

# Comparative Study between Intrathecal Dexmedetomidine and Intrathecal Magnesium Sulfate for the Prevention of Post-Spinal Anesthesia Shivering in Lower Limb Orthopedic Surgeries: A Randomized Controlled Trial

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## Abstract

**Background:** Shivering is a common and unpleasant perioperative event following general as well as neuraxial anesthesia. It has been reported in 40-70% of regionally anesthetized patients. Shivering is a physiological compensatory response to core hypothermia precipitated by anesthetic induced thermoregulatory impairment, exposure to a cool environment, infusion of unwarmed fluids and evaporation from exposed surfaces. However, some shivering like tremors is not thermoregulatory.

**Aim of Study:** To compare the efficacy of intrathecal dexmedetomidine versus intrathecal magnesium sulphate when added to hyperbaric bupivacaine for reducing the severity and incidence of post-spinal shivering in lower limb orthopedic surgeries.

**Patients and Methods:** We compared the efficacy of intrathecal dexmedetomidine versus intrathecal magnesium sulphate for reducing the severity and incidence of post-spinal shivering in lower limb orthopedic surgeries. This study was a randomized controlled trial, 105 adult patients (ASA I-II) of both sexes, aged 18-45 years, were scheduled for lower limb orthopedic surgeries in Ain Shams University Hospitals. Patients were randomly allocated into three equal groups; each group consists of 35 patients and had spinal anesthesia with one of the following mixture:

- In group A, spinal anesthesia was performed with 3.5ml of 0.5% hyperbaric bupivacaine (17.5mg), plus 5 µg dexmedetomidine in 0.5ml normal saline.
- In group B, 3.5ml of 0.5% hyperbaric bupivacaine (17.5mg), plus 25mg MgSO<sub>4</sub> in 0.5ml normal saline was injected intrathecally.
- In group C, 3.5ml of 0.5% hyperbaric bupivacaine (17.5mg), plus 0.5ml of normal saline was injected intrathecally.

**Results:** Our results showed that all patients in the three groups were comparable regarding demographic data (including age, sex, weight and height) and intraoperative hemody-

namics (SBP, DBP and HR). Regarding temperature, though difference in decreased core temperature was clinically insignificant, there was statistical significant difference between the three groups at almost all times as temperature at dexmedetomidine group was higher than magnesium group but the temperature at controlled group was lower than other two groups. Regarding shivering, we found that C group showed statistically significant higher number of total patients who developed shivering than B group and A group. 9 patients (25.7%) in dexmedetomidine group (group A), 12 patients (34.3%) in magnesium sulfate group (group B), and 20 patients (57.1%) in control group (group C).

**Conclusion:** Our study viewed that intrathecal administration of dexmedetomidine or magnesium sulphate as adjuvant to heavy bupivacaine in spinal anesthesia, reduced incidence and severity of shivering in patients presented for lower limb orthopedic surgery with non-significant difference among both adjuvants.

**Key Words:** Post-anesthetic care unit – Intrathecal dexmedetomidine – Intrathecal magnesium sulfate.

## Introduction

**SPINAL** anesthesia is the most common performed technique in prolonged lower limb surgeries. Bupivacaine is routinely used with the addition of number of adjuvants to increase its duration and potency of analgesia such as opioids [1].

Shivering is a common and unpleasant perioperative event following general as well as neuraxial anesthesia. It has been reported in 40-70% of regionally anesthetized patients. Shivering is a physiological compensatory response to core hypothermia precipitated by anesthetic induced thermoregulatory impairment, exposure to a cool environment, infusion of unwarmed fluids and evaporation from exposed surfaces. However, some shivering like tremors is not thermoregulatory [2].

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Post-spinal shivering presents by different degrees ranging from piloerection in the mild form up to generalized skeletal muscle contraction in the severe form that interferes with pulse rate, blood pressure and electrocardiographic (ECG) monitoring [3].

Shivering increases the metabolic rate, the oxygen consumption and carbon dioxide production with lactic acidosis which is hazardous in patients with poor cardiac and/or respiratory reserves. It also increases intraocular and intracranial pressures and leads to hypertension, tachycardia, patient discomfort, increased wound pain, delayed wound healing, and delayed discharge from the post-anesthetic care unit (PACU). That is why its primary prevention and prompt control are warranted [4].

Dexmedetomidine is a highly selective alpha-2-adrenoreceptor agonist with potent effects on the central nervous system, decreasing the sympathetic tone [5]. It has been effectively used intravenously for the treatment and prevention of shivering following SA without any major adverse effects in several studies [6]. Few trials have examined intrathecal dexmedetomidine for the prevention of post-SA shivering [7].

On the other hand, magnesium sulphate has been shown to suppress postoperative shivering, it is suggested that it reduces the shivering threshold. The drug not only exerts a central effect, but is also a mild muscle relaxant and may thus simultaneously reduce the gain of shivering (incremental shivering intensity with progressing hypothermia) [8].

#### *Aim of the work:*

The aim of the present trial is to compare the efficacy of intrathecal 5 µg dexmedetomidine versus intrathecal 25mg magnesium sulphate when added to 3.5ml of 0.5% hyperbaric bupivacaine (17.5mg) in 0.5ml normal saline for reducing the severity and incidence of post-spinal shivering in lower limb orthopedic surgeries.

