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COMPARISON OF THE IMPACTS OF ADMINISTERING IV FLUIDS AT WARM TEMPERATURES VERSUS NORMAL TEMPERATURES ON CORE BODY TEMPERATURE IN SURGICAL PATIENTS

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Abstract:

Objectives: To compare the impacts of administering intravenous fluids at warm temperatures versus normal temperatures on the core body temperature of individuals undergoing surgical procedures.

Materials and Methods: This RCT study was conducted at Shah Bhittai Hospital Hyderabad, Pakistan The study duration was 6 month from August, 2023 to January 2024. 300 patients fulfilling the inclusion criteria were included in the study equally divided into two groups using sealed, opaque envelopes containing computer-generated numbers. Throughout the study period, a range of physiological parameters, such as body temperature, oxygen saturation, heart rate, shivering, blood pressure, and fluid intake, were meticulously monitored and documented at two specific time points: upon admission to the post-anesthesia recovery (PAR) area and again one and a half hours later. The severity of shivering observed in participants was evaluated and categorized according to the classification system developed by Crossley and Mahajan. This thorough monitoring strategy enabled a comprehensive assessment of the physiological responses to abdominal surgery, yielding valuable insights for analysis and interpretation of the study outcomes. For statistical analysis we used SPSS Version 25.

Results: In this study, a total of 300 patients, evenly distributed between two groups with mean ages of 46.04±10.29 and 47.50±8.22 years were enrolled. In the study, participants in Group A exhibited core body temperature fluctuations from 96.33±1.51 upon entering the operating room (OR) to 96.04±1.78 in the post-anesthesia recovery area (PAR), stabilizing at 96.22±1.81 after 30 minutes. Control group members saw variations from 96.07±1.58 in the OR to 95.6±1.61 in the PAR, stabilizing at 95.8000±1.69 after 30 minutes. While initial core temperatures showed no statistically significant differences between groups, differences became significant after 30 minutes in the PAR. Group B patients had initial pulse rates of 98.41±12.53 in the OR, decreasing to 90.22±11.90 in the intensive care unit, and further to 84.14±8.12 after 30 minutes. In contrast, Group A patients started with pulse rates of 96.46±9.98 in the OR, decreasing to 83.11±10.36 in the PAR, and further to 81.31±9.76 after 30 minutes. Statistical analysis indicated significant differences. Additionally,

factors like oxygen pressure, diastolic and systolic blood pressure, and respiratory rate showed significant differences between groups across all observation periods.
Conclusion: It was concluded that following the administration of warm fluids intravenously, a reduction in shivering was observed in the intervention group.

Key words: Core Body Temperature, Fluid Administration, Intravenous Fluids.

INTRODUCTION:

The administration of intravenous (IV) fluids is a common practice in perioperative care aimed at maintaining hydration, hemodynamic stability, and electrolyte balance.(1) However, the temperature of IV fluids administered during surgery has been a subject of debate.(1, 2) Maintaining normothermia in surgical patients is crucial to prevent perioperative complications such as hypothermia, which is associated with adverse outcomes including increased risk of surgical site infections, prolonged hospital stays, and impaired wound healing.(3) Administering IV fluids at warm temperatures has been proposed as a potential strategy to mitigate perioperative hypothermia.(4) A study conducted by Frank et al. investigated the effects of administering warmed IV fluids compared to room temperature fluids during surgery.(5) They found that patients who received warmed fluids had significantly higher core body temperatures intraoperatively compared to those receiving room temperature fluids. This suggests that warmed IV fluids may help in preserving normothermia during surgery. Conversely, a meta-analysis by Smith and colleagues examined multiple studies comparing the effects of warmed versus room temperature IV fluids on core body temperature in surgical patients.

Shivering is a well-documented complication in the operating room, often directly correlated with core body temperature.(6) It serves as a physiological response to maintain body heat in response to cold exposure, such as during surgery. Studies have indicated that even minor fluctuations in core temperature can trigger shivering, leading to discomfort for patients and potentially complicating surgical procedures. Research has shown that the incidence of shivering increases as core body temperature decreases.(7) In a study it was found that approximately 5% of patients experienced shivering when their core temperature was at or above 35°C, whereas the incidence increased to around 9% when the core temperature dropped to 34.5°C or lower.(8) A variety of medical specialties and nonpharmacological methods are utilized to manage shivering, particularly in the perioperative setting where maintaining normothermia is crucial.(9) Nonpharmacological interventions are often preferred, especially when medication therapies pose risks or side effects such as nausea, vomiting, dizziness, cardiovascular complications, or sedation.

Objective: To compare the impacts of administering intravenous fluids at warm temperatures versus normal temperatures on the core body temperature of individuals undergoing surgical procedures.

