

# A Randomized Double Blind Comparative Study of Intrathecal Dexmedetomidine and Magnesium Sulfate for Post-spinal Anesthesia Shivering in Lower Segment Cesarean Section

Original  
Article

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## ABSTRACT

**Background:** Shivering is one of the most common problems in parturients receiving regional anesthesia during Lower segment cesarean section (LSCS). It usually interferes with the readings of the oxygen saturation and electrocardiogram. The aim of this study was to evaluate and compare the effects of intrathecal dexmedetomidine versus intrathecal Magnesium Sulfate (MgSO<sub>4</sub>) with hyperbaric bupivacaine for the prevention of post-spinal anesthesia shivering in LSCS patients.

**Results:** This prospective study included 150 patients and were randomized into 3 equal groups (n = 50); Group BN patients received with 0.5 % of heavy bupivacaine 2.0 ml (10 mg) with NS (0.5 ml), Group BD patients received dexmedetomidine (5 mcg) with 0.5 % of heavy bupivacaine 2.0 ml (10 mg) and Group BM patients received MgSO<sub>4</sub> (25 mg) with 0.5 % of heavy bupivacaine 2.0 ml (10 mg). The primary outcomes were the incidence and intensity of shivering. The secondary outcomes were the haemodynamic, rescue drug requirement, adverse effects. The Parturients of control group had more incidence and intensity of shivering than dexmedetomidine and MgSO<sub>4</sub> group, 18 (36.0 %), 6 (12.0 %) and 8 patients (16.0 %) respectively. Nonsignificant difference of incidence of shivering was observed when dexmedetomidine group was compared with MgSO<sub>4</sub> group. The rescue drug requirement was significantly lower in dexmedetomidine and MgSO<sub>4</sub> group compared to control group.

**Conclusion:** Hence both, dexmedetomidine and MgSO<sub>4</sub> intrathecally are hemodynamically stable and significantly decreased the incidence and intensity of shivering and rescue drug requirement with nonsignificant adverse effects in LSCS patients undergoing spinal anesthesia.

**Key Words:** Dexmedetomidine, MgSO<sub>4</sub>, Parturient, Shivering, Spinal anesthesia.

**Received:** 28 November 2023, **Accepted:** 22 January 2024

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**ISSN:** 2090-925X, 2024, Vol.16, No. 1

## BACKGROUND

In obstetrical populations, neuraxial anesthesia is associated with shivering in approximately 53.0 % of patients (Crowley *et al.*, 2008). There are various causative factors of shivering such as pain, decreased sympathetic activity, uncontrolled spinal reflux, release of pyrogen and cytokines following surgery but thermoregulation disorders caused by hypothermia (0.5 - 1°C decrease in central heating) has been accepted as the most common factor (Ghasemi M *et al.*, 2018). It usually interfere with the readings of the oxygen saturation (SpO<sub>2</sub>), electrocardiogram (ECG). Increase oxygen consumption, production of carbon dioxide about four folds, the intensity of the pain arising from the wound, can delay the healing of the wound and can also increase the length of stay in the post anesthesia care unit (PACU) (Nasseri K *et al.*, 2017). It is distressing to both patients and anesthesiologists

and Severe adverse effects may occur if the patient has cardiopulmonary insufficiency (Miao *et al.*, 2018).

Dexmedetomidine is an  $\alpha_2$ -adrenergic agonist, decreases sympathetic tone (Moawad *et al.*, 2015). It decreases the incidence of shivering through increasing vasodilatation and inhibition of central thermoregulation (Zhang *et al.*, 2017). Magnesium sulfate (MgSO<sub>4</sub>) is an inorganic salt, it suppresses postoperative shivering by reducing the shivering threshold (Wadhwa *et al.*, 2005). It has a good safety profile, as no significant changes have been seen in hemodynamic parameters regarding its intrathecal use (Nath *et al.*, 2012). The aim of the study was to evaluate and compare both the study drugs with bupivacaine in terms of decreasing the incidence and intensity of shivering in LSCS with Primary Objective: Incidence and Intensity of shivering, Secondary Objectives: Hemodynamic parameters, rescue drug requirement and adverse effects due to study drugs.