### **Patients and Methods**

This is a randomized controlled trial set at Ain Shams University Hospitals over a period of 3-6 months on 105 patients who were scheduled to undergo lower limb orthopedic surgeries receiving spinal anesthesia at Ain Shams University Hospitals during 2020. The patients divided into three groups; group A included patients who received dexmedetomidine as adjuvant to 0.5% heavy bupivacaine,

group B included patients who received magnesium sulphate as adjuvant to 0.5% heavy bupivacaine and group C who received 0.5% heavy bupivacaine as a control group.

#### *Inclusion criteria:*

*Our inclusion criteria were:* No sex predilection. Age between 18 and 45 years old. Patients with American Society of Anesthesiologists (ASA) physical status classification I and II. Anticipated duration of surgery to be not more than 120 minutes. Normothermia (36.5°C - 37.2°C).

#### *Exclusion criteria:*

*Our exclusion criteria were:* Refusal of procedure or participation in the study. Temperature below 36.5°C or above 37.2°C. Obese patients (BMI >30kg/m<sup>2</sup>). Expected intraoperative bleeding and blood transfusion. Allergy to dexmedetomidine or magnesium sulphate. Drug or alcohol abuse. Patients who are taking β blockers, vasodilators, gonadotropin, tramadol, clonidine or pregabalin before the surgery. Patients with any contraindication to neuraxial block (relative or absolute). Bleeding disorders.

#### *Sampling method:*

Non-probability consecutive sample. Using PASS 11 program for sample size calculation and assuming incidence of shivering in study groups are 79%, 31% and 6%, sample size of 35 patients /group can detect the difference between 3 groups setting power at 80% and α-error at 0.05.

#### *Methods:*

A written informed consent was obtained from all participants or their guardians prior to screening and enrolment. Benefits from participation in the research were explained to all patients. The study's protocol gained the ethical approval of the Ethics Committee of Ain Shams University Hospitals.

All cases were assessed for any hemodynamic abnormalities in the preoperative room. All participants underwent full history taking, clinical examination, routine investigations including CBC, liver function tests, renal function tests and coagulation profile.

Randomization was done through opaque and well-sealed envelopes. The sequence generation was done with a computer. The number was printed on envelopes and the group was written on the card together with the serial number. When the patient arrived. The envelope was opened to see the group that would be assigned. A drug solution

was prepared by a doctor who did not participate in the study, and drugs were filled in pre-coded syringes and given to the anesthetist. Patients were also blinded for the administered drug.

After entering the operating room, an IV cannula (18 Gauge) was inserted under complete aseptic conditions. Standard ASA monitoring [electrocardiography (ECG), non-invasive arterial blood pressure (NABP), pulse rate, and pulse oximetry monitoring] in addition to temperature monitoring was applied.

Before performing SA, all the patients were infused with 500mL of Ringer lactate, which had been warmed to 37°C. For all participants, SA was conducted by an expert anesthesiologist who was unaware of the patients' grouping and was not involved in data collection.

#### *Conduct of anesthesia:*

Under all aseptic precautions, a midline spinal puncture was performed at the L3-L4 or L4-L5 level in a sitting position using a 25 gauge Quincke spinal needle after prior local infiltration with 2ml of 1% lignocaine.

All injections were given at a rate of 1ml over 4-5sec and intrathecal solutions were at room temperature. Thereafter, the patients were placed in the supine position for surgery.

- In group A, spinal anesthesia was performed with 3.5ml of 0.5% hyperbaric bupivacaine (17.5mg), plus 5 µg dexmedetomidine in 0.5ml normal saline.
- In group B, 3.5ml of 0.5% hyperbaric bupivacaine (17.5mg), plus 25mg MgSO<sub>4</sub> in 0.5ml normal saline was injected intrathecally.
- In group C, 3.5ml of 0.5% hyperbaric bupivacaine (17.5mg), plus 0.5ml of normal saline was injected intrathecally.

#### *Data collection:*

The following parameters will be recorded: Vital signs including BP and heart rate every 5 minutes for 1<sup>st</sup> 15 minutes and every 10 mins until transfer to PACU. Temperature measurement, utilizing thermistor fixed to axilla immediately after spinal anaesthesia, then every 15mins until transfer to PACU. Shivering occurrence with Crossley and Mahajan scoring system at the following times: Immediately after spinal anaesthesia, every 15

minutes until patient transferred to PACU and every 15 minutes in PACU for two readings.

The method of Crossley and Mahajan was used for measuring the intensity of shivering. The scoring was as follows: 0 = without shivering; 1 = piloerection or peripheral vasoconstriction without visible shivering; 2 = muscular activation only in one group of muscles; 3 = muscular activation in more than one group of muscles without generalized shivering; 4 = generalized shivering.

Twenty-five milligrams of IV meperidine was given when a patient presented grade 3 shivering. The temperature was monitored using a thermistor fixed to axilla before the block, immediately after the block and every 15min for 2h after the block. Hypothermia and active warming were considered if the core temperature reached 36°C.

