Open Access

Original Article

Comparison of Forced Air Warming with Warm Intravenous Fluid Versus Forced Air Warming Alone in Preventing Hypothermia and Shivering in Obstetric Patients

Shujaat Hussain, Syed Qasim Ali Shah, Hassam Abdullah, Saddam Hussain, Taffazal Mehdi, Najam ul Hassan

Department of Anesthesia, Combined Military Hospital, Rawalpindi/National University of Medical Sciences (NUMS) Pakistan

ABSTRACT

Objective: To compare methods of forced air warming combined with warm intravenous fluid administration versus forced air warming alone in preventing hypothermia and shivering associated with spinal anesthesia for elective caesarian section.
Study Design: Randomized controlled trial (IRCT number iRCT20231022059809N1).
Place and Duration of Study: Department of Anesthesia, Combined Military Hospital Rawalpindi, Pakistan from May to Nov 2023.
Methodology: The patients were randomized into Group FWI (forced warming with warm IV fluid) and FWA (forced warming alone). Primary variables measured were core body temperature in both groups' pre-spinal, 30 and 60 minutes into the procedure and then at 30- and 60-minute intervals in the PACU post-procedure. Secondary variable measured was incidence of shivering during the procedure and in the recovery.
Results: Core body temperature measured in degrees Celsius between Group FWI and Group FWA was 37.34±0.17 degrees Celsius versus 37.34±0.16 degrees Celsius measured pre-spinal administration (p=0.922). It was 36.85±0.09 degrees Celsius versus 36.12±0.10 degrees Celsius 30 minutes after spinal during the procedure between both groups (p<0.001) and was 36.84±0.09 degrees Celsius versus 36.11±0.10 degrees Celsius measured 60 minutes in the procedure between both groups (p<0.001)
Conclusion: We conclude that addition of warm intravenous fluid with forced air warming maintains better core body temperature, decreases hypothermia and incidence of shivering both per-operatively and in the recovery.

Keywords: Body Temperature, Caesarian Section, Hypothermia, Intravenous fluid, Shivering, Warm.

How to Cite This Article: *Hussain S, Shah SQA, Abdullah H, Hussain S, Mehdi T, Hassan N. Comparison of Forced Air Warming with Warm Intravenous Fluid Versus Forced Air Warming Alone in Preventing Hypothermia and Shivering in Obstetric Patients. Pak Armed Forces Med J 2026; 76(Suppl-5): S742-S746. DOI: https://doi.org/10.51253/pafmj.v76iSUPPL-5.11677*

INTRODUCTION

Caesarian section has one of the highest frequencies for a surgical procedure being done globally, with an estimated 21.1% of all babies delivered by the procedure in 2021.[1,2] With better methods of early diagnoses of fetal complications and increase in the incidence of maternal diseases during pregnancy, this incidence is projected to increase in the coming decade.[1] Caesarian section can be done with multiple anesthetic techniques including general anesthesia, spinal anesthesia, and epidural anesthesia.[3] Every technique is associated with their risks and benefits and individual patient centric approach is recommended and followed to select the best possible technique for the surgical procedure.[4]

Spinal anesthesia has been the choice modality worldwide for elective caesarian section.[5] It is associated with excellent pain relief, acceptable patient comfort and decreased chances of complications both for the mother and baby when compared to general and epidural anesthesia.[6] Despite all advantages, it is not without its drawbacks. The most common are hypotension, bradycardia, hypothermia, and shivering.[7] While hypotension and bradycardia can be quickly addressed with pressor support, hypothermia and shivering require good ambient temperature and appropriate patient preparation since once developed, the take time to resolve and result in untoward complications both per- and post-operatively.[8] Hypothermia defined per-operatively as a core temperature measured by the tympanic route as <36°C is associated with incidence of shivering, patient discomfort, increased blood loss, increased chances of transfusion and resulting in delayed wound healing, increased hospital stay post-operatively.[9]

Maintaining ambient temperature in the operating room alone is not sufficient enough to prevent hypothermia and shivering in obstetric patients. The decreased ability of body homeostatic mechanisms following sympathectomy to maintain core body temperature needs to be addressed

Correspondence: Dr Shujaat Hussain, Department of Anesthesia, Combined Military Hospital, Rawalpindi Pakistan
Received: 05 Mar 2024; revision received: 25 May 2024; accepted: 26 May 2024

vigorously and consistently to prevent heat loss by conduction, convection, and radiation to the surroundings.[10]

Among the methods being used for the purpose, we aim to study and compare methods of forced air warming combined with warm intravenous fluid administration versus forced air warming alone in preventing hypothermia and shivering associated with spinal anesthesia for elective caesarian section.