## METHODS

After institutional ethical committee approval [RNT/Stat./IEC/2021/472, Dated 4/8/2021] and written informed consent from patients, the present study was carried out in the department of Anaesthesiology, at Panna Dhai Zanana Hospital associated to our Institute, on the parturient posted for lower segment caesarean section under spinal anesthesia for the period of one year [Oct. 2021 to Sept. 2022]. A total 150 patients were enrolled. Inclusion Criteria: Age 18 to 45 year, Scheduled for elective LSCS under Spinal Anesthesia, Gestation  $\geq$  36 weeks. Exclusion Criteria: Patient refusal, Patient with coagulopathies or anticoagulant medication, Any systemic disease, Severe pre-eclampsia, eclampsia, placenta previa, antepartum haemorrhage (APH), Psychiatric patient and history of allergic reaction to study drugs.

Group allocation: Study was conducted in a randomized double blinded fashion. They randomly allocated into three equal groups of 50 patients in each group using chit method. Group BN (n = 50): 0.5 % of Bupivacaine Heavy 2.0 ml (10 mg) + NS (0.5 ml), Group BD (n = 50): 0.5 % of Bupivacaine Heavy 2.0 ml (10 mg) + Dexmedetomidine 5 mcg in NS (0.5 ml), Group BM (n = 50): 0.5 % Bupivacaine heavy 2.0 ml (10 mg) + MgSO<sub>4</sub> 25 mg in NS (0.5 ml).

**Blinding:** The anesthesiologist, who was not involved in care of patients, had prepared the drug solution based on the instructions from the principal investigator (anesthesiologist). The patients and the anesthesiologist involved in the anesthetic technique and data recording were unaware of the group allocation.

**Technique:** All patients visited on the day prior to surgery and explained about the anesthetic technique and perioperative course. Pre anesthetic check-up and all routine investigations obtained. Patients kept fasting for 8 hrs before surgery. All patients received tablet alprazolam 0.25 mg at night before surgery and capsule omeprazole 20 mg at 6 am on the day of surgery with sip of water. In operation theatre (OT), preloading with Ringer lactate 10 ml/kg preheated at 37 °C had done after securing 20 G peripheral I.V. cannula. Standard monitorings were applied and baseline vital parameters were recorded. Subarachnoid anesthesia was administered with study drug according to the group at L3 - 4 or L4 - 5 interspace using 25 G Quincke's spinal needle under all aseptic conditions. OT was maintained at an ambient temperature of around 24-25°C. Supplemental oxygen was administered at 5 L/min via face mask. Vital parameters (HR, SBP, DBP and SPO<sub>2</sub>) and temperature were recorded at intervals of every 5 min for first 30 min and every 15 min till the end of surgery and up to 90 min postoperatively. During surgery, the shivering scale was recorded at every 5 min for first 30 min and every 15 min till the end of surgery and up to 90 min postoperatively using Shivering Assessment Score (Badjatia *et al.*, 2012); 0 = None, 1 = Mild Shivering

localized to the neck and thorax only, 2 = Moderate Shivering (gross movements of the upper extremities), 3 = Severe Shivering involving gross movements of the trunk, upper and lower extremities. Degree of sedation was recorded on a 5-point scale (Park *et al.*, 2012); 1 = Awake and oriented, 2 = Drowsy, 3 = Arousable to command, 4 = Arousable to mild physical stimulation, 5 = Unarousable to mild physical stimulation. Inj. Tramadol 25 mg I.V. was administered as a rescue drug if the patients were exhibit shivering any time during the study. Number of patients who required rescue drug were recorded. Any side-effects (hypotension, bradycardia, nausea and vomiting) were recorded. Hypotension (decrease in mean blood pressure (MBP) of  $>$  20.0 % of baseline) was treated with i.v incremental bolus dose of inj. Mephentermine 6 mg and a further i.v. infusion of Ringer lactate. Bradycardia was defined as HR  $<$  60 per min, then inj. atropine 0.4 mg was given to treat bradycardia. Degree of sedation was also recorded. Patients were shifted to PACU postoperatively, monitoring applied and PACU temperature was maintained at 24 - 25°C.

Sample size and Statistical analysis: On the basis of previous study (Omar *et al.*, 2019) using Epi-info Version 3 considering confidence interval of 95.0 %, a power of 0.8 and error of 5.0 % with mean difference in time of need of meperidine between MgSO<sub>4</sub> and dexmedetomidine was 7.5. Sample size was calculated as 49, so total cases were 150 for three groups after rounding off. Data was entered in MS EXCEL and analysed using Statistical Package for Social Sciences (SPSS) version 20. Categorical data (qualitative) was presented as number (proportion) and compared using chi-square test. Continuous variable (quantitative) was presented as Mean $\pm$ S.D., analysed and compared using ANOVA test. *P*-value  $<$  0.05 was considered statistically significant.

