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Original Research Article

Post spinal anaesthesia shivering- incidence and associated risk factors in patients undergoing lower limb and abdominal surgeries

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ABSTRACT

Background: This study was conducted to evaluate the incidence of shivering and likely associated risk factors following spinal anaesthesia in patients undergoing lower abdominal and lower limb surgeries.
Methods: The present study was conducted in MMIMSR, Department of anaesthesia from December 2016 to September 2018. It was an observational study which was conducted over a period of 2 years. Patients who were scheduled to undergo elective lower abdominal and lower limb surgeries under spinal anaesthesia were included in study.
Results: The present study depicts a high incidence of post spinal shivering, which was 42.8%. Majority of the patients belonged to the young age group between 20-30 years. The mean time of onset of shivering, was around 25 mins. Duration of shivering was observed between 15-75 minutess with a mean of 43.75 and SD±19.39.
Conclusions: Shivering is one of the distressing complications of spinal block, which may be deleterious to the patients with poor cardio-respiratory reserve.

Keywords: Hypothermia, Postspinal anaesthesia, Shivering

INTRODUCTION

Regional anaesthesia is the most preferred and versatile technique for lower abdominal and lower limb surgical procedure.[1] Spinal anaesthesia allows the patient to remain awake and minimizes or completely avoid the problems associated with airway management. However, the technique is not devoid of limitations. They are limited duration of anaesthesia, missed segments, patchy block, inadequate muscle relaxation etc.

Shivering is one of the complications of spinal anaesthesia, which is highly distressing for the patient undergoing surgery under both regional and general anaesthesia. Incidence of shivering is upto 40-70% in spinal anaesthesia.[2,3] Shivering is a physiological response to increase the metabolic heat production in the face of hypothermia.[2] Although it is not a life-threatening event but could make the patient uncomfortable and may also affect with the monitoring of heart rate (HR), blood

pressure (BP), oxygen saturation (SpO_2) and electrocardiogram (ECG).[4]

The main causes for perioperative shivering after subarachnoid blockade are decreased sympathetic tone below the blocked level, heat loss, pain (inadequate analgesia) and systemic pyrogens release, effect of local anaesthetic temperature directly on thermosensitive neurons present in the spinal cord.[5-10] Neuraxial anaesthesia produces vasodilatation, which hasten redistribution of heat from center to peripheral part, decreases the shivering threshold and also increases sweating threshold.[3,11,12] Regional anaesthesia causes fall in this threshold by 0.5 degree Celsius (°C), which causes constriction of vessels and shivering above the level of block.[11,13,14]

Range of normal core temperature is 36.1-37.2°C. Core temperature less than 36°C is termed as hypothermia.[15]

Hypothermia commonly occurs during spinal blockade, which could be a cause of shivering.[16] Three causes for hypothermia following intrathecal block are: 1) Inner redistribution of heat from center to periphery.[12] 2) Increased loss of heat from body surfaces which is due to loss of thermoregulatory vasoconstriction below the level of spinal block. 3) Altered regulation in temperature under subarachnoid block which is marked by a 0.5°C decline in shivering thresholds and vasoconstriction.[11]

Shivering increases loss of cardiac and systemic energy oxygen (O_2) consumption by 200-500%, causing acid base disturbances, may decrease mixed venous saturation, increases production of carbon dioxide (CO_2) and rate of metabolism by 600%.[17-19] It also raises intracranial (ICP) and intraocular pressure (IOP), increase wound pain and delay in healing of wound and discharge from postoperative care unit.[20,21]

The autonomic nervous system in homeothermic mammals is responsible to maintain normothermia.[22-24]

Risk factors implicated with shivering comprises of: Duration and type of anaesthesia.[4,19,25] Duration of operative procedure.[4,19,25] Height (ht.) of sensory blockade.[2] Age and gender of the patient.[4.15,19,25] Temperature of the infused fluids and the operating room.[2,15,25] Core temperature.[26]

Longer the duration of surgery, more the fall in core temperature. One of the possible reasons could be longer duration of surgery which are more invasive and complex, release of pyrogenic substances due to trauma to the tissue, which raises the thermoregulatory system set point and thus causes post anaesthesia shivering (PAS).[26]

The other possibilities are an increase in concentration of interleukin-6 which are more often seen after long and more invasive surgeries in comparison to short ones and more heat loss due to evaporation from exposed sites and prolonged exposure to cold environments, more amount of intravenous (i.v.) fluids.[2,21,27]

Intraoperative and post operative management of shivering comprises of pharmacological and non-pharmacological methods. Pharmacological measures comprise of opoids, 5-hydroxytryptamine receptor (5HT3) antagonists, N-methyl D-aspartate (NMDA) receptor blocker, cholinomimetics and biogenic amines. Non-pharmacological methods being warming blankets, warm IV and irrigating fluids, use of forced air warming etc.[6,28-30]

The ill effects of shivering may further worsen the situation and hence deserves prevention and adequate control. Hence, the present study aimed to analyse the incidence of shivering and evaluate likely associated risk factors for shivering under spinal anaesthesia.