METHODOLOGY

This randomized controlled trial was carried out at the Department of Anesthesiology, Combined Military Hospital Rawalpindi, Pakistan from May to November 2023 after approval form the ethical review board (vide letter no ERB 492 dated 3 Mar 2023).The sample size was calculated keeping the confidence interval at 95%, power of test at 80% with proportion of patients with incidence of shivering 30 minutes after being shifted to the recovery room being 31.2% in the forces air warming with warm fluids group versus 45.6% in the forced air warming group alone.[11] Minimum sample size according to WHO calculator came out to be 176. We included 390 patients in our randomized controlled trial, (Trial iD 74016, iRCT number iRCT20231022059809N1). The method of randomization was non-probability consecutive via lottery method.

Inclusion Criteria: ASA-I and II female patients presenting for elective caesarian with a gestational age of 37 or more weeks under spinal anesthesia were included in the study.

Exclusion Criteria: Patients with pre-maturity, caesarian converted to general anesthesia following spinal administration, patients with fever, cardiac or respiratory disease, patients with PIH (pregnancy induced hypertension) or gestational diabetes mellites and patients unwilling to be included in the study were excluded.

The study method included all patients as per the inclusion criteria furnished. The patients were randomized into Group-FWI (forced warming with warm IV fluid) and Group-FWA (forced warming alone). An informed written consent was taken, and patients in both groups were explained in detail about the procedure and possible complications. Standard monitoring including non-invasive blood pressure, heart rate, capnography and ECG was attached to participants in both groups.

Core temperature in both groups was recorded using a standard Braun Infrared Thermoscan,[5] thermometer (IRT 6500) by a resident anesthetist in the operating room unaware of the study protocol. Three readings were recorded at each interval and mean was taken to improve accuracy of the readings. Mean readings were taken 5 minutes pre-spinal, and at 30 and 60 minutes into the procedure. Same readings were taken 30 minutes and 1 hour in the post-anesthesia care unit (PACU). Incidence of shivering was recorded by the resident in the operating room and recovery and noted. Spinal anesthesia in both groups was administered using a 27 G pencil point Braun spinal needle using 0.5% hyperbaric Bupivacaine in the L2 spinal space to achieve a sensory block level at the T6 level confirmed by pin prick and cold spray method. Bradycardia (defined as heart rate less than 60 beats per minute),[12] and hypotension (mean arterial pressure less than 50 mmHg),[13] was countered with IV Atropine 0.5 mg bolus and IV Phenylephrine 50 mcg bolus respectively.

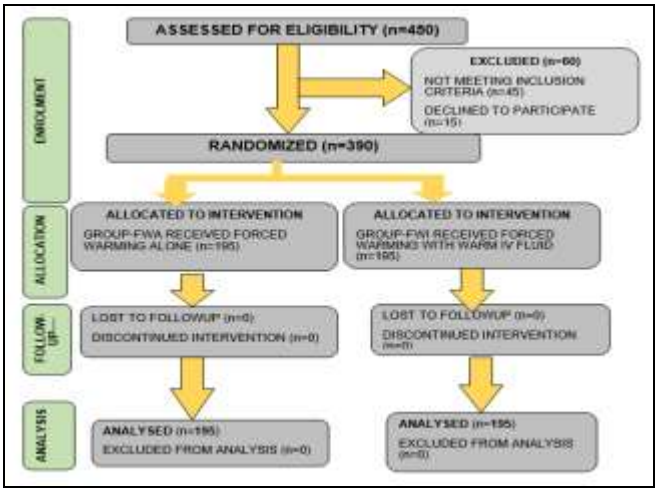

Figure: Phases of Randomized Controlled Trial

Patients in Group-FWI received intravenous Lactated Ringer warmed to 38° C using a standard fluid warming cabinet at 15 ml/kg 30 minutes prior to spinal anesthesia and continued till the end of the procedure. Forced air warmer was used to deliver warming to the lower part of the body below the umbilicus set at 38° C. the upper body was covered with disposable gown to prevent heat loss. Patients in Group-FWA only received forced air warming similar to the protocol used for the first group till the end of the procedure.