Postoperatively, patients were transferred to the postanesthesia care unit (PACU), monitored and covered with a warm blanket. The PACU temperature was maintained at 25°C.

#### *Study outcome:*

The primary outcome parameters are the incidence and intensity of postoperative or intraoperative shivering in both groups according to Crossley and Mahajan scoring system. The secondary outcome parameters are the frequency of need and dose of pethidine to control shivering, incidence of sedation, hypothermia and complications including hypotension, bradycardia, nausea and vomiting.

#### *Statistical analysis:*

Data were collected, revised, coded and entered to the Statistical Package for Social Science (IBM SPSS) version 22. The quantitative data were presented as mean, standard deviations and ranges when parametric. Also qualitative variables were presented as number and percentages. The comparison between groups with qualitative data was done by using Chi-square test. The comparison between more than two groups with quantitative data and parametric distribution were done by using One Way Analysis of Variance (ANOVA). The confidence interval was set to 95% and the margin of error accepted was set to 5%. So, the *p*-value was considered significant as the following: *p*>0.05: Non significant. *p*<0.05: Significant. *p*<0.01: Highly significant.

## **Results**

Table (1): Comparison between the three studied groups regarding demographic data, anthropometric measures.

	Group A No. = 35	Group B No. = 35	Group C No. = 35	Test value	<i>p</i> - value	Sig.
<i>Age:</i>						
Mean $\pm$ SD	31.20 $\pm$ 8.35	33.14 $\pm$ 8.06	31.86 $\pm$ 8.59	0.492•	0.613	NS
Range	18-45	18-44	18-45			
<i>Sex:</i>						
Females	11 (31.4%)	12 (34.3%)	18 (51.4%)	3.441*	0.179	NS
Males	24 (68.6%)	23 (65.7%)	17 (48.6%)			
<i>Weight:</i>						
Mean $\pm$ SD	82.40 $\pm$ 9.45	84.03 $\pm$ 8.92	78.83 $\pm$ 9.75	2.814•	0.065	NS
Range	60-98	59-99	59-95			
<i>Height:</i>						
Mean $\pm$ SD	176.86 $\pm$ 11.69	175.50 $\pm$ 11.35	172.54 $\pm$ 10.21	1.384•	0.255	NS
Range	152-196	153-194	152-190			

*p*-value >0.05: Non significant. *p*-value <0.05: Significant. *p*-value <0.01: Highly significant. \*: Chi-square test. •: One Way ANOVA test.

Table (2): Systolic blood pressure (mmHg).

SBP		Group A No. = 35	Group B No. = 35	Group C No. = 35	Test value	<i>p</i> - value	Sig.
Pre-spinal	Mean $\pm$ SD	126.74 $\pm$ 5.87	128.23 $\pm$ 8.25	129.37 $\pm$ 7.73	1.126•	0.328	NS
	Range	110-140	118-148	110-145			
After-spinal	Mean $\pm$ SD	124.43 $\pm$ 5.11	127.94 $\pm$ 7.57	126.94 $\pm$ 6.89	2.631•	0.077	NS
	Range	111-135	115-140	111-140			
5min	Mean $\pm$ SD	120.37 $\pm$ 5.63	120.37 $\pm$ 7.15	121.00 $\pm$ 6.49	0.111•	0.895	NS
	Range	105-133	103-133	103-133			
10m	Mean $\pm$ SD	116.83 $\pm$ 5.28	115.77 $\pm$ 7.53	116.09 $\pm$ 6.92	0.234•	0.792	NS
	Range	100-127	100-127	100-127			
15m	Mean $\pm$ SD	113.83 $\pm$ 6.54	113.83 $\pm$ 6.26	112.63 $\pm$ 7.33	0.372•	0.691	NS
	Range	90-122	100-125	90-122			
25m	Mean $\pm$ SD	114.20 $\pm$ 7.40	115.37 $\pm$ 6.92	111.69 $\pm$ 8.60	2.108•	0.127	NS
	Range	89-128	94-128	89-128			
35m	Mean $\pm$ SD	114.80 $\pm$ 8.25	117.54 $\pm$ 7.32	113.20 $\pm$ 8.71	2.564•	0.082	NS
	Range	90-129	90-130	90-129			
45m	Mean $\pm$ SD	116.03 $\pm$ 8.66	119.86 $\pm$ 5.36	115.34 $\pm$ 8.14	3.657•	0.029	S
	Range	95-130	100-132	95-130			
55m	Mean $\pm$ SD	118.09 $\pm$ 8.54	121.57 $\pm$ 5.33	118.29 $\pm$ 8.29	2.364•	0.099	NS
	Range	93-132	102-136	93-132			
65m	Mean $\pm$ SD	119.31 $\pm$ 7.33	122.57 $\pm$ 5.67	119.74 $\pm$ 8.00	2.194•	0.117	NS
	Range	98-133	100-134	98-133			
75m	Mean $\pm$ SD	120.97 $\pm$ 6.67	123.97 $\pm$ 5.59	121.06 $\pm$ 6.96	2.468•	0.090	NS
	Range	100-130	104-136	100-130			
85m	Mean $\pm$ SD	122.94 $\pm$ 6.32	124.51 $\pm$ 5.30	122.26 $\pm$ 6.75	1.236•	0.295	NS
	Range	100-132	105-137	100-132			
95m	Mean $\pm$ SD	123.14 $\pm$ 5.65	124.60 $\pm$ 5.56	122.49 $\pm$ 5.99	1.246•	0.292	NS
	Range	105-136	110-140	105-130			
105m	Mean $\pm$ SD	124.46 $\pm$ 6.12	126.49 $\pm$ 5.73	124.23 $\pm$ 6.20	1.490•	0.230	NS
	Range	104-139	115-140	104-132			
115m	Mean $\pm$ SD	124.40 $\pm$ 5.94	127.46 $\pm$ 6.17	124.74 $\pm$ 6.45	2.561•	0.082	NS
	Range	105-135	116-140	105-135			