METHODS

Study approach

After obtaining approval from the Ethical Committee of Institution, the present study was conducted in MMIMSR, Department of Anaesthesia from December 2016 to September 2018. It was an observational study which was conducted over a period of 2 years. Patients who were scheduled to undergo elective lower abdominal and lower limb surgeries under spinal anaesthesia were included in study.

Study design

The study was a prospective, observational study conducted in a tertiary care institution.

Study population

The study was conducted on subsequent 140 patients who were posted for lower abdomen and lower limb operative procedures under spinal block. Out of these patients, who experience shivering, were included in the study for analysis of incidence and likely associated risk factors.

Inclusion criteria

ASA group I and II, age group 20-60 years, both sexes, patient posted for abdomen and lower limb surgeries were included.

Exclusion criteria

ASA grade III, IV and emergency nature of surgery, disease and deformity of spine, known sensitivity to drugs, pre-existing neurological disorders with increased intracranial pressure, any sign of infection at puncture site, coagulation disorders, a core temperature more than 37.5˚Celsus or less than 36.5˚Celsus were excluded.

Methods used

Intravenous line was secured with 18G cannula and patient was trolleyed to the operation theatre. Patients were connected to the multipara monitor which includes pulse oximeter (SpO_2), non- invasive blood pressure (NIBP) monitor, pulse rate (PR), ECG and core temperature.

The temperature of the operating room was maintained at 22-28˚C.

Standard warming method of blanket were used. All the patients were well covered with one layer of surgical drape over the chest, thighs and calves intraoperatively and then one cotton blanket over the entire body post operatively. A core temperature less than the 36˚C was considered hypothermia. Then each patient received 10 ml/kg/hr of Ringer Lactate solution, after that the infusion rate was reduced to 6 ml/kg/hr.

Under all aseptic precautions, subarachnoid block was given with three ml of 0.5% bupivacaine with 25 Gauge Quinckes needle in the sitting position at the level of L_3-L_4 or L_4-L_5 using midline approach.

During the intraoperative period, heart rate (HR), NIBP, SpO_2 were monitored. Temperature was recorded every 15 minutes throughout the surgery upto 2 hours (intraoperative or postoperative period) by introducing the temperature probe into the nasopharynx.

A core temperature below 36˚C is considered hypothermia. After giving spinal anaesthesia, the patient was observed for the occurrence of shivering and its onset time in the intra-operative and post-operative period upto two hours. In the postoperative period patient will be shifted to the recovery room where the recovery room temperature will be maintained at 22-28˚C.

Parameters observed

Time of onset of sensory block, height of sensory blockade, time of onset of shivering, grade of shivering by shivering score, record of core temperature, HR, SBP, MAP, DBP and SpO_2

For grade 1 and 2, non pharmacological treatment was given and if the grade of shivering was more than two, pharmacological treatment was administered according to the institutional protocol in the form of either intravenous dexamethasone 0.1 mg/kg or intravenous tramadol 0.5 mg/kg.

Grades of shivering by Tsai and Chu included 0- no shivering, 1- piloerection with no visible shivering, 2- muscular activity observed in 1 muscle group, 3-muscular activity in more than 1 muscle group, 4- shivering which is generalised involving the whole body.

RESULTS

The data was entered in excel sheet and then analysed using statistical software SPBS 21 version.

Qualitative variables were expressed as percentages and quantitative variable expressed as mean and standard deviation. Association among variables for parameteric data was established by using one way analysis of variance and for non-parametric data, chi-square test used. A p value <0.05 was considered significant at 95% confidence interval.

Table 1: Percentage distribution of overall incidence of shivering.

	No. of patients	Percentage
Total	140	100
Shivering	60	42.8
No shivering	80	57.2

As evident from Table 1, the overall incidence of shivering after spinal anaesthesia was 42.8% and there was no shivering in 57.2% of patients.

Table 2: Percentage distribution of patients according to age.

Age group (years)	No. of patients	Percentage
20-30	23	38.3
31-40	13	21.7
41-50	9	15.0
51-60	15	25.0
Total	60	100.0

Table 2 depicts incidence of shivering (%) following intrathecal block according to age groupwise distribution of patients. There were 23 (38.3%) patients in the age group between 20-30 years, 13 (21.7%) patients between 31-40 years, 9 (15%) patients between 41-50 years, and 15 (25%) patients between 51-60 years.

Table 3 shows that the mean age was 39.53 and SD±12.78.

Table 3: Mean distribution of the patients according to age.

Age (years)	N	Minimum	Maximum	Mean±SD
	60	20	59	39.53±12.78

Table 4: Percentage distribution of patients according to gender.

Sex	No. of patients	Percentage
F (female)	32	53.3
M (male)	28	46.7
Total	60	100.0

Table 5: Percentage distribution of patients according to ASA grade.