## RESULTS

The result was statistically nonsignificant regarding their demographic profile including age, weight and ASA grading (Table 1). Table 2 shows that, shivering in control group was significantly greater (36.0 %) in proportion as compared to dexmedetomidine and magnesium sulfate group (12.0 % and 16.0 % respectively). Grade 3 shivering developed in 5 patients in control group and 1 in BM group and no patient developed grade 3 shivering in BD group (10.0 %, 1.0 %, 0.0 % respectively). In the dexmedetomidine group there was minimal fall in mean systolic blood pressure (SBP) observed at 15 min after spinal anesthesia, the result was statistically significant among all the three groups (*p*-value  $<$  0.05) (Figure 1). All the patients were statistically nonsignificant regarding their DBP and HR (*p*-value  $>$  0.05) (Figures 2 and 3) throughout the study.

Table 3 shows that about 1/3<sup>rd</sup> patients in control group (18/50) needed rescue anti-shivering drug compared

to (6/50) and (8/50) patients in group BD and BM respectively, this difference was statistically significant ( $p$ -value < 0.05). The incidence of adverse effects were statistically nonsignificant among all the three groups

( $p$ -value > 0.05). No sedation was observed in any group, sedation score was 1 among all the three groups at various time interval (Table 4).

**Table 1:** Patients' characteristics and operative times among the studied groups:

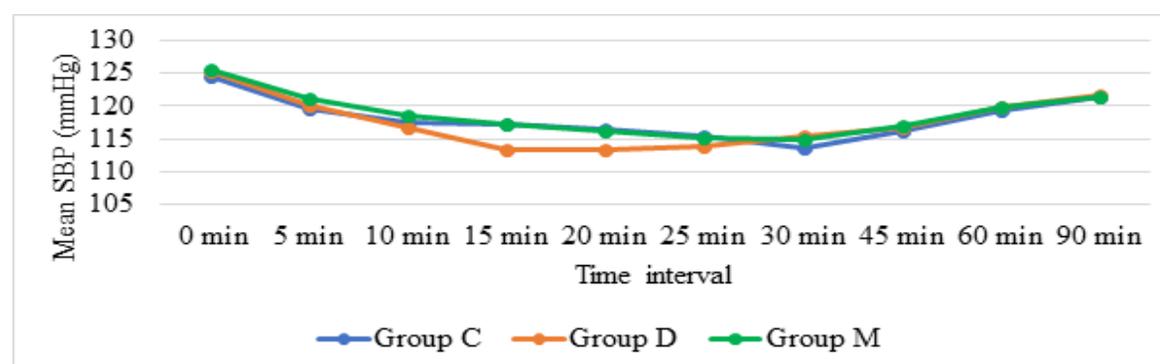
	Group BN (n = 50)	Group BD (n = 50)	Group BM (n = 50)	p Value
Age (years)	26.36 ± 3.94	25.78 ± 4.05	25.42 ± 3.25	0.454
Weight (kg)	55.60 ± 4.09	55.60 ± 4.09	56.86 ± 4.12	0.071
ASA	II	II	II	> 0.05

Data expressed as Mean±SD, Test applied: ANOVA Test.

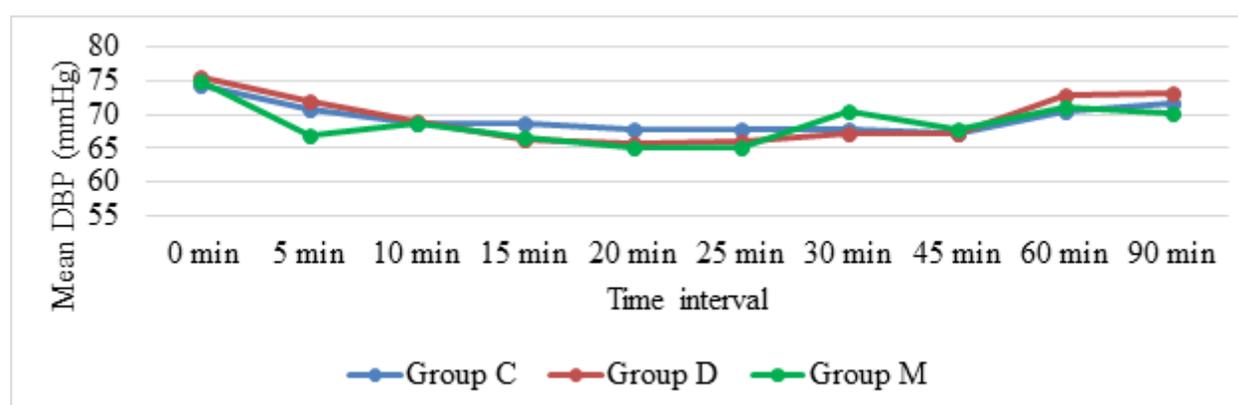
**Table 2:** Shivering incidence and grades:

Groups	Grade of shivering				Total Incidence of shivering	P	P1	P2	P3
	0	1	2	3					
Group BN (n = 50)	32 (64.0 %)	4 (8.0 %)	9 (18.0 %)	5 (10.0 %)	18 (36.0 %)	0.018	0.010	0.022	0.742
Group BD (n = 50)	44 (88.0 %)	4 (8.0 %)	2 (4.0 %)	0 (0.0 %)	6 (12.0 %)				
Group BM (n = 50)	42 (84.0 %)	4 (8.0 %)	3 (6.0 %)	12 (0.0 %)	8 (16.0 %)				
<b>Total</b>	118 (78.7 %)	12 (8.0 %)	14 (9.3 %)	6 (4.0 %)	32 (21.0 %)				

Test Applied: chi square test, P1: p value for comparing between group BN and BD, P2: p value for comparing between group BN and BM, P3: p value for comparing between group BD and BM.



**Figure 1:** Comparison of Systolic blood pressure (mmHg) variation among all the three groups.



**Figure 2:** Comparison of Diastolic blood pressure (mmHg) variation among all the three groups.

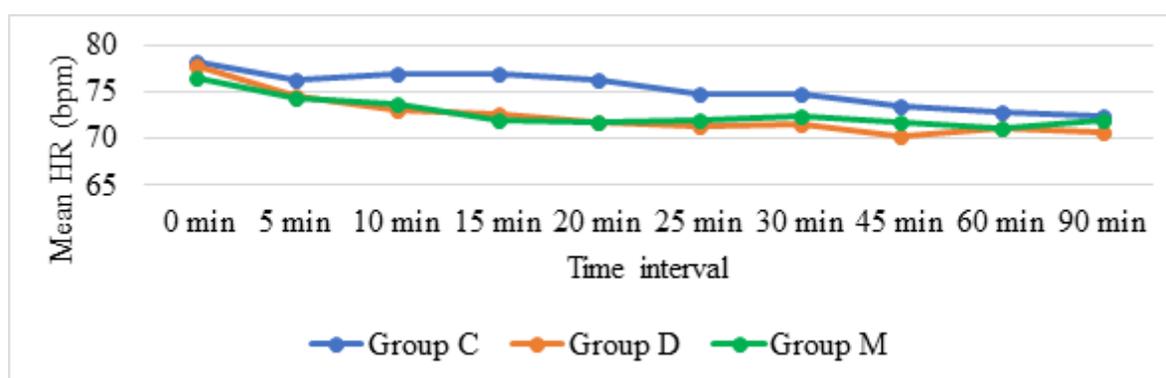


Figure 3: Comparison of Heart Rate (bpm) variation among all the three groups.

Table 3: Need of rescue drug:

Rescue Drug	Group BN (n = 50)	Group BD (n = 50)	Group BM (n = 50)	P value
Not given	32 (64 %)	44 (88 %)	42 (84 %)	0.007
Given	18 (36 %)	6 (12 %)	8 (16 %)	

Data expressed as Number (%), Test applied: chi square test.

Table 4: Adverse effects:

Adverse effects	Group BN (n = 50)	Group BD (n = 50)	Group BM (n = 50)	P value
Nausea and vomiting	4 (8.0 %)	3 (6.0 %)	3 (6.0 %)	0.898
Bradycardia	2 (4.0 %)	4 (8.0 %)	5 (10.0 %)	0.503
Hypotension	7 (14.0 %)	8 (16.0 %)	4 (8.0 %)	0.457
Sedation score	1	1	1	1.000

Data expressed as Number (%), Test applied: chi square test.

