e-ISSN: 0975-1556, p-ISSN:2820-2643

Available online on www.ijpcr.com

International Journal of Pharmaceutical and Clinical Research 2024; 16(6); 2126-2135

Original Research Article

Role of Dexmedetomidine in Preventing Postoperative Shivering Following Craniotomy: A Randomized Placebo-Controlled Double-Blind Trial

Jisnu Nayak[1], Arun Kumar Mandi[2], Priyabrata Shit[3], Amita Acharjee[4], Jayanta Chakraborty[5], Sukanta Sen[6]

[1]Assistant Professor, Department of Anaesthesiology, Burdwan Medical College and Hospital, Baburbag, P.O. Rajbati, Purba Bardhaman 713104 West Bengal, India
[2]Assistant Professor, Department of Anaesthesiology, Midnapore Medical College and Hospital, Vidyasagar Road, Paschim Medinipur, Midnapore 721101, West Bengal, India
[3]Associate Professor, Department of Anaesthesiology, Santiniketan Medical College, Gobindapur, PO Muluk, Bolpur 731204, West Bengal, India
[4]Professor, Department of Anaesthesiology, Institute of Post Graduate Medical Education & Research, Kolkata 700020, West Bengal, India
[5]Professor, Department of Anaesthesiology, Burdwan Medical College and Hospital, Baburbag, P.O. Rajbati, Purba Bardhaman 713104 West Bengal, India
[6]Professor & Head, Department of Pharmacology, ICARE Institute of Medical Sciences and Research, PO Balughata, Banbishnupur, Purba Medinipur, Haldia, West Bengal, India

Received: 25-03-2024 / Revised: 23-04-2024 / Accepted: 26-05-2024
Corresponding Author: Dr. Priyabrata Shit
Conflict of interest: Nil

Abstract:

Background: Shivering is a point of concern in post-operative patients with several adverse outcomes in patients undergoing neurosurgeries where haemodynamic stability, cerebral auto-regulation and post-operative pain relief are required. Traditionally, opioids like pethidine, tramadol or fentanyl had been used to address post-operative shivering. But these drugs can produce several untoward side-effects like nausea, vomiting, itching, hypersensitivity reactions and most importantly respiratory depression inadvertently. Dexmedetomidine, a newer α2 agonist, not known to have above side-effects has shown to reduce the requirement of opioids in craniotomy surgery.

Aim: Assess and compare the efficacy of dexmedetomidine for prevention of shivering in post-operative craniotomy patients to a placebo.

Materials and Methods: Seventy-six patients of ASA grade I and II, undergoing craniotomy under general anaesthesia matching the inclusion and exclusion criteria, were randomly divided into two groups, after obtaining a written informed consent. Group D (n=38) received a dexmedetomidine infusion of 0.7µg kg-1 hr-1 and group P (n=38) received normal saline infusion. The infusion was started 10 minutes before induction and continued till start of skin closure. The patients' heart rate, blood pressure, nasopharyngeal temperatures were noted. In the post-operative period, shivering, sedation and any side-effects were noted.

Results: No significant difference was noticed in terms of demographic, baseline parameters and core temperature (p>0.05). The haemodynamic parameters were better controlled in group D. The incidence of shivering was significantly higher in group P (p=0.0178). The patients in group D were more sedated for 50 minutes in the post-operative period. No significant difference was found in terms of side-effects.

Conclusion: The study demonstrates that infusion of 0.7µg kg-1 hr-1 dexmedetomidine, started ten minutes before operation and continued throughout the intra-operative period, prevents post-operative shivering after craniotomy, with better control of intra-operative haemodynamics, lesser anaesthetic consumption and no significant side-effects. Patients were more co-operative, oriented and tranquil in the immediate post-operative period.

Keywords: Dexmedetomidine, Haemodynamic Parameters, Postoperative Shivering, Craniotomy.

Introduction

Shivering can be defined as an involuntary, repetitive activity of the skeletal muscle producing uncontrollable muscular shaking and heat production. Risk factors of post-operative shivering can be several, which includes male gender, young age, length of surgery, peri-operative hypothermia etc. The causes of shivering are mainly of two types- thermoregulatory and non-thermoregulatory.

Thermoregulatory shivering [1,2] may be a response to drop of core temperature due to peri-operative hypothermia, while non-thermoregulatory shivering [3,4] is due to systemic release of pyrogens and increased sympathetic activity in response to post-operative pain. So, post-operative shivering not only increase discomfort in the patients, it can also be the cause of increased oxygen consumption, increased metabolic demand, increased intracranial tension, increased CO2 production, lactic acidosis etc. [5] Several studies done so far had concluded that post-operative shivering remained one of the most common complications, occurring in 5-65% patients who had been operated under general anaesthesia. [6]

Craniotomy requires prolonged duration of surgery in a relatively cool environment of operating room. As it has been already mentioned, prolonged surgery and peri-operative hypothermia being two most important risk factors, chance of post-operative shivering becomes higher in these groups of patients. Anaesthesia that ensures optimal conditions for brain surgery may also increase the incidence of post-operative shivering following weaning off effect8 of anaesthetic medications immediately after surgery. [7,8]

Non-pharmacological options to tackle shivering can be very helpful if taken adequately and appropriately which includes skin surface re-warming, raising temperature operative room, warm solutions, adequate covering following completion of surgery and during transport. [9,10]

Maintenance of stable and optimum haemodynamical condition throughout surgery and reducing post-operative pain are also important prerequisite to counter shivering which can be achieved by many pharmacological options. Over the past few years opioids and more recently α2 agonists had been shown to have effective role in preventing shivering in several studies done worldwide.