ASA	No. of patients	Percentage
I	25	41.7
II	35	58.3
Total	60	100.0

Table 4 depicts, number of female patients who experienced shivering were 32 (53.3%) and male patients were 28 (46.7%).

As evident from Table 5, out of 60 patients, ASA-I patients were 25 (41.7%) and ASA-II patient were 35 (58.3%).

Table 6: Percentage distribution of patients according to surgery.

Diagnosis	No. of patients	Percentage
Obstetrics and gynaecology	25	41.7
Urology	13	21.7
Orthopaedics	13	21.7
Surgery	9	15
Total	60	100.0

As evident from Table 6, number of patients who experienced post spinal shivering were 25 (41.7%) in obstetrics and gynaecology, 13 (21.7%) in urology, 13 (21.7%) in orthopaedics and 9 (15%) in surgery.

Table 7: Mean duration of surgery (minutes).

Duration of surgery	N	Minimum	Maximum	Mean±SD
	60	50	105	77.75±20.63

As evident from Table 7, duration of surgery was between 50-105 minutes with a mean of 77.75 and SD±20.63.

Table 8: Percentage distribution of patients according to onset of sensory block.

Onset of sensory block (minutes)	No. of patients	Percentage
2	13	21.7
3	33	55.0
4	14	23.3
Total	60	100.0

As evident from Table 8, patients who developed onset of sensory block at two mins were 13 (21.7%), at three mins were 33 (55.0%) and 14 (23.3%) at four minutes.

As evident from Table 9, onset of sensory block was in between 2-4 minutes with a mean of 3.02 and SD ±0.68.

Table 9: Mean onset of sensory block (minutes).

Onset of sensory block	N	Minimum	Maximum	Mean±SD
	60	2	4	3.02±0.68

Table 10: Percentage distribution of patients with hypothermia and normothermia.

	No. of patients	Percentage
Hypothermia	47	78.3
Normothermia	13	21.7
Total	60	100.0

As evident from Table 10, out of 60 patients who developed shivering, hypothermia was present in 47 (78.3%) and normothermia in 13 (21.7%).

All patients (60) had hypothermia from 30 mins-60 minutes after spinal blockade. Thirty-six patients (60%) persisted to have hypothermia till 75 minutes (depending upon the length of operative procedure).

DISCUSSION

The overall incidence of shivering was observed to vary from 40-70% in various studies, overall incidence of shivering after spinal anaesthesia in the present study was also 42.8%. In study done by Crowley et al in 2008 the overall incidence of postspinal shivering was found to be 55%.[31] In 2015 the study done by Yimer et al, the overall incidence of postspinal shivering was found to be 53.8%, in the study done by Safavi et al and in the study of Onyekwulu et al, it was found to be 43.3% and 42.2% respectively, and in 2016 study designed by Kishore et al showed the incidence of shivering of 49.52%.[32-35] Thus the incidence of post spinal anaesthesia shivering in the present study was in accordance with all these studies.

The mean onset of shivering in the present study was 25 minutes while 20 minutes in the study designed by Luggya et al, 14 minutes in the study performed by Kishore et al and 20 minutes by the study of Mittal et al.[35-37] Therefore, present study data was in accordance with the study done by Luggya et al, Mittal G et al and Kishore et al.[35-37]

Maximum number of patients had grade 2 shivering in the present study and in other studies.

The grade of shivering was statistically significant from 15-90 minutes of time interval ($p<0.05$), also distribution of patients according to mean grade of shivering in hypothermic and normothermic patients was statistically significant between 30-60 minutes time interval ($p<0.05$), as shown in Table 17.

A statistically significant correlation between duration of surgical procedure and core temperature at different time

interval as p value <0.05 except at 105 minutes in the present study which was in accordance with the study designed by Kiekkas et al and not in accordance with the study designed by Frank et al and Eberhart et al.[38-40]

A statistically significant correlation between core temperature and shivering (p<0.05) except at 105 minutes.

In the study by Kiekkas et al, concluded a significant correlation between hypothermia and shivering (p=0.01).[38]

CONCLUSION

Shivering is one of the distressing complications of spinal block, which may be deleterious to the patients with poor cardio-respiratory reserve. Besides monitoring haemodynamic parameters, core temperature monitoring should be inculcated in day-to-day practice to avoid hypothermia. Majority of the associated risk factors are preventable. Active warming measures should be instituted for a better patient outcome.

The present study depicted a high incidence of post spinal shivering, which was 42.8%. Majority of the patients belonged to the young age group between 20-30 years. The mean time of onset of shivering, was around 25 mins. Duration of shivering was observed between 15 mins-75 minutes with a mean of 43.75 and SD ±19.39. The incidence was more in obstetrics and gynaecology, urological and orthopaedic procedures. Grade of shivering was significant between 15 to 90 minutes of time interval.

Statistically significant likely risk factors were, hypothermia and duration of surgery. Although patients with higher level of spinal blockade had high incidence of shivering, similar to other studies, statistical significance could not be attributed as p>0.05.

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