MATERIALS AND METHODS:

Study Design: Randomised control trial.
Study setting: Shah Bhittai Hospital Hyderabad, Pakistan.
Duration of the study: The study duration was 6 month from August, 2023 to January 2024

Inclusion Criteria:

- Surgical patients of both genders, aged 18-60 years.
- Patients undergoing elective surgical procedures requiring intravenous fluid administration.

Exclusion Criteria:

- Patients with a history of thyroid abnormalities, hypertension, diabetes, vascular illnesses, or endocrine disorders.
- Patients undergoing emergency surgeries or surgeries with expected significant blood loss.
- Patients with known or suspected allergies or sensitivities to IV fluids used for temperature adjustment.

- Patients with pre-existing conditions affecting thermoregulation, such as fever, hypothermia, or hyperthermia.
- Patients who were pregnant or breastfeeding.

Methods:

This randomized controlled trial (RCT) study was conducted at Shah Bhittai Hospital Hyderabad, Pakistan after obtaining approval from hospital ethical committee. Total of 302 patients fulfilling the inclusion criteria were enrolled. All the patients were randomly assigned to either the warm temperature IV fluid group (Group A) or the normal temperature IV fluid group (Group B). Patients in the warm temperature IV fluid group receive intravenous fluids warmed to a predetermined temperature (e.g., 37°C), while patients in the normal temperature IV fluid group receive intravenous fluids at room temperature (e.g., 20-22°C). Intravenous fluids were administered via an 18-G tubing inserted into the ginglymoid joint vein, at a rate of 8–10 ml per kg per hour. Before infusion, all fluids were stored at the surgical temperature for surgical use. Within thirty minutes before transfer to the Post Anesthesia Recovery (PAR) area, participants in the intervention cluster were administered Ringer's solution heated to 38°C. The duration of the procedure was recorded upon completion, followed by the patient's transfer to the PAR. During transfer, a single thick blanket was draped over all patients, and each received oxygen via a mask at a rate of 5 L/minute. Upon admission to the Post Anesthesia Recovery (PAR) area and one hour later, assessments and documentation were conducted for pulse rate, core temperature, SpO2, diastolic and systolic blood pressures, presence of shivering, and fluid intake. Shivering severity was determined using the Crossley and Mahajan classification method, which categorizes shivering into five levels: 'zero' (no shivering), 'one' (hair standing straight, visible environmental symptoms without shivering), 'two' (visible muscle tremors in a specific group of muscles), 'three' (muscle tremors in more than one group of muscles), and 'four' (muscle tremors in all muscles).For statistical analysis we used SPSS Version 25.

RESULTS:

In this study total of 300 patients with mean age of 46.77±9.33 years were enrolled (Table 1). Each group had 150 patients with mean age of 46.04±10.29 and 47.50±8.22 years respectively. 90(60.0%) and 60(40.0%) were male patients in group A group B respectively while 88(58.7%) and 62(41.3%) were female patients in group A and group B respectively. The core body temperature of participants in the group A varied from 96.33±1.51 upon entering the operating room (OR) to 96.04±1.78 upon entering the post-anesthesia recovery area (PAR), and eventually settled at 96.22±1.81 after 30 minutes. The core temperature of control group members varied from 96.07±1.58 upon admission to the operating room (OR) to 95.6±1.61 upon admission to the post-anesthesia recovery area (PAR), and eventually stabilized at 95.8000±1.69 after 30 minutes. The mean core temperatures upon admission to the operating room (OR) did not exhibit statistically significant differences between the intervention group and the control group. However, after 30 minutes following admission to the post-anesthesia recovery area (PAR), the average core temperature difference became statistically significant.

Group B patients had an average pulse of 98.41±12.53 upon entering the operating room, which decreased to 90.22±11.90 upon entering the intensive care unit, and further decreased to 84.14±8.12 upon entering the facility 30 minutes later. The patients in group A had an average pulse of 96.46±9.98 upon entering the operating room (OR), which decreased to 83.11±10.36 upon entering the post-anesthesia recovery area (PAR), and further decreased to 81.31±9.76 when they re-entered the PAR 30 minutes later. Statistical analysis revealed a significant p-value. The differences between the groups in factors such as oxygen pressure, diastolic and systolic blood pressure, and respiratory rate were statistically significant at all periods of observation.