Opioids like pethidine and tramadol though have good effects on shivering; respiratory depression remains a point of concern in the post-operative craniotomy patients. Over the past few years clonidine, α2 agonist has been successfully used to tackle shivering. [11] Another α2 agonist dexmedetomidine, potent with more specific action, is recently in use in neuroanaesthesia to control sympathetic surge during endotracheal intubation or extubation in patients undergoing craniotomy. [12,13]

Another important aspect of this drug is reduction in requirement of opioids and other anaesthetic agents during surgery. [14] Moreover dexmedetomidine has been shown to possess analgesic effect when used as adjuvant. [15] Studies showing efficacy of dexmedetomidine in prevention of shivering in patients undergoing craniotomy are limited.

Therefore, this study is proposed to evaluate the effect of dexmedetomidine on post-operative shivering in patients undergoing craniotomy when compared to a placebo. haemodynamic changes, rescue drug to treat post-operative shivering and any untoward effects during operative and post-operative period in each group were also noted.

Materials & Methods

This prospective double blinded parallel group randomized control study was conducted between February, 2014 and August, 2015 at Neurosurgery Operation Theatre and Post Anaesthetic Care Unit at Bangur Institute of Neurosciences in IPGMER. & SSKM. Hospital, Kolkata.

Placebo control in the form of normal saline infusion was used. Patients undergoing craniotomy in this institution, who matched the inclusion criteria and gave informed consent in writing about participating in the study voluntarily after knowing and understanding the consequences, which was properly explained to them beforehand.

The primary goal of anaesthesia is to make the surgery safe and effective, while reducing the psychophysical distress of the patient. This study was meant to judge the efficacy of dexmedetomidine in preventing post-operative shivering in patients undergoing craniotomy. [16]

Inclusion Criteria

- Written informed consent of the patients.
- ASA grade I and II.
- Age between 18 – 60 years.
- Patients of either sex.
- Patients scheduled for craniotomy operations who are supposed to be operated within 3 hours.

Exclusion Criteria

- ASA grade III and IV.
- Patients allergic to study medications.
- Patients' with thyroid disorder, Parkinsons disease, dysautonomia, Raynaud's syndrome, cardiopulmonary disease, history of allergy to drugs used, history of chronic use of sedative and hypnotic drugs.
- History of conduction defect of heart.
- Initial core temperature >37.5oC or <36.5oC.
- Obese patients with B.M.I >30
- Pregnant or lactating women.
- Renal or hepatic dysfunction

Complete pre-anaesthetic evaluation were performed in each patient, including detailed history taking, thorough physical check-up, airway evaluation and assessment of routine pre-operative investigation. Written informed consent was obtained from all the patients prior to including

them in the study during pre-anaesthetic check-up. The patients did not receive any pre medication and was kept fasting from midnight day before surgery.

The patients were received in the pre-anaesthesia room on the morning of the surgery and monitors were attached. Baseline parameters like heart rate, SpO2 and non-invasive blood pressure (systolic, diastolic and mean) and other demographic parameters were noted. An intra-venous line and intra-arterial line was inserted and warmed intravenous drips were started. Anaesthesia machine, airway equipment and drugs for resuscitation were kept ready in hand before starting the procedure. A temperature probe was placed in the nasopharynx.

For the purpose of sample size calculation the proportion of subjects experiencing shivering within 6 hour of completion of surgery was considered as the outcome measure. It was estimated that 38 subjects will be required per group in order to detect a difference of 30% with respect to incidence in the placebo group, assuming this incidence to be 50%. This calculation assumes 80% power, 5% probability of Type I error and 2 sided testing.

Age, weight, height from history, heart rate, blood pressure, electrocardiogram, SpO2, EtCO2, nasopharyngeal temperature from multipara monitor were noted. Post-operative shivering was assessed by Tsai and Chu scale.17 Post-operative sedation was assessed by Ramsey sedation scale. [18]

The patients were randomly allocated into two groups – Group D (38) received infusion dexmedetomidine (0.7 μg kg-1 hr-1), and Group P (38) received normal saline as placebo. Solutions infused were prepared and marked by an operating room technician who was not involved in the study. The solutions were prepared in a 50 c.c. syringe containing 200μg dexmedetomidine(4μg ml-1) for group D and 50c.c. normal saline for group P. Infusion was started 10 minutes before induction of anaesthesia of each patient and was continued throughout the surgery. Infusion was stopped immediately at the beginning of skin closure. In the operating room, the temperature was maintained at 22oC, measured by a wall hanging thermometer. Anaesthetic management was standardized. Anaesthesia was induced with fentanyl (2 μg kg-1) and propofol (2 mg kg-1) followed by administration of rocuronium (0.6 mg kg-1) to facilitate endotracheal intubation. An appropriate sized endotracheal tube was placed for mechanically controlled ventilation with a tidal volume of 8ml kg-1, maintaining an end-tidal carbon dioxide pressure tension of 30 mm of Hg. All the patients were provided adequate warm covering of the body. Monitoring included: HR, SpO2, ECG with lead II, IBP and EtCO2. Anaesthesia was maintained with 50% air in oxygen and sevoflurane, propofol infusion adjusted according to the haemodynamic parameters and rocuronium infusion guided by train of four ratio. Nasopharyngeal temperature was monitored throughout the surgical procedure. Fentanyl (50μg) was injected as analgesic, when SBP and HR increased by 20%. Atropine (0.5mg i.v. bolus) was given for bradycardia (heart rate<50/min) and phenylephrine (20-100μg i.v. increments) was to be given for hypotension (systolic pressure< 90 mm of Hg). The intra-operative parameters to be studied were noted as per the data collection sheet. At the end of surgery residual neuromuscular block was antagonized with intravenous neostigmine 50 μg kg-1and atropine 20 μg kg-1. The patients were extubated after fulfilling standard criteria. The patients were then shifted to the post-anaesthetic care unit. The patients were covered with warm sheets and environment temperature maintained at 22oC. Any episode of shivering, pain, post-operative nausea and vomiting, dry mouth or other complaints were noted. Shivering grade was assessed by scale validated by Tsai and Chu.90