*p*-value >0.05: Non significant. *p*-value <0.05: Significant. *p*-value <0.01: Highly significant. •: One Way ANOVA test.

Table (3): Diastolic blood pressure (mmHg).

DBP	Group A No. = 35	Group B No. = 35	Group C No. = 35	Test value	p- value	Sig.
<i>Pre-spinal:</i>						
Mean ± SD	84.09±4.85	84.66±5.71	84.89±5.00	0.220•	0.803	NS
Range	70-90	70-94	70-92			
<i>After-spinal:</i>						
Mean ± SD	82.09±5.01	81.91±5.91	82.60±5.07	0.156•	0.856	NS
Range	70-90	70-90	70-90			
<i>5min:</i>						
Mean ± SD	77.89±5.96	76.23±6.65	77.97±5.51	0.920•	0.402	NS
Range	65-90	58-88	58-85			
<i>10m:</i>						
Mean ± SD	74.43±5.29	72.34±6.20	74.14±5.99	1.313•	0.274	NS
Range	60-86	57-80	57-83			
<i>15m:</i>						
Mean ± SD	73.26±5.85	70.74±5.98	71.00±6.54	1.783•	0.173	NS
Range	55-84	59-82	55-80			
<i>25m:</i>						
Mean ± SD	72.86±6.81	71.80±5.82	70.03±7.58	1.558•	0.216	NS
Range	50-82	60-85	50-82			
<i>35m:</i>						
Mean ± SD	73.97±6.12	73.80±5.31	71.57±6.91	1.659•	0.195	NS
Range	60-82	60-82	60-82			
<i>45m:</i>						
Mean ± SD	75.34±6.28	75.29±5.24	73.86±6.45	0.686•	0.506	NS
Range	60-85	63-83	62-85			
<i>55m:</i>						
Mean ± SD	76.06±6.67	76.51±4.97	75.80±6.52	0.123•	0.884	NS
Range	59-89	66-86	60-89			
<i>65m:</i>						
Mean ± SD	76.74±6.80	77.14±5.65	76.80±7.25	0.038•	0.963	NS
Range	60-90	60-86	60-90			
<i>75m:</i>						
Mean ± SD	78.63±6.01	78.74±5.93	77.69±6.56	0.309•	0.735	NS
Range	62-88	63-88	63-88			
<i>85m:</i>						
Mean ± SD	80.17±6.10	78.91±5.77	79.49±6.71	0.360•	0.699	NS
Range	60-90	65-88	60-90			
<i>95m:</i>						
Mean ± SD	81.60±5.11	79.43±5.92	80.57±5.86	1.297•	0.278	NS
Range	69-90	66-90	69-89			
<i>105m:</i>						
Mean ± SD	82.11±5.05	80.83±6.09	81.71±4.82	0.530•	0.590	NS
Range	70-90	65-91	70-90			
<i>115m:</i>						
Mean ± SD	82.11±5.49	81.83±6.12	82.00±5.53	0.022•	0.978	NS
Range	68-90	64-90	68-90			

p-value >0.05: Non significant.

p-value <0.05: Significant.

p-value <0.01: Highly significant.

•: One Way ANOVA test.

Table (4): Heart rate.