Table 1: Mean age of all enrolled Patient *(n=300)*

Variables	Mean±SD
Age (Years)	46.77±9.33

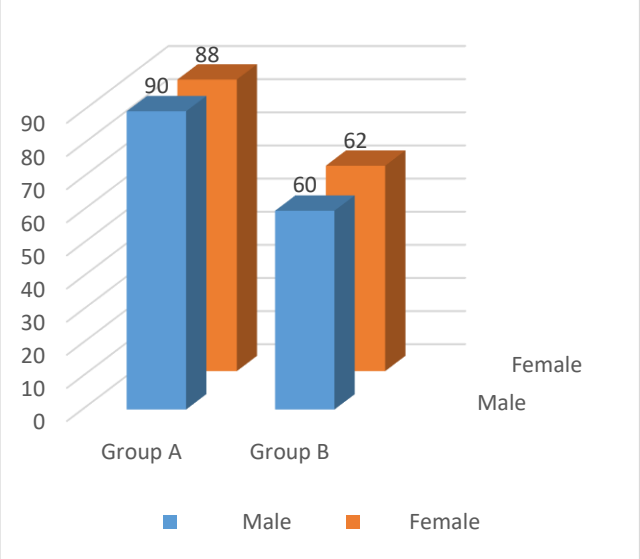

Fig 1: Frequency of gender in both groups

Table 2: The demographic data of patients of both groups (n=300)

Variables	**Groups**	
	Group A	Group B
Age	46.04±10.29	47.50±8.22
Gender		
Male	90(60.0%)	60(40.0%)
Female	88(58.7%)	62(41.3%)

Table 3:

		Groups		
Factors	**Admission Timing**	**Group A**	**Group B**	**P-Value**
Core temperature (°F)	OR	96.33±1.51	96.07±1.58	0.14
	PAR	96.04±1.78	95.6±1.61	0.06
	30 min after entering the PAR	96.22±1.81	95.8000±1.69	0.03
Pressure of O2 (mmHg)	OR	97.13±1.62	96.3000±1.64	0.00
	PAR	96.20±1.61	98.02±1.83	0.00
	30 min after entering the PAR	96.83±2.09	97.54±2.10	0.004
Systolic Blood Pressure (mmHg)	OR	145.19±6.61	128.6±10.61	0.00
	PAR	125.19±6.05	134.03±10.0	0.00
	30 min after entering the PAR	135.29±5.86	134.94±5.68	0.05
Diastolic Blood Pressure (mmHg	OR	83.40±2.64	81.26±2.98	0.00
	PAR	79.10±4.63	74.15±5.60	0.00
	30 min after entering the PAR	79.72±4.15	73.64±5.20	0.00
Pulse rate (bpm)	OR	96.46±9.98	98.41±12.53	0.00
	PAR	83.11±10.36	90.22±11.90	0.03
	30 min after entering the PAR	81.31±9.76	84.14±8.12	0.02
Respiratory rate (breath per minute)	OR	24.10±4.2	23.90±3.76	0.00
	PAR	22.12±2.14	21.06±5.02	0.02
	30 min after entering the PAR	25.10±3.82	23.21±5.23	0.00

Discussion:

The comparison of the impacts of administering intravenous (IV) fluids at warm temperatures versus normal temperatures on core body temperature in surgical patients is a crucial area of research in perioperative care. The present study investigated the effect of IV fluid temperature on core body temperature in surgical patients. Hypothermia is a serious complication after surgery, accompanied by a significant increase in oxygen use proportional to intraoperative heat loss, underscores the critical importance of preventing perioperative hypothermia.(10) Hypothermia, defined as a core body temperature below 36°C (96.8°F), is a common occurrence during and after surgery.(11) Surgical procedures often expose patients to various factors that can disrupt normal thermoregulation mechanisms, leading to heat loss and subsequent hypothermia.(12) During this condition oxygen use can increase by 200-600% in direct proportion to intraoperative heat loss.(13)

The present study revealed significant differences in core body temperature between surgical patients receiving warm IV fluids and those receiving fluids at normal temperatures. Initially, both groups had comparable baseline temperatures upon entering the operating room, indicating effective randomization. However, after 30 minutes in the post-anesthesia recovery area, the intervention group showed a smaller decrease in core temperature compared to the control group, suggesting the efficacy of warm IV fluids in attenuating postoperative temperature decline. This underscores the importance of warm IV fluids in maintaining perioperative normothermia and reducing the risk of hypothermia during the critical recovery phase. These findings emphasize the importance of temperature management in perioperative care, supporting the use of warm IV fluids as a proactive measure to optimize patient outcomes and promote thermal stability during surgery. The findings from Yokoyama et al.(14) demonstrate that individuals who received heated fluids at 38 °C experienced significantly higher core temperatures compared to those who received fluids at room temperature, highlighting the efficacy of warm IV fluids in maintaining perioperative normothermia. Similarly, another study corroborated these findings by successfully utilizing warm fluids to combat hypothermia.(15) This underscores the importance of temperature management strategies, particularly in the context of abdominal surgery, where hypothermia was observed in a significant proportion of patients. Notably, despite interventions, one-third of patients still presented with hypothermia upon admission to the post-anesthesia recovery area (PAR), indicating the persistent challenge of preventing perioperative hypothermia despite efforts to mitigate its occurrence. These findings emphasize the ongoing need for effective interventions, such as the use of warm IV fluids, to optimize patient outcomes and minimize the incidence of perioperative complications associated with hypothermia. In a study conducted by Viqar Aslam et al.(8) stated that After 30 minutes, there was a statistically significant average temperature difference between the two groups upon admission to the post-anesthesia recovery area (PAR). The present study results further emphasize the importance of proactive temperature management strategies, such as the use of warm IV fluids, in optimizing patient outcomes and minimizing the risk of complications associated with perioperative hypothermia.