Primary variables measured were core body temperature in both groups' pre-spinal, 30 and 60 minutes into the procedure and then at 30- and 60-minute intervals in the PACU post-procedure. Secondary variable measured was incidence of shivering during the procedure and in the recovery.

Demographic data were statistically described in terms of Mean±SD frequencies, and percentages when appropriate. Independent samples t-test was used to compare statistically significant means. A p value of ≤0.05 was considered statistically significant. All statistical calculations were performed using Statistical Package for Social Sciences 26.0.

RESULTS

A total of 390 patients were included in the study divided into Group-FWI (n=195) and Group-FWA (n=195) after randomization for analysis. Mean age of patients in Group-FWI was 25.19±3.18 years versus 25.44±3.17 years in Group-FWA (p=0.455). Mean weight was 75.57±3.76 kg in Group-FWI versus 75.32±3.82 kg in Group-FWA (p=0.513). Mean duration of surgery was 75.73±3.69 minutes in Group-FWI versus 75.74±3.65 minutes in Group-FWA (p=0.967) (Table-I).

Table-I: Comparison of Age and Height Characteristics Among Groups (n=390)

Variable(s)	Group-FWI (n=195)	Group-FWA (n=195)	*p* value
Mean Age (Years)	25.19±3.18	25.44±3.17	0.455
Mean Weight (Kg)	75.57±3.76	75.32±3.82	0.513
Mean Duration of Surgery (Min)	75.73±3.69	75.74±3.65	0.967

Core body temperature measured in degrees Celsius between Group-FWI and Group-FWA was 37.34±0.17 degrees Celsius versus 37.34±0.16 degrees Celsius measured pre-spinal administration (p=0.922). It was 36.85±0.09 degrees Celsius versus 36.12±0.10 degrees Celsius 30 minutes after spinal during the procedure between both groups (p<0.001) and was 36.84±0.09 degrees Celsius versus 36.11±0.10 degrees Celsius measured 60 minutes in the procedure between both groups (p<0.001) (Table-II).

The same core temperature measured in the post-anesthesia care unit (PACU) after being shifted post-procedure was 36.65±0.23 degrees Celsius versus 36.11±0.13 degrees Celsius between Group-FWI and Groups-FWA respectively after 30 minutes in the PACU (p<0.001). The same was 36.66±0.24 degrees Celsius versus 36.11±0.10 degrees Celsius between both groups when measured at 60 minutes in the PACU before being shifted to the ward (p<0.001) (Table-II).

Table-II: Comparison of Core Body Temperature Between Both Groups (n=390)

Variable	Group-FWI (n=195)	Group-FWA (n=195)	*p*-value
Core Body Temp Pre- and Per-Operatively (° C)			
Pre-Spinal	37.34±0.17	37.34±0.16	0.922
30 Minutes Following Spinal	36.85±0.09	36.12±0.10	<0.001
60 Minutes Following Spinal	36.84±0.09	36.11±0.10	<0.001
Core Body Temp In Post-Anesthesia Care Unit (° C)			
30 Minutes In Pacu	36.65±0.23	36.11±0.13	<0.001
60 Minutes In Pacu	36.66±0.24	36.11±0.10	<0.001

The incidence of shivering was seen in 32(16.4%) patients during the procedure post-spinal in Group-FWI versus 56 (28.7%) patients in Group-FWA during the procedure. The same observed in PACU showed incidence in 53(27.2%) versus 83(42.6%) patients between Group FWI and FWA (Table-III).

Table-III: Comparative Incidence of Shivering Among Groups

Incidence of Shivering	Group-FWI (n=195)	Group-FWA (n=195)
During Procedure Post-Spinal	32(16.4%)	56(28.7%)
Post-Procedure in Pacu	53(27.2%)	83(42.6%)

Pacu: post-anesthesia care unit

DISCUSSION

The study was carried out in our institute to study and assess cost-effective ways to reduce the incidence of hypothermia and shivering in the obstetric population. The findings suggest that the addition of warm intravenous fluid with forced air warming maintains better core body temperature, decreases hypothermia and incidence of shivering both per-operatively and in the recovery. Since spinal anesthesia remains the choice modality in our setup as well due to its ease of use, decreased adverse effects to the mother and baby when compared to general anesthesia, its associated complications need to be addressed to better patient compliance and satisfaction.[4] Spinal anesthesia has been proposed to cause hypothermia and shivering following sympathectomy from several mechanisms including impairment of autoregulation by inhibition and

blunting of central and peripheral shivering and vasomotor mechanisms as well as thermal redistribution in the body from the center to the peripheries.[13] This, added with the extra effect of cold operating room environment and cold infusions increase the incidence in patients.[5]