HR		Group A No. = 35	Group B No. = 35	Group C No. = 35	Test value	p- value	Sig.
Pre-spinal	Mean $\pm$ SD Range	78.77 $\pm$ 11.34 55-99	79.57 $\pm$ 11.73 54-99	81.74 $\pm$ 10.54 59-97	0.658•	0.520	NS
After-spinal	Mean $\pm$ SD Range	79.46 $\pm$ 10.53 57-96	79.14 $\pm$ 10.82 53-98	82.31 $\pm$ 10.19 58-98	0.966•	0.384	NS
5min	Mean $\pm$ SD Range	77.86 $\pm$ 9.76 58-94	77.57 $\pm$ 9.95 54-96	80.09 $\pm$ 9.63 59-96	0.693•	0.502	NS
10m	Mean $\pm$ SD Range	75.94 $\pm$ 10.13 51-98	76.11 $\pm$ 9.86 57-98	78.57 $\pm$ 8.89 57-92	0.814•	0.446	NS
15m	Mean $\pm$ SD Range	74.74 $\pm$ 9.58 54-93	74.57 $\pm$ 9.19 55-93	77.03 $\pm$ 9.35 55-93	0.749•	0.475	NS
25m	Mean $\pm$ SD Range	74.03 $\pm$ 8.55 56-90	73.74 $\pm$ 8.70 57-90	76.83 $\pm$ 8.27 59-90	1.406•	0.250	NS
35m	Mean $\pm$ SD Range	74.63 $\pm$ 9.18 58-92	73.97 $\pm$ 10.63 51-94	76.86 $\pm$ 9.47 60-94	0.837•	0.436	NS
45m	Mean $\pm$ SD Range	74.23 $\pm$ 8.69 57-90	74.71 $\pm$ 10.08 55-98	76.74 $\pm$ 9.63 62-98	0.692•	0.503	NS
55m	Mean $\pm$ SD Range	74.17 $\pm$ 9.00 57-90	74.34 $\pm$ 9.94 57-95	75.97 $\pm$ 9.36 57-95	0.388•	0.680	NS
65m	Mean $\pm$ SD Range	73.89 $\pm$ 9.68 54-94	75.43 $\pm$ 10.51 54-94	76.00 $\pm$ 9.60 54-94	0.424•	0.656	NS
75m	Mean $\pm$ SD Range	74.69 $\pm$ 9.04 58-92	76.20 $\pm$ 10.22 53-95	76.80 $\pm$ 8.90 58-95	0.470•	0.626	NS
85m	Mean $\pm$ SD Range	75.17 $\pm$ 8.99 57-90	76.09 $\pm$ 9.74 51-92	77.14 $\pm$ 9.61 59-92	0.381•	0.684	NS
95m	Mean $\pm$ SD Range	76.00 $\pm$ 8.63 58-92	77.14 $\pm$ 9.42 59-95	78.00 $\pm$ 9.63 60-95	0.413•	0.663	NS
105m	Mean $\pm$ SD Range	76.94 $\pm$ 8.98 59-94	77.89 $\pm$ 8.93 60-92	78.37 $\pm$ 9.11 62-94	0.228•	0.797	NS
115m	Mean $\pm$ SD Range	77.49 $\pm$ 9.53 57-93	78.46 $\pm$ 9.14 57-94	79.09 $\pm$ 9.37 61-94	0.260•	0.771	NS

p-value >0.05: Non significant. p-value <0.05: Significant. p-value <0.01: Highly significant. •: One Way ANOVA test.

Table (5): Temperature.

Temperature		Group A No. = 35	Group B No. = 35	Group C No. = 35	Test value	p- value	Sig.
After-spinal	Mean $\pm$ SD Range	37.13 $\pm$ 0.08 36.99-37.2	37.16 $\pm$ 0.06 37-37.2	37.11 $\pm$ 0.08 36.99-37.2	4.915•	0.009	HS
15m	Mean $\pm$ SD Range	37.12 $\pm$ 0.07 36.95-37.2	37.12 $\pm$ 0.08 36.8-37.2	37.08 $\pm$ 0.09 36.8-37.19	2.942•	0.057	NS
30m	Mean $\pm$ SD Range	37.08 $\pm$ 0.08 36.92-37.2	37.05 $\pm$ 0.11 36.8-37.19	37.00 $\pm$ 0.11 36.8-37.2	5.146•	0.007	HS
45m	Mean $\pm$ SD Range	37.05 $\pm$ 0.09 36.86-37.18	36.99 $\pm$ 0.17 36.55-37.18	36.94 $\pm$ 0.14 36.69-37.16	5.789•	0.004	HS
60m	Mean $\pm$ SD Range	36.99 $\pm$ 0.10 36.84-37.19	36.96 $\pm$ 0.20 36.5-37.19	36.89 $\pm$ 0.16 36.5-37.15	3.657•	0.029	HS
75m	Mean $\pm$ SD Range	36.94 $\pm$ 0.11 36.82-37.19	36.85 $\pm$ 0.22 36.4-37.19	36.83 $\pm$ 0.19 36.5-37.16	3.732•	0.027	HS
90m	Mean $\pm$ SD Range	36.85 $\pm$ 0.12 36.7-37.10	36.52 $\pm$ 0.25 36.31-37.17	36.55 $\pm$ 0.22 36.32-37.17	27.905•	0.000	HS
105m	Mean $\pm$ SD Range	36.73 $\pm$ 0.12 36.5-37.19	36.50 $\pm$ 0.27 36.3-37.19	36.51 $\pm$ 0.27 36.1-37.17	11.077•	0.000	HS
120m	Mean $\pm$ SD Range	36.68 $\pm$ 0.12 36.4-37.15	36.45 $\pm$ 0.29 36.3-37.17	36.47 $\pm$ 0.31 36.1-37.2	8.759•	0.000	HS

p-value >0.05: Non significant. p-value <0.05: Significant. p-value <0.01: Highly significant. •: One Way ANOVA test.

Table (6): Comparison between the three studied groups regarding incidence of shivering.

