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Original Article

Anaesthesia Section

Comparative Evaluation of Dexmedetomidine and Tramadol for Attenuation of Post-Spinal Anaesthesia Shivering

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ABSTRACT

Introduction: It is important that as anaesthesiologists we understand the adverse effects of hypothermia and shivering on human body which can occur when the patients are anaesthetized, and provide timely intervention. Various non-pharmacological and pharmacological methods have been studied to control intraoperative shivering with varying success. Tramadol and dexmedetomidine have been studied in literature with varying success but few studies have been reported from the Indian subcontinent.

Aim: To compare the effects of dexmedetomidine 0.5 µg/kg with tramadol 0.5 mg/kg for treating shivering developed intraoperatively after spinal anaesthesia for patients undergoing lower limb, lower abdominal surgeries, gynaecological procedures and caesarean sections.

Materials and Methods: This was a prospective, randomised, double blind comparative study carried out in the Department of Anaesthesiology of a tertiary care Rural Medical College and Hospital. All patients who fulfilled the inclusion criteria and developed post-spinal anaesthesia shivering during the intraoperative course were enrolled and randomised equally into either of the two groups. Group D (n=60) received inj. dexmedetomidine 0.5 µg/kg IV whereas Group T received inj. tramadol 0.5 mg/kg IV after development of post-spinal anaesthesia shivering. Response rate, haemodynamics, recurrence of shivering and complications were monitored. The data was statistically evaluated using STATA version 10 software.

Results: A 98.30% of patients shivering ceased after administration of dexmedetomidine, where as success rate was 86.67% in tramadol group. There was early response as well as less recurrence of shivering in dexmedetomidine group. Nausea and vomiting occurred significantly more in tramadol group. There was no significant haemodynamic instability in any group.

Conclusion: Dexmedetomidine when used at a dose of 0.5 µg/kg IV is more effective and rapid than tramadol used at a dose of 0.5 mg/kg IV to treat shivering as developed after spinal anaesthesia without any increased side effects as well as inducing a comfortable sedation for the patient.

Keywords: Haemodynamics, Lower abdominal surgery, Motor block, Peak sensory block

INTRODUCTION

Anaesthesia leads to thermoregulatory impairment and exposure to cold operating room environment makes patients who are undergoing surgical procedures hypothermic [1]. Normal thermoregulatory balance between heat generation and loss of heat is impaired by surgery and anaesthesia, particularly implicated agents are anaesthetic agents, opioids and sedatives which blunt the behavioural and autonomic responses [2].

Apart from ill effects of hypothermia, it has some advantages too as it protects against tissue ischemia. This effect has been utilised in clinical scenarios like cardiopulmonary bypass, post cardiac arrest care of the patients, carotid surgeries, liver surgeries, certain neurosurgeries. However, if we keep aside these specific clinical scenarios, there is good amount of clinical evidence that hypothermia causes multiple physiological derangements [3-5]. Some of them include coagulation abnormalities due to impaired platelet function, wound infection with delayed wound healing due to impaired immune-regulation [6-8]. Shivering is another response of body to hypothermia which has its own sets of complications. It is an involuntary, oscillatory muscular activity that can double or triple the O_2 consumption and CO_2 production [3].

Various non-pharmacological and pharmacological methods have been studied to control intraoperative shivering [3]. Some of the non-pharmacological methods taken to control shivering are covering bare parts of body with surgical drapes or blankets, airway heating and humidification, warming intravenous fluids and active cutaneous warming with insulator. Some of the drugs studied and used are meperidine, ketamine, midazolam, ondansetron, granisetron, tramadol, dexmedetomidine [1-3,9].

Various studies have found incidence of shivering to be 40-70% after regional anaesthesia [1,10]. Shivering was listed amongst top 10 clinical anaesthesia outcomes associated with routine outpatient surgery that anaesthesiologists believe occur frequently but at the same time many anaesthesiologists kept it at a low priority score when the question was as to which clinical outcomes needs to be avoided [11].

It is important that as anaesthesiologists we understand the adverse effects of hypothermia and shivering on human body and provide timely intervention. There have been few studies about comparison of dexmedetomidine and tramadol for treating intraoperative shivering in Indian setup. Furthermore many other studies comparing Dexmedetomidine and Tramadol have focused on preventing shivering [9,12]. Hence, in our study we wish to compare the effects of dexmedetomidine 0.5 µg/kg with tramadol 0.5 mg/kg for treating shivering developed intraoperatively after spinal anaesthesia for patients undergoing lower limb, lower abdominal surgeries, gynaecological procedures and caesarean sections.