A study carried out by Dendis *et al*.[14] concluded that just by altering the ambient temperature of the operating room and decreasing heat loss through convection and radiation, the chances of hypothermia can be decreased by more than 50%. Similar studies carried out by Jun JH *et al*.[15] and WA Chen *et al*.[16] were in line with findings of our study concluding that forced air warmers when combined with the simple and cost effective method of warm fluid administration resulted not only in better maintenance of core body temperatures in the operating room per-operatively but also resulted in better temperature maintenance in the recovery room. This combined with the benefit of decreased incidence of shivering in these patients results in excellent patient satisfaction and decreased length of stay in the recovery room post-operatively.

These measures not only result in better results and decrease incidence of complications for the mother, studies done by L Marin *et al*.[17] proved that these methods also results in overall better APGAR scores for the newborns at 01 and 05 minutes respectively. These findings were also confirmed by studies done by N TT *et al*.[18] We did not measure newborn parameters in our study, but these findings advocate a better outcome both for the mother and the baby.

The secondary variable of shivering studied in our trial showed an increased incidence in the FWA group. When comparing the incidence of shivering, it was observed that the frequency was more in the post-operative recovery than in the operating room in both groups. We attribute it to the possible change in ambient temperature of the recovery which is less ideal than that of the operating room and without the forced air warming the core temperature was also decreased in all mean values observed in the post-anesthesia care unit (PACU). Our results were in line with studies carried out by Golmohammadi *et al*.[19] and S Rasoli *et al*.[20] who also concluded the incidence of shivering being more in the recovery than in the operating room in patients under caesarian section under spinal anesthesia.

RECOMMEDATIONS

The study recommends the use of warm intravenous fluids as a cost-effective and easy method to reduce incidence of hypothermia and shivering when combined with forced air warming for patients undergoing caesarian section under spinal anesthesia.

LIMITATIONS OF STUDY

The limitations are that the study is single center only. With the change in physiological parameters during pregnancy, the study may only be validated in pregnant patients.

CONCLUSION

The study concludes that the addition of warm intravenous fluid with forced air warming maintains better core body temperature, decreases hypothermia and incidence of shivering both per-operatively and in the recovery.

Conflict of Interest: None.

Funding Source: None.

Authors' Contribution

Following authors have made substantial contributions to the manuscript as under:

SH & SQAS: Data acquisition, data analysis, critical review, approval of the final version to be published.

HA & SH: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

TM & NH: Conception, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

REFERENCES

1. Betran AP, Ye J, Moller A-B, Souza JP, Zhang J. Trends and projections of caesarean section rates: global and regional estimates. BMJ Glob Health 2021; 6(6): e005671. https://doi.org/10.1136/bmjgh-2021-005671
2. Tollånes MC. Increased rate of Caesarean sections--causes and consequences. Tidsskrift for den Norske lægeforening: tidsskrift for praktisk medicin, ny række 2009; 129(13): 1329-1331. https://doi.org/10.4045/tidsskr.08.0453
3. Binici O, Büyükfırat E. Anesthesia for cesarean section in parturients with abnormal placentation: a retrospective study. Cureus 2019; 11(6). https://doi.org:10.7759/cureus.5033
4. Ahmed F, Chithrala B, Barve K, Biladeau S, Clifford S. Value-Based Care in Anesthesia. Cureus 2023; 15(8): e44410. https://doi.org/10.7759/cureus.44410
5. Iddrisu M, Khan ZH. Anesthesia for cesarean delivery: general or regional anesthesia—a systematic review. Ain-Shams J Anesthesiol 2021; 13(1): 1-7. https://doi.org/10.1186/s42077-020-00121-7