## DISCUSSION

Spinal anesthesia is the technique of choice in parturient undergoing lower segment cesaerean section because of the ease to perform, rapid onset, excellent quality of surgical anesthesia and it allows mother to remain conscious and avoid risks associated with general anesthesia (Reynolds *et al.*, 2005). It also causes redistribution of core heat from the trunk (below the block level) to the peripheral tissues that predispose patients to hypothermia and shivering (Ozaki *et al.*, 1994), which further increases lactic acidosis and metabolic rate by up to 400.0 % (Tsai *et al.*, 2001). Dexmedetomidine is an  $\alpha_2$  adrenergic agonist that reduce shivering by inhibiting central thermoregulatory control by restraining neuronal conductance and suppressing vasoconstriction and shivering thresholds (Mittal *et al.*, 2014). The MgSO<sub>4</sub> shows its anti-shivering effect by reducing the shivering threshold, it also has a peripheral mild muscle relaxation effect that may reduce the intensity of shivering (incremental shivering intensity with progressing hypothermia) (Lee *et al.*, 1996).

This study shows that, both dexmedetomidine (5 mcg) and MgSO<sub>4</sub> (25 mg) significantly reduces the incidence of shivering after post-SA in LSCS patients. Incidence of shivering was statistically lower in group BD and BM as

compare to group BN (P 0.05). Grade 3 shivering developed in 5 patients in BN group, 1 patient in BM group and no patient developed grade 3 shivering in BD group. Similar to present study (Nasseri *et al.*, 2017, Miao *et al.*, 2018 and Mostafa *et al.*, 2019) concluded that control group had significantly higher proportions of patients developed shivering than the dexmedetomidine and MgSO<sub>4</sub> group. Omar *et al.*, 2019, found that both MgSO<sub>4</sub> and dexmedetomidine were effective for postspinal anesthesia shivering with non-significant difference between them in uroscopic surgery. Ellakany *et al.*, 2014, found that the incidence of shivering was higher in control group than the dexmedetomidine and meperidine group, but meperidine was associated with more side effects. Moawad *et al.*, 2015, studied the effect of intrathecal dexmedetomidine (10 mcg) with bupivacaine in prostatectomy at a higher dose than in present study (5 mcg) and found noticeable control of shivering even in occurrence of tolerable side effects.

In present study, temperature was taken by skin probe and it was statistically significant among all the three groups at various time interval ( $p$ -value < 0.05) which was similar to the study done by Omar *et al.*, 2019 and Mostafa *et al.*, 2019.

In this study, we used injection tramadol (25 mg) as a rescue drug to treat shivering episodes. Rescue drug requirement was, 6 patients (12.0 %), 8 patients (16.0 %) and 18 patients (36.0 %) in dexmedetomidine, magnesium sulfate and control group. we found that rescue drug requirement was significantly higher in control group (BN) ( $p$ -value = 0.007) and was statistically comparable between BD and BM group ( $p$ -value = 0.056). This result was similar to the studies done by Omar *et al.*, 2019, Mohamed *et al.*, 2021 and Botros *et al.*, 2018.

## CONCLUSION

We observed that, dexmedetomidine(5 mcg) and MgSO<sub>4</sub> (25 mg) are hemodynamically stable and significantly decreased the incidence and intensity of shivering and rescue drug requirement with nonsignificant adverse effects in LSCS patients. Hence, both the drugs can be added safely to bupivacaine for the prevention of post spinal anesthesia shivering in LSCS patients.

## SUGGESTIONS

1. To improve the quality of hospital stay in parturient underwent LSCS by decreasing the post-spinal anesthesia shivering.

2. More studies are needed to establish strong evidence for usage of intrathecal MgSO<sub>4</sub> and dexmedetomidine.

## LIST OF ABBREVIATIONS

- HR- heart rate.
- SPO<sub>2</sub>- oxygen saturation.
- SBP-systolic blood pressure.
- DBP- diastolic blood pressure.
- LSCS- lower segment cesaerean section.
- ASA- american society of anesthesiologist.
- MgSO<sub>4</sub>- magnesium sulfate.
- PACU- post anesthesia care unit.

## CONFLICT OF INTEREST

There are no conflicts of interests.