MATERIALS AND METHODS

The study was started after obtaining approval from the Institutional

Ethical approval was obtained from Institutional Ethical Committee of Mahatma Gandhi Institute of Medical Sciences, Wardha.

This was a prospective, randomised, double blind comparative study, conducted from January 2015 to December 2016. A total of 120 patients, scheduled for elective lower limb, lower abdominal and gynaecological procedures as well as for caesarean sections who met the eligibility criteria were included in the study.

For a study power of 80%, with 95% confidence and to detect a response rate of 96% and 73% respectively in the two groups as determined in previous studies, the estimated number of participants in each group came to be 45 using OpenEpi version 3.01 open source calculator [13-15]. To account for any missing observation and further improvement in the power of the study we included additional 15 participants in each group thus taking the number of participants to 60 in each group.

Inclusion criteria (Patients with either Wrench grade 3 or grade 4 shivering):

1. American Society of Anaesthesiologists (ASA) physical status I/II patients.
2. Patients with haemodynamic HR >60/min, SBP >100 mmHg, after atleast 15 minutes of administering spinal anaesthesia.
3. Patients aged 18-65 years.
4. Patients scheduled for lower limb, lower abdominal and gynaecological procedures as well as caesarean section.
5. Patients with both male and female gender.
6. Patients willing to consent voluntarily for the study.

Exclusion criteria:

1. Patients with known hypersensitivity to dexmedetomidine or tramadol.
2. Patients with cardio-pulmonary disease.
3. Patients with renal or hepatic disease.
4. Patients with thyroid disorder.
5. Patients with psychiatric disorder
6. Patients with uncontrolled diabetes mellitus or hypertension.
7. Patients with peripheral neuropathy or any neurological deficit.
8. Haemodynamically unstable patients.
9. Patients with history of substance or alcohol abuse.
10. Patients not willing to consent for this study.

After obtaining PAC fitness, detail discussion in person was done with patient and family regarding the anaesthesia technique, drugs being used and their side effects and its management and all their queries were solved. They were informed that if the patient develops shivering during the anaesthesia and surgical procedure, patient will be given one of the study drugs and the selection of study drug were done according to computer generated tables. They were informed in detail about the probable side effects of the drugs and assured that the safety of the drugs has been proven in various previous studies. They were assured that if they do not participate in this study, then it will not affect their treatment anyways. Patient and family was given enough time to ask questions. After knowing all the facts, written informed consent form was signed by patients before surgery.

All patients who fulfilled the inclusion criteria and developed post-spinal anaesthesia shivering during the intraoperative course were enrolled and randomized using computer generated tables with allocation ratio of 1:1 into either of the two groups. Group D (n=60) was administered dexmedetomidine intravenous (I.V.) and Group T (n=60) was given tramadol I.V. as per randomisation by the computer generated table. Group D was administered dexmedetomidine 0.5 µg/kg IV after development of post-spinal anaesthesia shivering. Group T was administered tramadol 0.5 mg/kg IV after development of post-spinal anaesthesia shivering. Dosages of both the drugs were calculated after going through previous studies on same drugs as explained in the discussion. Both these groups were monitored for time of onset of shivering, response to shivering, time taken for cessation of shivering, and recurrence of shivering. Also, haemodynamic profile of both the respective groups was monitored along with monitoring of spinal anaesthesia dermatome level.

Shivering was graded using a four point scale as per Wrench IJ et al., Grade 0 (no shivering) to Grade 4 (gross muscle activity involving the whole body) [16]. The time in minutes at which shivering started after spinal anaesthesia (onset of shivering), severity of shivering, time to disappearance of shivering and response rate (shivering ceasing within 15 minute after treatment) was recorded. Duration of surgery was recorded. Also the peak effect was recorded 30 minutes after spinal anaesthesia. Motor block was assessed using Modified Bromage scale and peak sensory block was assessed using pin-prick method at the end of 30 minutes [17]. In case of recurrence of shivering, patients were treated with warm forced air blankets along with an additional dose of dexmedetomidine 0.5 µg/kg I.V. or tramadol 0.5 mg/kg I.V. in the respective groups. Adverse effects such as nausea, vomiting, pruritus, bradycardia (<50/minutes), bradycardia requiring inj. Atropine, arterial oxygen saturation and sedation score were noted.