6. Watson SE, Richardson AL, Lucas DN. Neuraxial and general anaesthesia for caesarean section. Best Pract Res Clin Anaesthesiol 2022; 36(1): 53-68. https://doi.org/10.1016/j.bpa.2022.04.007
7. Omar H, Aboella WA, Hassan MM, Hassan A, Hassan P, Elshall A, et al. Comparative study between intrathecal dexmedetomidine and intrathecal magnesium sulfate for the prevention of post-spinal anaesthesia shivering in uroscopic surgery;(RCT). BMC Anesthesiol 2019; 19(1): 1-10. https://doi.org/10.1186/s12871-019-0853-0
8. Feng G, Wang Y, Feng J, Luo X, Li C, Yao S. The relationship between core temperature and perioperative shivering during caesarean section under intrathecal anesthesia with bupivacaine and ropivacaine: a randomized controlled study. J Anesth 2021; 35(6): 889-895. https://doi.org/10.1007/s00540-021-02995-9
9. Mendonça FT, Ferreira JdS, Guilardi VHF, Guimarães GMN. Prevalence of inadvertent perioperative hypothermia and associated factors: a cross-sectional study. Ther Hypothermia Temp Manag 2021; 11(4): 208-215. https://doi.org/10.1089/ther.2020.0038
10. Simegn GD, Bayable SD, Fetene MB. Prevention and management of perioperative hypothermia in adult elective surgical patients: a systematic review. Ann Med Surg 2021; 72: 103059. https://doi.org/10.1016/j.amsu.2021.103059
11. Meghana V, Vasudevarao SB, Kamath SS. The effect of combination of warm intravenous fluid infusion and forced air warming versus forced air warming alone on maternal temperature and shivering during cesarian delivery under spinal anesthesia. Ann Afr Med 2020; 19(2): 137. https://doi.org/10.4103%2Faam.aam_58_19
12. Abbas SA, Hamadani SM, Ahmad U, Desai A, Kitchloo K. Ophthalmic timolol and hospitalization for symptomatic bradycardia and syncope: a case series. Cureus 2020; 12(3): e7270. https://doi.org/10.7759/cureus.7270
13. Cai J, Tang M, Wu H, Yuan J, Liang H, Wu X, et al. Association of intraoperative hypotension and severe postoperative complications during non-cardiac surgery in adult patients: A systematic review and meta-analysis. Heliyon 2023; 9(5): e15997. https://doi.org/10.1016/j.heliyon.2023.e15997
14. Dendis M, Hooven K. Preventing hypothermia during cesarean birth: an integrative review. MCN: Am J Matern Child Nurs 2020; 45(2): 102-108. https://doi.org/10.1097/nmc.0000000000000599
15. Jun J-H, Chung MH, Jun I-J, Kim Y, Kim H, Kim JH, et al. Efficacy of forced-air warming and warmed intravenous fluid for prevention of hypothermia and shivering during caesarean delivery under spinal anaesthesia: A randomised controlled trial. Eur J Anaesthesiol 2019; 36(6): 442-448. https://doi.org/10.1097/eja.0000000000000990
16. Chen W-A, Liu C-C, Mnisi Z, Chen C-Y, Kang Y-N. Warming strategies for preventing hypothermia and shivering during cesarean section: A systematic review with network meta-analysis of randomized clinical trials. Int J Surg 2019; 71: 21-28. https://doi.org/10.1016/j.ijsu.2019.09.006
17. Marin L, Hocker J, Esser A, Terhorst R, Sauerwald A, Schroder S. Forced-air warming and continuous core temperature monitoring with zero-heat-flux thermometry during cesarean section: a retrospective observational cohort study. Braz J Anesthesiol 2022; 72: 484-492. https://doi.org/10.1016/j.bjane.2021.10.007
18. Ni T-t, Zhou Z-f, He B, Zhou Q-h. Effects of combined warmed preoperative forced-air and warmed perioperative intravenous fluids on maternal temperature during cesarean section: a prospective, randomized, controlled clinical trial. BMC Anesthesiol 2020; 20(1): 1-8. https://doi.org/10.1186/s12871-020-00970-7
19. Golmohammadi M, Karami N, Tahmasebi R. Incidence of Shivering During Cesarean Section in Patients Under Spinal Anesthesia With or Without Fentanyl. Int J Pharm Clin Res 2020; 31(6): 423-432.
20. Rasoli S, Ansari E, Moslemi F, Ghojazadeh M. The Prophylactic Administration of Intravenous Paracetamol for Control of Shivering During and After Cesarean Section Under Spinal Anesthesia. Arch Anesthesiol Crit Care 2019; 5(2): 38-40. https://doi.org/10.18502/aacc.v5i2.748