The comparison of pulse rates between patients in Group B and Group A throughout the perioperative period reveals dynamic physiological responses to anesthesia, surgery, and recovery. While both groups experienced decreasing pulse rates over time, Group B, receiving standard IV fluids, exhibited higher initial pulse rates upon entering the operating room, progressively decreasing until re-entering the facility 30 minutes later. In contrast, Group A, receiving warm IV fluids, demonstrated lower initial pulse rates upon entering the operating room, further declining upon entering the post-anesthesia recovery area (PAR), and remaining stable upon re-entering the PAR 30 minutes later. Statistical analysis confirmed significant differences in pulse rates between the groups. These findings suggest potential variations in the physiological responses to anesthesia and surgery, possibly influenced by factors such as fluid management and patient characteristics. Lower pulse rates in Group A during recovery phases indicate a potentially more stable postoperative course, emphasizing the potential benefits of warm IV fluid administration in optimizing perioperative care. a study by De Hert et al.(16) demonstrated similar trends in pulse rates among patients undergoing major surgery, with pulse rates decreasing progressively from preoperative baseline levels to postoperative recovery.

Additionally, the observed differences in pulse rates between Group B and Group A are consistent with the findings of other investigations evaluating the impact of interventions such as fluid management on perioperative hemodynamics. For example, a study by Hahn et al. (2015) reported lower postoperative pulse rates in patients receiving warmed IV fluids compared to those receiving standard fluids, suggesting a potential role for warm IV fluids in mitigating perioperative hemodynamic changes.

The statistically significant differences observed between the groups in factors such as oxygen pressure, diastolic and systolic blood pressure, and respiratory rate throughout all periods of observation highlight the multifaceted impact of interventions, such as warm IV fluid administration, on perioperative physiology. These findings underscore the dynamic interplay between temperature management and various physiological parameters during the perioperative period. The consistent differences in oxygen pressure, blood pressure, and respiratory rate between the groups suggest that warm IV fluid administration may exert broader effects on systemic physiology beyond temperature regulation alone. These findings align with previous research demonstrating the interconnectedness of hemodynamic and respiratory responses to temperature changes and highlight the importance of comprehensive perioperative monitoring to optimize patient outcomes. The studies by Oshvandi et al., Frank et al., and Kurz et al. offer differing perspectives on the relationship between temperature regulation, hemodynamic parameters, and perioperative outcomes. Oshvandi et al.(5) found no significant differences in systolic and diastolic blood pressure between groups, conflicting with observed pulse rate changes in the present study. Frank et al.'s (17) discovery of altered pulse rates and blood pressure in hypothermic patients suggests temperature regulation may impact hemodynamics differently. Conversely, Kurz et al.(18) found no temperature-related differences in hemodynamics among healthy individuals. Despite these discrepancies, inadvertent hypothermia remains concerning for perioperative patients, underscoring the complexity of perioperative physiology. Further research is needed to clarify the interplay between temperature management and hemodynamics, emphasizing the importance of effective temperature management strategies to optimize patient care during surgery.

Conclusion:

It was concluded that the comparison of administering intravenous (IV) fluids at warm temperatures versus normal temperatures on core body temperature in surgical patients underscores the significance of temperature management in perioperative care. The study findings reveal that warm IV fluid administration leads to a smaller decrease in core body temperature during the postoperative recovery phase compared to normal temperature IV fluids. This highlights the effectiveness of warm IV fluids in maintaining perioperative normothermia and mitigating the risk of hypothermia, a common complication associated with adverse surgical outcomes. These results emphasize the importance of incorporating warm IV fluid administration into perioperative protocols to optimize patient outcomes and minimize perioperative complications. Further research is warranted to explore optimal temperature management strategies and their impact on patient recovery and overall surgical care.

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