Shivering grade was assessed by scale validated by Tsai and Chu. [17]

- Grade 0: No shivering.
- Grade 1: Pilo-erection or peripheral vasoconstriction, but no visible shivering.
- Grade 2: Muscular activity in only one muscle group.
- Grade 3: Muscular activity in more than one muscle group but not generalized.
- Grade 4: Shivering involving the whole body.

Sedation was assessed by Ramsey Sedation Scale [18]

1. Patient is anxious and agitated or restless, or both.
2. Patient is co-operative, oriented and tranquil.
3. Patient responds to commands only.
4. Patient exhibits brisk response to light glabellar tap or loud auditory stimulus.
5. Patient exhibits a sluggish response to light glabellar tap or loud auditory stimulus.
6. Patient exhibits no response.

Patients received injection tramadol (25 mg) as rescue drug for shivering in the post-operative period. Patients developing grade III and grade IV shivering were considered for treatment. Nausea or vomiting was treated by ondansetron (4 mg i.v.).

Data was summarized by routine descriptive statistics namely mean and standard deviation for numerical values and counts, and percentages for categorical variables. Numerical variables were compared between two groups by unpaired t test if normally distributed or by Mann – Whitney test if otherwise. Categorical variables were compared between groups by Fischer exact probability test. All analysis was two tailed and $p < 0.05$ was

considered to be statistically significant. The last observation was carry forwarded in cases where surgery had ended earlier than others and inputed into the blank spaces of the grand chart made by the help of Microsoft excel.

Statistics was done by the help of statistical software - Graphpad Prism 5 for windows version 5.00.

Results

Seventy-six patients, aged between 19-59 years of ASA grade I and II, scheduled to undergo craniotomy under general anaesthesia were randomly divided into two groups.

Group D received dexmedetomidine at the rate of 0.7µg kg-1 hr-1, started ten minutes before induction. Group P received same volume of normal saline. The comparison between various parameters is done below.

Demographic Characteristics

Table 1: Age (in years), body weight (in Kg) and duration of surgery of the study groups

Group	Mean	Min.	Max.	Std. Dev.	S.E. of Mean	P-Value
D	37.08	19	58	11.94	1.936	0.9627
P	36.79	20	59	36.79	1.916	
D	58.89	40	80	8.880	1.441	0.9597
P	58.79	40	78	9.224	1.496	
D	135.9	105	170	14.60	2.369	0.9110
P	136.2	110	165	14.02	2.274	

The above table describes the descriptive statistics for age between the two groups. Applying the Mann-Whitney test, it was found that, there was no statistical significant difference between the groups (p= 0.9627). The above also describes the descriptive statistics for body weight between the two groups. Applying the unpaired t test, it was found out that there was no statistical significance between the groups (p= 0.9597). It describes the descriptive statistics for duration of operation between control (group P) and case (group D) groups. Applying the unpaired t test, it was found that there was no statistical difference between the groups (p= 0.9110) [table1].

Table 2: Comparison of heart rate in the two groups during intra-operative period

Time Point	Group	Median	I.Q.R.	P-Value
Baseline	D	82.00	74-96	0.2055
	P	84.00	72-96	
Just Before Induction	D	76.00	68-87	<0.0001*
	P	87.50	76-102	
Just After Induction	D	74.00	62-84	<0.0001*
	P	94.00	82-106	
Just After Intubation	D	83.00	72-94	<0.0001*
	P	100.00	90-122	
Start of Surgery	D	80.50	68-90	<0.0001*
	P	98.00	88-120	
15 Min. Intra-Operative	D	77.50	64-86	<0.0001*
	P	97.00	87-115	
30- Min. Intra-Operative	D	75.00	64-84	<0.0001*
	P	94.50	85-100	
45 Min. Intra-Operative	D	72.00	62-82	<0.0001*
	P	93.00	86-99	
60 Min. Intra-Operative	D	69.50	60-78	<0.0001*
	P	90.00	84-100	
75 Min. Intra-Operative	D	68.50	58-78	<0.0001*
	P	89.50	82-98	
90 Min. Intra-Operative	D	67.00	52-76	<0.0001*
	P	89.50	83-99	
105 Min. Intra-Operative	D	66.00	48-74	<0.0001*
	P	90.00	80-98	
120 Min. Intra-Operative	D	65.00	51-88	<0.0001*
	P	90.00	80-100	
135 Min. Intra-Operative	D	65.00	50-80	<0.0001*
	P	90.00	80-100	

150 Min. Intra-Operative	D	64.00	47-80	<0.0001*
	P	90.00	79-100	
165 Min. Intra-Operative	D	64.50	52-90	<0.0001*
	P	90.00	79-100	

The above table 2 compare the trend in heart rate in both the groups. The unpaired t test was applied to determine any significant change in median heart rate at any time point between the groups. The symbol (*) denotes statistically significant change in heart rate at the mentioned time points (*p* value<0.05). Heart rate attenuation was better during laryngoscopy and intubation in Group D.