Incidence of shivering	Group A No. = 35	Group B No. = 35	Group C No. = 35	Test value	p-value	Sig.
No (G0)	26 (74.3%)	23 (65.7%)	15 (42.9%)	7.763*	0.020	S
Yes (G1-4)	9 (25.7%)	12 (34.3%)	20 (57.1%)			

p-value >0.05: Non significant. p-value <0.05: Significant. p-value <0.01: Highly significant. \*: Chi-square test.

Table (7): Comparison between the two drugs regarding incidence of shivering.

Incidence of shivering	Group A No. = 35	Group B No. = 35	Test value	p-value	Sig.
No (G0)	26 (74.3%)	23 (65.7%)	0.612	0.434	NS
Yes (G1-4)	9 (25.7%)	12 (34.3%)			

Table (8): Comparison between the three studied groups regarding shivering grade.

Shivering	Group A No. = 35	Group B No. = 35	Group C No. = 35	Test value	p-value	Sig.
Grade 0	26 (74.3%)	23 (65.7%)	15 (42.9%)	7.763	0.020	S
Grade I	0 (0.0%)	0 (0.0%)	0 (0.0%)			–
Grade II	4 (11.4%)	6 (17.1%)	2 (5.7%)	2.258	0.323	NS
Grade III	2 (5.7%)	2 (5.7%)	3 (8.6%)	0.306	0.858	NS
Grade IV	3 (8.6%)	4 (11.4%)	15 (42.9%)	15.296	0.001	HS

p-value >0.05: Non significant. p-value <0.05: Significant. p-value <0.01: Highly significant. \*: Chi-square test.

Table (8): Comparison between the two drugs regarding shivering grade.

Shivering	Group A No. = 35	Group B No. = 35	Test value	p-value	Sig.
<i>Incidence of shivering:</i>					
Grade 0	26 (74.3%)	23 (65.7%)	0.612	0.434	NS
Grade I	0 (0.0%)	0 (0.0%)			
Grade II	4 (11.4%)	6 (17.1%)	0.467	0.494	NS
Grade III	2 (5.7%)	2 (5.7%)	0.000	1.000	NS
Grade IV	3 (8.6%)	4 (11.4%)	0.159	0.690	NS

p-value >0.05: Non significant. p-value <0.05: Significant. p-value <0.01: Highly significant. \*: Chi-square test.

Table (9): Comparison between the three studied groups regarding need to pethidine.

Recurrence of shivering after 1 st dose of pethidine	Group A No. = 35	Group B No. = 35	Group C No. = 35	Test value	p-value	Sig.
<i>Need of 1 st dose of pethidine:</i>						
No	26 (74.3%)	23 (65.7%)	14 (40.0%)	9.286*	0.010	S
Yes	9 (25.7%)	12 (34.3%)	21 (60.0%)			
<i>Need of 2 nd dose of pethidine:</i>						
No	32 (91.4%)	32 (91.4%)	24 (68.6%)	8.984*	0.011	S
Yes	3 (8.6%)	3 (8.6%)	11 (31.4%)			

p-value >0.05: Non significant. p-value <0.05: Significant. p-value <0.01: Highly significant. \*: Chi-square test.

Table (10): Comparison between the two drugs regarding need to pethidine.

Recurrence of shivering after 1 st dose of pethidine	Group A No. = 35	Group B No. = 35	Test value	p-value	Sig.
<i>Need of 1 st dose of pethidine:</i>					
No	26 (74.3%)	23 (65.7%)	0.612	0.434	NS
Yes	9 (25.7%)	12 (34.3%)			
<i>Need of 2 nd dose of pethidine:</i>					
No	32 (91.4%)	32 (91.4%)	0.000	1.000	NS
Yes	3 (8.6%)	3 (8.6%)			

p-value >0.05: Non significant. p-value <0.05: Significant. p-value <0.01: Highly significant. \*: Chi-square test. •: One way ANOVA test.

## Discussion

Spinal anaesthesia (SA) is a very reliable and convenient technique, especially for procedures in which patient consciousness must be maintained to detect intraoperative complications. However, shivering is a common complication after SA, with an incidence of 40-60% in patients who undergo SA, especially when large amounts of cold intraluminal irrigating fluids are used. SA impairs thermoregulation, inhibits tonic vasoconstriction, and causes the redistribution of core heat from the trunk to the peripheral tissue [9].

Various causes such as pain, decreased sympathetic activity, uncontrolled spinal reflux, release of pyrogen, cytokines following surgery, or adrenal suppression, etc. have been suggested as causative factors of shivering, however, thermo-regulation disorders caused by hypothermia (0.5-1 °C decrease in central heating) has been accepted as the most common factor [10].

Shivering interferes with proper monitoring and is associated with several adverse effects, as it increases the circulating catecholamine, heart rate, cardiac output, minute ventilation, patient oxygen consumption, metabolic CO<sub>2</sub> production, lactic acid level, intraocular and intracranial pressure, and postoperative pain from surgical incision stretching [11].

In this study we compared the efficacy of intrathecal dexmedetomidine versus intrathecal magnesium sulphate for reducing the severity and incidence of post-spinal shivering in lower limb orthopedic surgeries.

Our results showed that all patients in the three groups were comparable regarding demographic data (including age, sex, weight and height).