## REFERENCES

1. Crowley LJ, Buggy DJ. Shivering and neuraxial anaesthesia. *Reg Anesth Pain Med* 2008; 33: 241-52.
2. Ghasemi M, Behnaz F, Hajian H. The Effect of Dexmedetomidine Prescription on Shivering during Operation in the Spinal Anesthesia Procedures of Selective Orthopedic Surgery of the Lower Limb in Addicted Patients. *Anesth Pain Med* 2018 April; 8(2): e63230.
3. Nasser K, Ghadami N, Nouri B. Effect of intrathecal dexmedetomidines on shivering after spinal anesthesia for caeserean sections: a double blind randomized clinical trial. *Drug Des Devel Ther* 2017; 11:1107-1113.
4. Miao S, Shi M, Zou L, Wang G. Effects of intrathecal dexmedetomidine on preventing shivering in ceserean section after spinal anesthesia: a meta-analysis and trial sequential analysis. *Drug Des, Devel Ther* 2018;12 :3775-3783.
5. Moawad HES, Elawdy MM. Efficacy of intrathecal dexmedetomidine in prevention of shivering in patients undergoing transurethral prostatectomy: A randomized controlled trial. *Egypt J Anaesth* 2015; 31:181-187.
6. Zhang J, Zhang X, Wang H, Zhou H, Tian T, Wu A. Dexmedetomidine as a neuraxial adjuvant for prevention of perioperative shivering: meta-analysis of randomized controlled trials. *PLoS ONE* 2017; 12(8): e0183154. <https://doi.org/10.1371/journal.pone.0183154>.
7. Wadhwa A, Senguta P, Durrani J, Akca O, Lenhardt R, Sessler D I, *et al.* Magnesium sulfate only slightly reduces the shivering threshold in humans. *Br J Anesth* 2005; 94(6):756–62.
8. Nath MP, Garg R, Talukdar T, Choudhary D, Chkrabarty A. To evaluate the efficacy of intrathecal magnesium sulfate for hysterectomy under subarachnoid block with bupivacaine and fentanyl: a prospective randomized double blind clinical trial. *Saudi J Anaesth* 2012 Jul;6(3):254.
9. 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; 19:190.
10. Badjatia N. Shivering: scores and protocols. *Critical Care* 2012;16: A9.

11. Park SM, Mangat HS, Berger K, Rosengart AJ. Efficacy spectrum of antishivering medications: Meta-analysis of randomized controlled trials. *Crit Care Med* 2012 Nov;40(11):3070-82.
12. Reynolds F, Seed PT. Anaesthesia for caesarean section and neonatal acid- base status: a meta-analysis. *Anaesthesia* 2005; 60: 636-53.
13. Ozaki M, Kurz A, Sessler DI, Lenhardt R, Schroeder M. Thermoregulatory thresholds during epidural and spinal anesthesia. *Anesthesiology* 1994; 81: 282-288.
14. Tsai YC, Chu KS. A comparison of tramadol, amitriptyline, and meperidine for postepidural anesthetic shivering in parturients. *Anesth Analg* 2001;93: 1288-1292.
15. Mittal G, Gupta K, Katyal S, Kausal S. Randomized double blind comparative study of Dexmedetomidine and tramadol for post spinal anaesthesia shivering. *Indian J Anesth* 2014;58(3):257-62.
16. Lee C, Zhang X, Kwan WF. Electromyographic and mechanomyographic characteristics of neuromuscular blocker by magnesium sulphate in the pig. *Br J Anaesth* 1996; 76:278-83.
17. Mostafa MF, Hassan Z, El-Abden Z, Hassan SM. Shivering prevention during caesarean section by intrathecal injection of magnesium sulfate: randomized double-blind controlled study. *Res Opin in Anesth Intensive Care* 2019; 6:89– 94.
18. Ellakany MH, Abdelhamed SA, Messeha Girgis MM. Intrathecal dexmedetomidine or meperidine for post-spinal shivering. *Int J Anesthetic Anesthesiol* 2014, 1:004.
19. Mohamed S.A., El Mekawy N.M. Abdelfattah R. M., Elsonbaty AIA and Elsonbaty MIA. Magnesium sulfate intravenous infusion versus intrathecal injection for prevention of post-spinal shivering during lower limb fracture surgery: a randomized controlled study. *Ain-Shams J Anesthesiol* 2021;13: 27.
20. Botros JM, Mahmoud AMS, Ragab SG, Ahmad MAA, Roushdy HMS, Yassin HM. Comparative study between dexmedetomidine and ondansetron for prevention of post spinal shivering. A randomized controlled trial. *BMC Anesthesiol* 2018 Nov;18(1):179.