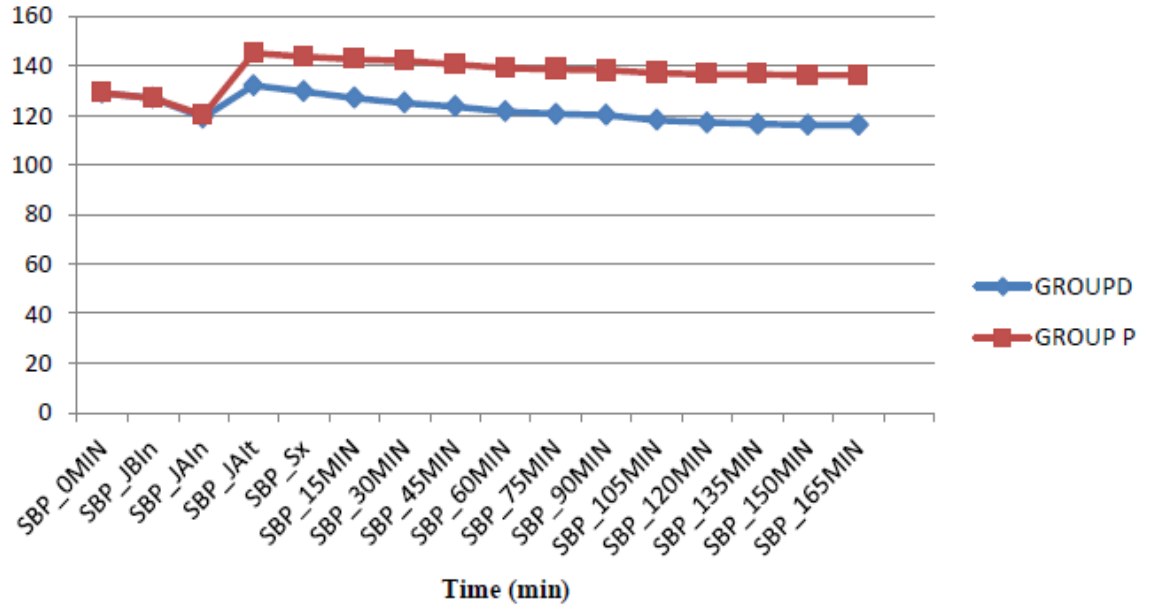

Figure 1: Trend of systolic blood pressure in the two groups during intra-operative period

The above diagram (Fig. 1) compares the trend in systolic blood pressure in both the groups. The unpaired t test was applied to determine any significant change in median heart rate at any time point between the groups. The symbol (*) denotes statistically significant change in heart rate at the mentioned time points (p value<0.05). Systolic blood pressure attenuation was better during laryngoscopy and intubation in Group D.

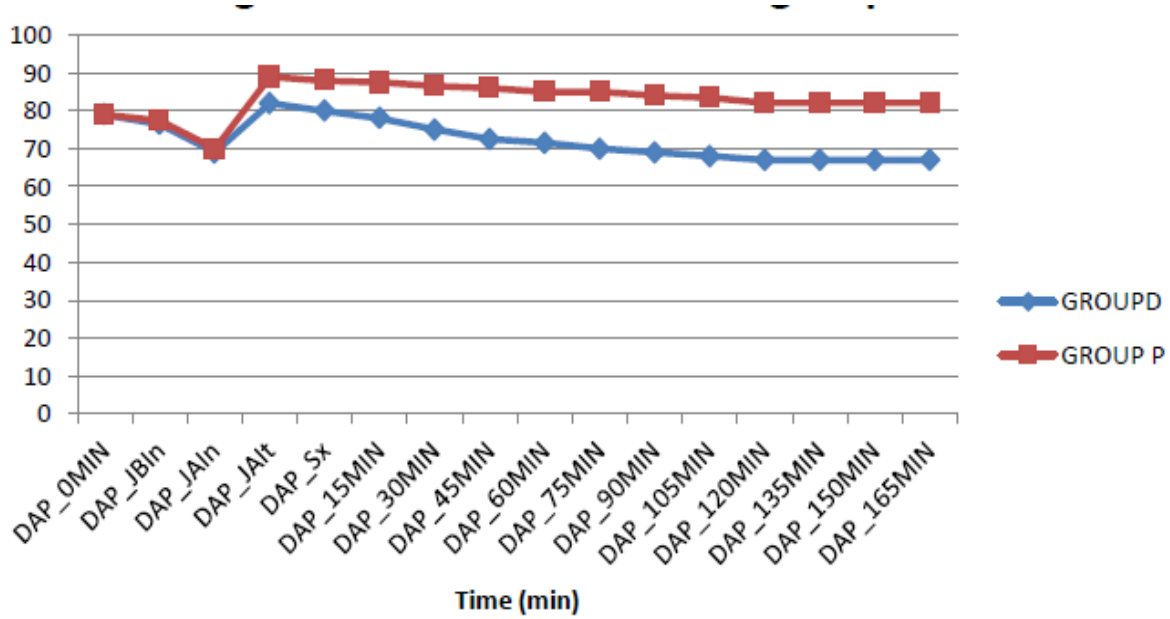

Figure 2: Trend of diastolic blood pressure in the two groups during intra-operative period

The above diagram (Fig. 2) compares the trend in diastolic blood pressure in both the groups. The unpaired t test was applied to determine any significant change in median heart rate at any time point between the groups. The symbol (*) denotes statistically significant change in heart rate at the mentioned time points (p value<0.05). Diastolic blood pressure attenuation was better during laryngoscopy and intubation in Group D.