RESULTS

Demographically both the groups were comparable to each other in respect of age groups, sex ratio, Body Mass Index (BMI), maximum level of sensory and motor block achieved as well as onset of action, duration of surgery, onset of shivering times.

Motor block was assessed using Modified Bromage scale in both the groups. At the end of 30 minutes, it was Grade 2 in 42(70%) and 30 (50%) patients in Groups D and T respectively while grade 3 was found in 18 30% and 27 (45%) patients in Groups D and T respectively. Sensory block at the end of 30 minutes was compared using pin-prick method. It was T4 sensory level in 1(1.67%) and 0 (0%), T6 sensory level in 18(30%) and 20(33.33%), T8 sensory level in 26(43.33%) and 21(35%) and T10 sensory level in 15(25%) and 19(31.67%) in groups D and T respectively.

The onset of shivering time was comparable in both the groups. It was 20.38±4.32 minutes and 20±4.43 minutes in groups D and T respectively.

Response to shivering was taken as cessation of shivering within 15 minutes by administration of drug. Shivering stopped in 59(98.33%) and 52 (86.67%) patients in groups D and T respectively (p-value<0.05). The mean time to cessation of shivering was 2.95±1.18 minutes and 7.15±1.77 minutes respectively in Groups D and T (p-value<0.05). Recurrence of shivering was found in 3(5%) and 5(8.33%) patients respectively in groups D and T.

Nausea and vomiting was found in 15(25%) and 8(13.33%) patients in group T, difference being statistically significant (p-value <0.05). Hypotension, bradycardia, bradycardia requiring inj. atropine were comparable in both the groups [Table/Fig-1]. Sedation profile of both the drugs was compared using Filos sedation scale, difference between the two drugs being statistically significant (p<0.01), [Table/Fig-2] [18].

Symptoms	Group D	Group T	p-value
Nausea	0(0%)	15(25%)	<0.001,S
Vomiting	0(0%)	8(13.33%)	0.006,S
Pruritus	0(0%)	0(0%)	-
Hypotension	3(5%)	0(0%)	0.24,NS
Bradycardia	3(5%)	0(0%)	0.24,NS
Bradycardia requiring Inj.atropine	1(1.67%)	0(0%)	1.00,NS
O_2 desaturation	0(0%)	0(0%)	-

[Table/Fig-1]: Comparison of side effects between two groups.
S- statistically significant; NS- statistically insignificant

Sedation Score	Group D	Group T	p-value
1	13 (21.67%)	46 (76.67%)	<0.001, S
2	47 (78.30%)	14 (23.33%)	
3	0 (0%)	0 (0%)	
4	0 (0%)	0 (0%)	
Total	60 (100.0%)	60 (100.0%)	

[Table/Fig-2]: Comparison of sedation score between two Groups (Filos sedation score)
S- statistically significant

DISCUSSION

The mechanism of shivering under regional anaesthesia is not fully understood and it is still a topic of interest among researchers, but its adverse effects are known and methods are being continuously evaluated to decrease these adverse effects. In our study, operating room temperature was maintained at 22±2ºC, intravenous fluids and drugs were administered at room temperature and also, patients were covered with standard sterile drapes for complete body surface except for face and operating site which is a routine standard protocol at our institute. In the present study, we found that dexmedetomidine took lesser time to control shivering with fewer side effects like nausea, vomiting.

John M et al., reported that a plan to prevent hypothermia and shivering in the peri-operative period should involve multiple modalities rather than a single one [19]. They also highlighted the importance of covering drapes, clothing, fluid warming and keeping the ambient room temperatures to 21ºC.

Amongst many agents, dexmedetomidine [14,20] and Tramadol [21,22] both have been evaluated in various studies for the prevention and treatment of shivering and they have proven safety profile and efficacy. But there are only few studies in this context directly comparing efficacy of dexmedetomidine versus tramadol in treatment of shivering [9]. Furthermore, this study again had a sample size of 25 cases in each group where as we had calculated our sample size to be 60 for each group [9]. That is why we decided to compare efficacy of dexmedetomidine versus tramadol in treatment of shivering.