Our results showed that all patients in the three groups were comparable regarding intraoperative hemodynamics (SBP, DBP and HR). Omar et al. [12] compared the effects of intrathecal dexmedetomidine versus intrathecal magnesium sulfate on the prevention of post spinal anesthesia shivering and found that all the patients were comparable regarding their SBP, DBP and HR throughout the study.

Regarding temperature, though difference in decreased core temperature was clinically insignificant, there was statistical significant difference between the three groups at almost all times as temperature at dexmedetomidine group was higher than magnesium group but the temperature at controlled group was lower than other two groups. Faiz et al. [13] demonstrated that core temperature was reduced in the MgSO<sub>4</sub> group 30min after block administration. Indeed, injection of MgSO<sub>4</sub> is known to result in reduction of core temperature following anesthesia. Omar et al. [12] found that the tympanic temperature remained above 36 °C in all the patients (who received intrathecal dexmedetomidine and intrathecal magnesium sulfate and the controlled group) at all times, and no patient required active warming.

Regarding shivering, we found that C group showed statistically significant higher number of total patients who developed shivering than B group and A group. 9 patients (25.7%) in dexmedetomidine group (group A), 12 patients (34.3%) in magnesium sulfate group (group B), and 20 patients (57.1%) in control group (group C).

In sixty patients who underwent lower abdominal surgery, Abdel Hamid and El-Lakany [14] concluded that adding 5 µg of dexmedetomidine to intrathecal bupivacaine improved the characteristics

of the spinal block, with less postoperative analgesic requirements and a lower incidence of shivering than the placebo with no sedation or other complications. Shivering occurred in 6.5% patients in the group I (dexmedetomidine), and in 41.9% patients in group II (placebo).

Ellakany et al. [7] administered the same intrathecal dexmedetomidine dose (5 µg) and found that shivering developed in (20%) in group D (dexmedetomidine) and (92%) in group S (placebo). So concluded that intrathecal dexmedetomidine effectively lowered the incidence of shivering following SA in patients who underwent lower abdominal surgery. Moawad and Elawdy [5] studied the effect of adding dexmedetomidine to intrathecal bupivacaine at a higher dose (10 µg) than that in our study (5 µg). They found that it significantly decreased the incidence and degree of shivering in patients undergoing TURP. The incidence of shivering was significantly reduced in group D (dexmedetomidine) (15%) compared with (57%) in group C (control).

Faiz et al. [13] concluded that an intrathecal injection of MgSO<sub>4</sub> (25mg) improved perioperative shivering in female patients who underwent an elective caesarean section.

Kawakami et al. [15] evaluated the effect of perioperative magnesium on prevention of shivering. They showed a significantly lower incidence of shivering in patients who received magnesium with IV administration, epidural administration, and intrathecal administration, but not with intra-articular administration. Omar et al. [12] found that control group (C) had a significantly higher number of patients (60%) who developed shivering than magnesium groups (M) (22.9%) and dexmedetomidine group (D) (14.3%).

In our study, C group showed statistically significant higher number of patients who developed grade IV shivering than B group and A group. Omar et al. [12] found that control group (C) had a significantly higher number of patients who developed grade IV shivering than Magnesium group (M) and Dexmedetomidine group (D).

In our study, there was significant difference between the three studied groups in number of patients who needed pethidine to treat shivering, as 9 patients (25.7%) required pethidine in group A which was statistically significant when compared to group B in which 12 patients (34.3%) required pethidine while group C 21 patients needed pethidine which was highly significant in comparison with the other two groups.

Omar et al. [12] found that control group (C) had a significantly higher number of patients who needed meperidine to treat shivering than groups Magnesium and Dexmedetomidine. They concluded that intrathecal injections of both dexmedetomidine and magnesium sulfate were effective in reducing the incidence of post-spinal anaesthesia shivering and this goes with our study.

Also the need for a second dose of pethidine in control group (C) was highly significant in comparison with the other two groups, and was non-significant among group A (dexmedetomidine) and group B (magnesium sulphate).

#### Conclusion:

Our study viewed that intrathecal administration of dexmedetomidine or magnesium sulphate as adjuvant to heavy bupivacaine in spinal anesthesia, reduced incidence and severity of shivering in patients presented for lower limb orthopedic surgery with non-significant difference among both adjuvants.

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## مقارنة بين الحقن داخل السائل النخاعي الشوكي جرعة من الديكسميديتوميدين مقابل كبريتات المغنسيوم فيما يتعلق بأثرها على حدوث وشدة الارتعاش في مرحلة ما بعد البنج التصفي في عمليات العظام للطرف السفلى

الارتعاش هو حدث شائع وغير سار حول الجراحة بعد التخدير العام وكذلك التخدير النصفي. تم الإبلاغ عنه في ٤٠-٧٠٪ من مرضى التخدير النصفي. الارتعاش هو استجابة تعويضية فسيولوجية لانخفاض درجة حرارة الجسم الأساسية الناتج عن التخدير الناجم عن ضعف التنظيم الحراري، والتعرض لبيئة باردة، وتسريب السوائل غير المحمية والتبخر من الأسطح المكشوفة. ومع ذلك، فإن بعض الارتعاش مثل الهزات لا يكون منظماً للحرارة.