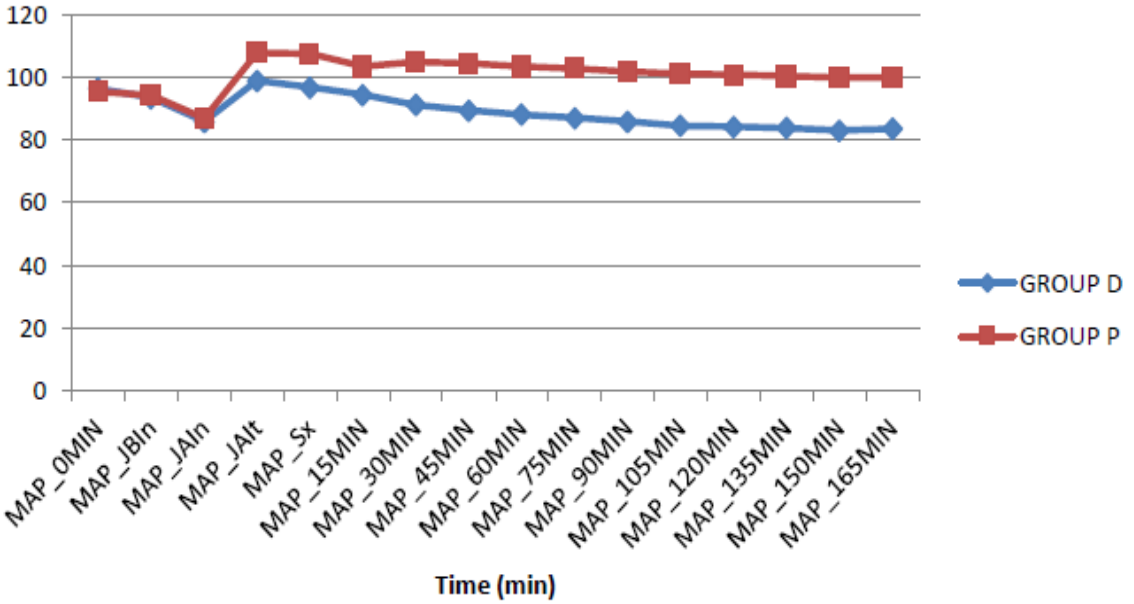

Figure 3: Trend of MAP in the two groups during intra-operative period

The above diagram (Fig. 3) compares the trend in mean blood pressure in both the groups. The unpaired t test was applied to determine any significant change in median heart rate at any time point between the groups. The symbol (*) denotes statistically significant change in heart rate at the mentioned time points (p value<0.05). Mean blood pressure attenuation was better during laryngoscopy and intubation in Group D.

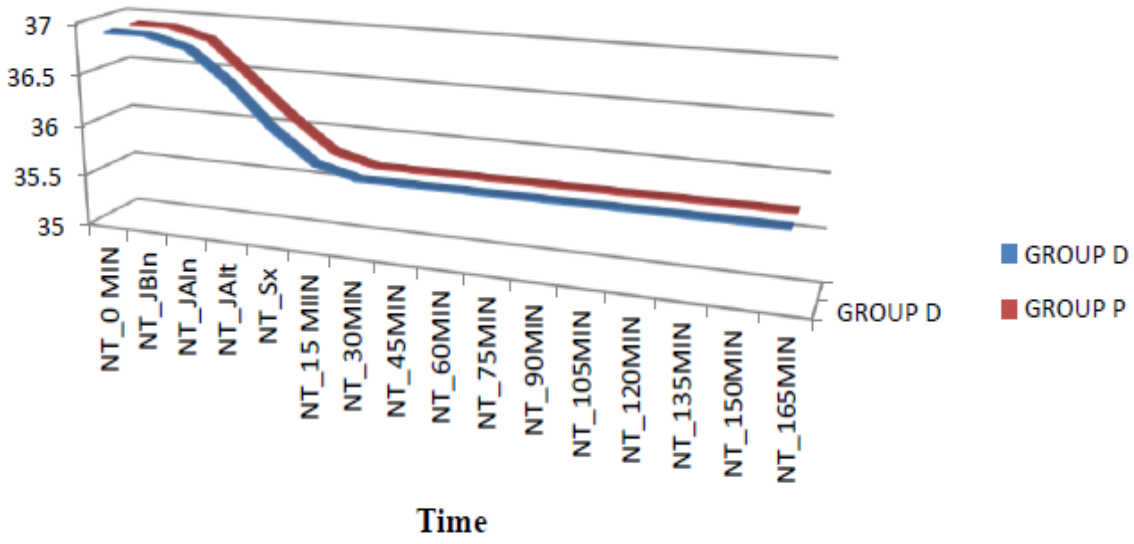

Figure 4: Trend of nasopharyngeal temperature in the two groups during intra-operative period

The above diagram (Fig. 4) depicts the trend of nasopharyngeal temperature in the two groups. Applying Mann-Whitney test, no significant difference was found between the groups at any point of time.

