler concluded that the use of infusion warmers alone is not enough to maintain normothermia [45].

But, our results were inconsistent with the results of **Hasankhani, Mohammadi, Moazzami, Mokhtari & Naghgizad** has they concluded that a significant temperature decrease in both groups, this drop was more enhanced in the hypothermic groups [46]. Also **Campbell, Alderson, Smith & Wartting** didn't agree with us as they showed that patients were given warmed fluids intravenously were about half a degree warmer and fewer of them shivered than those given fluids at room temperature, using warmed fluids for irrigation of body parts made no difference [47].

Furthermore, the results was contradicted with **Okeke** who found that the effect of irrigation fluid at 38°C and intravenous warmed fluid at 37°C showed no important temperature changes [48]. Also **Hart et al.** didn't agree with the results of the present study as they concluded that warming of infusions and blood products not recommended for patient rewarming because the fluid temperature cannot substantially exceed the patient's body temperature without causing hemolysis, thereby materially limiting warming effectiveness [49]. From researcher point of view this contradiction may be due to warming IV & irrigant fluids only while our study used passive & some of active warming measures.

**In relation to postoperative normothermia, and postoperative shivering** the current study hypothesized that subject who receive perioperative warming measures (study group I) will show no postoperative shivering when compared to subjects who don't receive it (control group II).

The result of the present study found that there was a highly statistical significant difference between studied groups P value < 0.001 in which the study group showed normothermia and no postoperative shivering. This finding is in agreement with **Lienhar** tconcluded that infusion of warmed fluids, combined with skin surface warming, helps to prevent hypothermia and reduces the incidence of postoperative shivering, one patient shivered in the group receiving warmed fluids and seven in the control group (P < 0.05) [50]. Similarly was the results **Bernard** who concluded that on average, the core temperatures of the pre warmed fluid group were significantly higher as the surgery began, at the end of the case and when they were admitted to PACU [51]. That group also showed a lower incidence of hypothermia upon PACU admission and shivered less after their surgeries.

Furthermore, the result was consistent with **Hasankhani et al.** systemic review who concluded that intraoperative administration of warm IV fluids reduces perioperative hypothermia, postoperative shivering, and recovery time [46]. Also, **El Gamal et al.** agreed with our results as they found the temperature of the OR also has a decisive effect on the patient's postoperative body temperature, which is significantly higher in a warmer OR (21 to 24 °C) than in a colder one (18 to 21 °C) [36].

## Conclusions

1. The total mean knowledge score among study group I was significantly higher than control group II after informed them

- with knowledge about hypothermia.
2. Patients received perioperative warming measures (study group I) showed:
    - a. Significantly perioperative normothermia compared to subjects who didn't receive it (control group II).
    - b. Significantly less needed blood transfusion compared to subjects who didn't receive it (control group II).
    - c. Significantly no postoperative shivering compared to subjects who didn't receive it (control group II).

### Recommendations

Based on the findings of the present study the following recommendations are derived and suggested:

#### Recommendations for patients

- Supervised health teaching program should be carried out for patients with major abdominal surgery the day before surgery about importance of perioperative warming measures to prevent postoperative hypothermia and shivering.
- A colored booklet should be available and distributed to all patients with major abdominal surgery. It should include knowledge about definition of hypothermia, causes, serious complications of hypothermia, how to conserve body temperature during preoperative and postoperative phase.

#### Recommendations for nurses:

- All staff of surgical nurses should be encouraged to be familiar with perioperative warming measures and use these measures in order to maintain perioperative normothermia and prevent postoperative hypothermia
- A booklet should be available and distributed to all nurses worked in the operating room about the importance of perioperative warming measures among patients with major abdominal surgery.

#### Recommendations for further research:

- Replication of the study using a larger probability sample from different geographical areas to help for generalization of the results.
- Replication of the study with using one method of anaesthesia as general anaesthesia only or general combined with epidural anaesthesia.
- Replication of the study to determine the effect of warming measures on postoperative pain and comfort level.

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