يظهر الارتعاش بعد التخدير النصفي بدرجات مختلفة تتراوح من الانتصاب الشعري في الشكل الخفيف إلى الانقباض العام للعضلات الهيكلية في الشكل الحاد الذي يتداخل مع معدل النبض وضغط الدم ومراقبة تخطيط القلب الكهربائي.

يؤدي الارتعاش إلى زيادة معدل الأيض واستهلاك الأكسجين وإنتاج ثاني أكسيد الكربون مع الحمض اللبني الذي يشكل خطورة على المرضى الذين يعانون من ضعف عضلة القلب و / أو الجهاز التنفسي. كما أنه يزيد من الضغط داخل العين وداخل الجمجمة ويؤدي إلى ارتفاع ضغط الدم، وعدم انتظام دقات القلب، وعدم راحة المريض، وزيادة آلام الجرح، وتأخر التئام الجروح، وتأخر الخروج من وحدة العناية بعد التخدير هذا هو السبب في أن الوقاية الأولية والسيطرة السريعة لهما ما يبرره.

ديكسميديتوميدين هو مادة انتقائية للغاية للمستقبلات الأدرينالية من نوع ألفا-٢ مع تأثيرات قوية على الجهاز العصبي المركزي. تم استخدامه بشكل فعال عن طريق الوريد لعلاج والوقاية من الارتعاش التالي التخدير النصفي دون أي آثار سلبية كبيرة في العديد من الدراسات.

من ناحية أخرى، ثبت أن كبريتات المغنسيوم تمنع الارتعاش بعد الجراحة، ويقترح أنها تقلل من عتبة الارتعاش. لا يمارس الدواء تأثيراً مركزياً فحسب، بل هو أيضاً مرخ خفيف للعضلات، وبالتالي قد يقلل في نفس الوقت من اكتساب الارتعاش (شدة الارتعاش المتزايد مع انخفاض درجة حرارة الجسم المتقدمة).

قارنا فعالية ديكسميديتوميدين داخل السائل الشوكي مقابل كبريتات المغنسيوم داخل السائل الشوكي لتقليل شدة ووقوع الارتعاش بعد التخدير النصفي في جراحات العظام السفلية. كانت هذه الدراسة عبارة عن تجربة عشوائية محكمة، حيث تم تحديد ١٠٥ مرضى بالغين (II-ASA I) من كلا الجنسين، تتراوح أعمارهم بين ١٨-٤٥ عاماً، لإجراء جراحات عظام الأطراف السفلية في مستشفيات جامعة عين شمس. تم تقسيم المرضى بشكل عشوائي إلى ثلاث مجموعات متساوية. تتكون كل مجموعة من ٣٥ مريضاً وخضعوا للتخدير النخاعي بإحدى الخطات التالية:

- تناولت مجموعة ديكسميديتوميدين (مجموعة) ٣.٥ مل بوبيفاكين عالي الضغط ٠.٥٪ (١٧.٥ مجم) + ٥ ميكروجرام ديكسميديتوميدين في ٠.٥ مل محلول ملحي عادي.
- تلقت مجموعة سلفات المغنسيوم (المجموعة ب) ٣.٥ مل بوبيفاكين عالي الضغط ٠.٥٪ (١٧.٥ مجم) + ٢٥ مجم سلفات مغنيزيوم في ٠.٥ مل محلول ملحي عادي.
- المجموعة الضابطة (المجموعة C) تلقت ٣.٥ مل بوبيفاكين عالي الضغط ٠.٥٪ (١٧.٥ مجم) + ٠.٥ مل محلول ملحي عادي.

أظهرت نتائجنا أن جميع المرضى في المجموعات الثلاث كانت قابلة للمقارنة فيما يتعلق بالبيانات الديموغرافية (بما في ذلك العمر والجنس والوزن والطول) والعلامات الحيوية أثناء العملية (ضغط الدم الانقباضي، ضغط الدم الأنساطي، ضربات القلب ونسبة الأكسجين في الدم). فيما يتعلق بدرجة الحرارة، على الرغم من أن الاختلاف في انخفاض درجة الحرارة الأساسية كان غير مهم سريرياً، كان هناك فرق مهم إحصائياً بين المجموعات الثلاث في جميع الأوقات تقريباً.

فيما يتعلق بالارتعاش، أظهرت المجموعة C عدداً ذا دلالة إحصائية أعلى من إجمالي المرضى الذين ظهر عليهم الارتعاش والمرضى الذين ظهر عليهم ارتعاشاً من الدرجة الرابعة مقارنة بالمجموعة ب والمجموعة أ التي كانت قابلة للمقارنة مع بعضها البعض.

في دراستنا، كان هناك فرق كبير بين المجموعات الثلاث المدروسة في عدد المرضى الذين يحتاجون إلى البيثيديين لعلاج الارتعاش، حيث كان العدد الأكبر مع المجموعة ج، بينما لم يكن هناك فرق واضح بين ديكسميديتوميدين (أ) ومجموعة كبريتات المغنسيوم (ب).