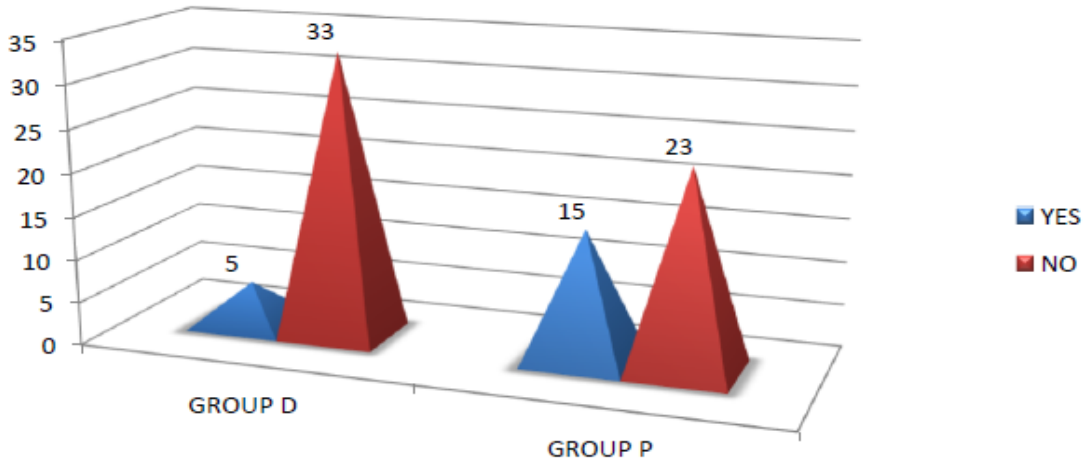

Figure 5: Comparison of the incidence of Shivering in the two groups

The above diagram (Fig. 5) shows the incidence of shivering in the two groups. Fischer's Exact test showed significant difference between the groups (p= 0.0178).

Table 3: Comparison of the incidence of different grades of shivering

Grade	Group D (N=38)	Group P (N=38)	p-Value
Grade 0	33	23	0.001*
Grade 1	2	1	
Grade 2	3	3	
Grade 3	0	8	
Grade 4	0	3	

The above table 3 shows the number of patients in each group suffering from different grades of shivering. The chi-square trend test revealed a significant difference between the groups (p= 0.01).

Table 4: Patients receiving treatment for shivering

Data Analyzed	Yes	No	P-Value
Group D (N=38)	0	38	0.0004*
Group P (N=38)	11	27	

Fischer's Exact test revealed a significant difference (p=0.0004) in requirement of treatment for shivering (table 4).

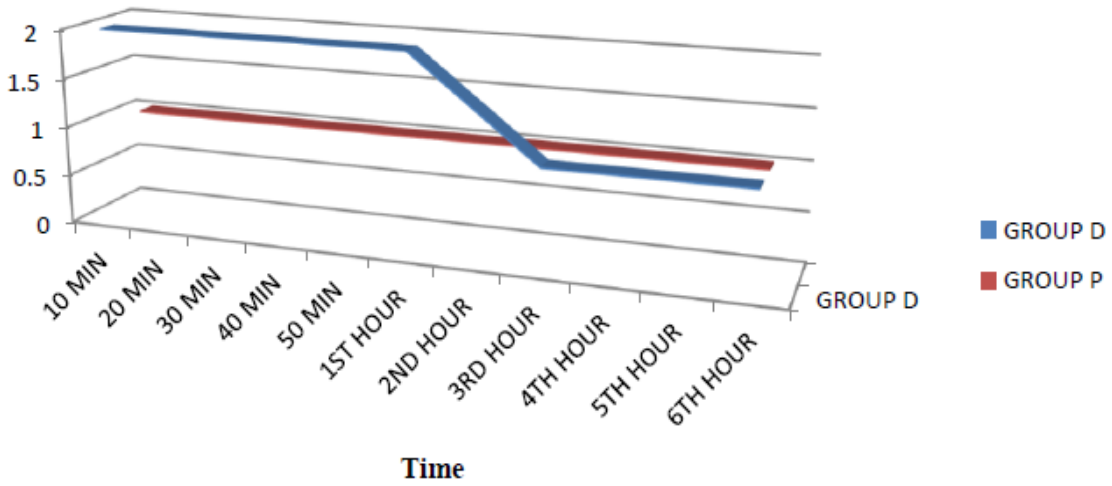

Figure 6: Trend of sedation scores in the two groups

The above diagram (Fig. 6) shows the median sedation scores during different time points in the two groups. Applying the Mann-Whitney test revealed a significant difference between the groups during the first 50 minutes.

Table 5: Incidence of different side-effects in the two groups

Side-Effects	Group	Incidence	P-Value
Bradycardia	D	2	0.4933
	P	0	
Dry Mouth	D	5	0.0543
	P	1	
Nausea Vomiting	D	3	1
	P	3	

The above table 5 depicts the incidence of different side-effects in the two groups. No significant differences were found between the groups after application of Fischer's Exact test.

Discussion

Dexmedetomidine is highly selective α2 adrenergic receptors agonist. It is approved to have sedative, analgesic, peri-operative sympatholytic, anaesthetic-sparing, and hemodynamic-stabilizing properties. It is highly lipophilic, the fact that may facilitate its rapid absorption into the cerebrospinal fluid and binding to the spinal cord α2 adrenoceptors. Activation of α2adrenergic receptors in the brain and spinal cord by dexmedetomidine decreases sympathetic tone and attenuates the neuroendocrine and hemodynamic responses to anaesthesia and surgery. Thus, dexmedetomidine can prevent unwanted effects of shivering provoked by hypothermia, such as increased catecholamine concentrations, oxygen consumption, blood pressure, and heart rates. [19]

The statistically non-significant differences of the demographic factors such as age, weight, gender distribution, ASA status, duration of anaesthesia and surgery in the present study has ruled out any visible or confounding bias which could have affected the results of the study. Potential risk99factors such as operating room temperature (22°C), temperature of the recovery room, and temperature of the infused fluids were very well controlled in the present study. In the current study, compared to patients receiving dexmedetomidine, placebo group experienced more incidence of shivering– 39.47% (15) versus 13.16% (5) (p= 0.0178, Fischer's Exact test). The patients in dexmedetomidine group suffered shivering of grade I and grade II and required no treatment. In contrast, patients in placebo group, out of 15 suffering from shivering, 11 patients belonged to grade III and IV. Thus, eleven patients in placebo group required tramadol injection (p=0.0004). Pethidine is considered the most effective anti-shivering drug in a dose of 25 mg.100 We however, preferred tramadol in a dose of 25 mg as rescue drug to control post-operative shivering as the latter is associated relatively less respiratory depression. [20] Tramadol exerts its anti-shivering mechanism by inhibiting the reuptake of 5HT, nor-epinephrine, and dopamine and at the same time facilitating the release of 5HT.