Dexmedetomidine and tramadol both have been used in different dosages for prevention and treatment of shivering. Abdel Ghaffar HS et al., compared the efficacy of dexmedetomidine in 3 different doses 0.5 µg/kg, 0.3 µg/kg and 0.2 µg/kg for the treatment of shivering in patients undergoing spinal anaesthesia for elective lower abdominal surgery [14]. They found that dexmedetomidine 0.2 µg/kg was associated with higher cessation time and lower response rates than the dexmedetomidine 0.3 µg/kg and dexmedetomidine 0.5 µg/kg. Also, recurrence of shivering was higher when dexmedetomidine 0.2 µg/kg was used.

Mohta M et al., compared the efficacy of tramadol in three different doses of 1, 2 and 3 mg/kg and reported that tramadol 3 mg/kg had good analgesic and anti-shivering effects but was associated with greater sedation than the other two doses [23]. Side effects like nausea and vomiting were found more in the tramadol 3 mg/kg group. Therefore, in the present study, we have used dexmedetomidine (0.5 µg/kg) and tramadol (0.5 mg/kg) in treatment of post-spinal anaesthesia shivering.

Demographically in the present study, both the groups were comparable to each other in respect of age groups, sex ratio, BMI, maximum level of sensory and motor block achieved along with their onset of action, duration of surgery, and onset of shivering times.

Dexmedetomidine was more effective in cessation of shivering in terms of a higher responsive rate i.e., (98.33% v/s 86.67%) as well as early cessation of shivering i.e., (2.95±1.18 minutes v/s 7.15±1.77 minutes) which was statistically significant. Mittal G et al., Abdel Ghaffar HS et al., found similar response rates for dexmedetomidine [9,14]. Bansal P and Jain G, Chan AM et al., found a similar range of tramadol response ranging from around 70-80% [13,22].

Recurrence rates with dexmedetomidine have been reported in range of 0-10% (Mittal G et al., Abdel Ghaffar HS et al., BlaineEasley R et al.,) [9,14,24], while with tramadol in range of 0-9% (Bansal P and Jain G, Shukla U et al.,) [13,25]. In the present study, we found 5.08% recurrence of shivering with dexmedetomidine 0.5 µg/kg and 9.66% with tramadol 0.5 mg/kg. Thus, recurrence rates with dexmedetomidine and tramadol were comparable and there was no significant difference.

Dexmedetomidine 0.5 µg/kg also caused a level of sedation without any respiratory depression or oxygen desaturation. The Grade 2 filos sedation which was seen in 78.30% of patients in dexmedetomidine group was more than 23.33% of patients with tramadol group and provided additional comfort to the patient without any unwanted side effects similar to study (Mittal G et al., Bozgeyik S et al.,) [9,26].

Tramadol caused increased nausea and vomiting (25% and 13.33% respectively) as compared to dexmedetomidine 0.5 µg/kg similar to study done by Mittal G et al., Shukla U et al., [9,25]. Myles PS et al., have reported a strong correlation between postoperative nausea, vomiting and patient dissatisfaction after surgery and anaesthesia [27].

Though dexmedetomidine 0.5 µg/kg caused a statistically non-significant increase in hypotension and bradycardia, it did not cause any clinically significant harm to the patients in the present study group. No other significant side effects were seen in both the study groups.

LIMITATION

It was a single centre study and we studied patients only undergoing spinal anaesthesia for a surgical procedure of short duration (mean time). Dexmedetomidine is a costly drug and present study was not intended to have a cost effective analysis.

Despite these limitations we believe that dexmedetomidine is an effective drug when used to control shivering developed intraoperatively for patients undergoing lower limb, lower abdominal, gynaecological procedures and caesarean sections under spinal anaesthesia.

CONCLUSION

Dexmedetomidine when used at a dose of 0.5 µg/kg IV is more effective and rapid than tramadol used at a dose of 0.5 mg/kg IV to treat shivering as developed after spinal anaesthesia without any increased side effects as well as inducing a comfortable sedation for the patient. Tramadol though effective to treat shivering in post spinal anaesthesia cases has a low efficacy as compared to dexmedetomidine as well as causes an increase in unwanted nausea and vomiting.

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