Similar results were found in the study conducted by Bicer and colleagues, 78where they reported 15% patients receiving dexmedetomidine developed shivering compared to 55% patients in placebo group. Coskuner et al. [21] also reported significant decrease in shivered patients in dexmedetomidine group. Usta et al. [16] reported the incidence of shivering as 20% in dexmedetomidine group as compared to 56% in the control group. Elvan and colleagues also reported similar results where 15% patients in dexmedetomidine and 46% patients in saline group developed shivering. [22]

In the present study, applying the Mann-Whitney test, no significant difference in nasopharyngeal temperature between the groups was detected. There was a dip in core temperature in both the groups following induction by propofol. Bajwa et al. [23] in their study on patients undergoing laparoscopic surgery under general anaesthesia found that the mean differences in both the groups were comparable. Karaman et al. [24] and Usta et al. [16] in their studies noticed similar findings, while Elvan [22] and his colleagues noticed lower core temperature in the dexmedetomidine group. Differences in the types of surgery and post-operative analgesia may be the source of discrepancy.

The present study showed that the haemodynamic parameters like heart rate, blood pressure were better controlled in patients receiving dexmedetomidine. The surge in these parameters was better controlled during laryngoscopy and intubation and at skin incision. The heart rate was 21% lower than the baseline in group D. The decrease in systolic arterial pressure was 10% while decrease in diastolic arterial pressure was 15%. The decrease in mean arterial pressure was 13.3%. It was observed that the patients in group D consumed lesser amount of anaesthetics to maintain

haemodynamic parameters in normal range as compared to patients in group P. The decrease in these parameters was less than 20% (except heart rate – 21%) and was within physiological limits. Taittonen et al. [25] showed that, after premedication with intra-muscular 2.5µ kg-1 dexmedetomidine, SAP and DAP decreased by 11% and HR decreased by 18%. Bekker et al. [26] reported that dexmedetomidine administered during neuroanaesthesia reduces the need for opioids, leads to fewer antihypertensive treatments, and provides better haemodynamic stability during incision.

Lawrence et al. [27] showed that dexmedetomidine given before the induction as a single dose of 2 µg kg-1 intra-venous, controls the hemodynamic responses to tracheal intubation and extubation as well as heart rate changes during the intraoperative period, in comparison to control treatment. Osman Ilhan et al. [28] in their study population undergoing supratentorial craniotomy observed a decrease of 13% in SAP, 9% in DAP, and 9% in HR after the bolus infusion of dexmedetomidine for 10 minutes. The patients in group D remained more sedated in the post-operative period. The sedation levels were significantly different during the first fifty minutes of the post-operative period (p <0.001; Mann-Whitney test).

Bozgeyik et al. [29] observed that the cases to which i.v. 0.5 µg/kg dexmedetomidine was injected, sedation could reach Ramsay three level and this level was significantly higher than that of other groups and this low sedation level may have removed anxiety in patients.

Usta et al. [16] noted statistically significant differences for sedation between groups, all patients in dexmedetomidine group and six patients in saline group were in levels 3-5 of sedation (p = 0.001). Karaman and his colleagues [24] observed that sedation scores were lower than 3 in all patients. However, sedation scores were significantly higher at all times in the dexmedetomidine group than in the placebo group (p < 0.05). In a placebo-controlled trial, Venn et al. [14] reported that dexmedetomidine decreased the need for rescue sedation and analgesia significantly for up to 24 h after the operation.

Bradycardia and hypotension are known complications of dexmedetomidine. In our study, 2 out of 38 patients (5.7%) were treated with atropine in group D. None of the patients were treated for hypotension in either group. The occurrence of dry mouth with α2 agonists is an established fact. 5 patients (13%) in patients receiving dexmedetomidine had to be administered 5ml of distilled water to alleviate their discomfort. Nausea and vomiting in the post-operative period had equal incidences in the two groups. All the side-effects were statistically non-significant when compared to placebo group.

Limitations of the study

Effect of dexmedetomidine at different doses was not assessed. Forced air warmers could have been used to prevent intra-operative hypothermia. Larger population would have been better for concluding the efficacy. The exact amount of anaesthetic consumption was not noted.

Conclusion

The study demonstrates that infusion of 0.7µg kg-1 hr-1 dexmedetomidine, started ten minutes before operation and continued throughout the intra-operative period, prevents post-operative shivering after craniotomy, with better control of intra-operative haemodynamics, lesser anaesthetic consumption and no significant side-effects. Patients were more co-operative, oriented and tranquil in the immediate post-operative period.

References

1. Witte J, Sessler DI. Perioperative shivering. Anesthesiology. 2002; 96(2): 467-84.
2. Feldman ME. Inadvertent hypothermia: a threat to homeostasis in the postanesthetic patient. J Post Anesth Nurs. 1988; 3: 82-87.
3. Sessler DI Temperature monitoring. In: Miller RD, Miller's Anesthesia 8th ed. Philadelphia: Elsevier Saunders, 2015: 1623-40.
4. Horn EP, Sessler DI, Standl T, et al. Non-thermoregulatory shivering in patients recovering from isoflurane or desflurane anesthesia. Anesthesiology. 1998; 89:878-86.
5. Macintyre et al. Effect of meperidine on oxygen consumption, carbon dioxide production, and repiratory gas exchange in postanesthesia shivering. Anesth Analg 1987; 66: 751-5.
6. Mathews S, Al Mulla a, Varghese PK, Ramdin K, Mumtaz S. Postanesthetic shivering – A new look at tramadol. Anesthesia. 2002: 57(387): 403.
7. Blackburn E. Prevention of hypothermia during anesthesia. Br J Theatre Nurs. 1994; 9: 12-14.
8. Arndt K. Inadvertent hypothermia in the OR. AORN J. 1999; 70: 204-214.
9. Poulos DA. Central processing of cutaneous temperature information. Fed Proc 1981; 40: 2825-9.
10. Buggy DJ. Crossley AWA. Thermoregulation, mild perioperative hypothermia and post anaesthetic shivering. British Journal of Anaesthesia 2000; 84(5):615-28.
11. Kranke P, Eberhart LH, Roewer N, Tramer MR. Pharmacological Treatment of Postoperative Shivering: A Quantitative Systematic Review of Randomised Controlled Trials. Anesth Analg 2002; 24: 453-60.

12. Carollo DS, Nossaman BD, Ramadhyani U. Dexmedetomidine: A review of clinical applications. Curr Opin Anaesthesiol 2008; 21: 457-61.
13. Hall JE, Uhrich TD, Barney JA, Arain SA, Ebert TJ. Sedative, amnestic, and analgesic properties of small-dose dexmedetomidine infusions. Anesth Analg 2000; 90: 699-705.
14. Venn RM, Bradshaw CJ, Spencer R, Brealey D, Caudwell E, Naughton C et.al. Preliminary UK experience of dexmedetomidine, a novel agent for postoperative sedation in the intensive care unit.Anaesthesia.1999; 54:1136-42.
15. Yildiz M, Tavlan A, Tuncer S, Reisli R, Yosunkaya A, Otelcioglu S. Effect of dexmedetomidine on haemodynamic responses to laryngoscopy and intubation: perioperative haemodynamics and anaesthetic requirements. Drugs R D 2006; 7: 43-52.
16. Usta B, Gozdemir M, Demircioglu RI, Muslu B, Sert H, Yaldiz A. Dexmedetomidine for the prevention of shivering during spinal anesthesia. Clinics (Sao Paulo). 2011; 66(7):1187-91.
17. Tsai YC, Chu KS. A comparison of tramadol, amitryptiline and meperidine for postepidural anesthetic shivering in parturients. Anesth Analg 2001; 93: 1288-92
18. Ramsay MA, Savege TM, Simpson BR, Goodwin R. Controlled sedation with alphaxalone-alphadolone. Br Med J. 1974; 2: 656-9
19. Naaz S, Ozair E. Dexmedetomidine in current anaesthesia practice- a review. J Clin Diagn Res. 2014 Oct; 8(10):GE01-4.
20. Saha E, Ray M, Mukherjee G. Effect of tramadol in prevention of postanaesthetic shivering following general anaesthesia for cholecystectomy. Indian J Anaesth 2005; 49:208-12.
21. Coskuner I1, Tekin M, Kati I, Yagmur C, Elcicek K. Effects of dexmedetomidine on the duration of anaesthesia and wakefulness in bupivacaine epidural block. Eur J Anaesthesiol. 2007; 24(6):535-40.
22. Elvan EG1, Oç B, Uzun S, Karabulut E, Coşkun F, Aypar U. Dexmedetomidine and postoperative shivering in patients undergoing elective abdominal hysterectomy. Eur J Anaesthesiol. 2008 May; 25(5):357-64.
23. Bajwa SJS, Gupta S, Kaur J, Singh A, Parmar SS. Reduction in the incidence of shivering with perioperative dexmedetomidine: a randomized prospective study. J Anesth Clin Pharma 2012; 28: 86-91.
24. Karaman S, Gunusen I, Ceylan MA, Karaman Y, Cetin EN, Derbent A, Ergenoglu AM. Dexmedetomidine infusion prevents postoperative shivering in patients undergoing gynecological laparoscopic surgery. Turk J Med Sci 2013; 43:232-37.
25. Taittonen M, Kirvelä OA, Aantaa R, Kanto JH. Effect of clonidine and dexmedetomidine premedication on perioperative oxygen consumption and haemodynamic state. Br. J. Anaesth 1997; 78(4): 400-6.
26. Ebert T J, Hall JE, Barney JA, Uhrich TD, Colinco MD. The effects of increasing plasma concentrations of dexmedetomidine in humans. Anesthesiology.2000; 93:382-94
27. Lawrence CJ, De Lange S. Effects of a single pre-operative dexmedetomidine dose on isofl urane requirements and peri-operative haemodynamic stability. Anaesthesia 1997; 52: 736-44.
28. Ilhan O, Koruk S, Serin G, Erkutlu I, Oner U. Dexmedetomidine in the supratentorial craniotomy. EAJM 2010; 42: 61-5
29. Bozgeyik S, Mizrak A, Kihc E, Yendi F, Ugur BK. The effects of pre-emptive tramadol and dexmedetomidine on shivering during arthroscopy. Saudi J Anaesth 2014; 8(2): 238-43.