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Original Article

Preventive Effect of Intraoperative Dexmedetomedine, Ketamine, Magnesium Sulfate on Perioperative Shivering Related to Transuretheral Resection of the Prostate [TURB]; A randomized Controlled Study

Ahmed Mohammed Abdel-Fattah [1] *; Hasanin Abdelkarim Hasanin Hamzawy [2]; Tawfik Noor El-Din [2]

[1] Department of Anesthesiology and Intensive Care, Damietta Faculty of Medicine, Al-Azhar University, Egypt.

[2] Department of Anesthesiology and Intensive Care, Faculty of Medicine, Al-Azhar University, Egypt

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*Corresponding author

Email: mohamedsafyeldeen123@gmail.com

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ABSTRACT

Background: Shivering is a frequent complication after spinal anesthesia [SA]. It is also more common after transurethral resection of the prostate [TURP] that may be due to the absorption of a large volume of the irrigating fluid.

Aim of the work: The current work aimed to assess the effect of intraoperative dexmedetomidine, ketamine, and magnesium sulfate to prevent shivering during and/or after spinal anesthesia for TURP.

Patients and Methods: This study included 80 patients, arranged for TURP. Patients were divided into four groups [each 20 patients]; the first received normal saline [control group], the second for dexmedetomedine, the third for ketamine and the fourth for magnesium sulphate. All were assessed in a systematic manner in the preoperative period, monitored for hemodynamic and adverse effects intra- and postoperatively, till the end of the first postoperative day.

Results: There was a significant decrease of intra-and/or post-operative shivering in treatment groups than the control group. The lowest rate of shivering was registered with dexmedetomedine [10.0%], followed by ketamine [15.0%] and magnesium sulfate [25.0%]. It was 55% in the control group. There was a significant variance between studied groups regarding the duration of analgesia and anesthesia. Mean arterial pressure revealed a statistically significant decrease in the study than the control group at 20, 30, 40, 50 and 60 minutes after induction. The highest reduction registered for dexmedetomidine followed by magnesium sulfate and ketamine. There was a statistically significant difference among groups regarding visual analogue scale [VAS] for pain, with the lowest score in dexmedetomidine and magnesium sulfate groups. Finally, there was a statistically significant increase of hypotension and bradycardia in dexmedetomidine than other groups.

Conclusion: Intravenous infusion of dexmedetomidine exerted a useful effect as an anti-shivering and sedating agent during SA without any major adverse effects. Thus, dexmedetomidine infusion could be considered as a good choice during SA to reduce postoperative shivering.

Keywords: Spinal Anesthesia; Dexmedetomidine; Ketamine: Magnesium Sulphate; Transuretheral Resection of the Prostate.

INTRODUCTION

Shivering is an involuntary, repetitive movement of skeletal muscles. Its mechanisms in surgery are intra-operative heat loss, high sympathetic tone, pain, and increased release of systemic pyrogens [1].

Spinal anesthesia (SA) considerably impairs the heat regulation system by inhibiting tonic vasoconstriction, which plays a crucial role in regulation of the temperature. SA also causes redistribution of core heat from the trunk [below the level of the block] to the peripheral tissues. These two mechanisms predispose to hypothermia and shivering [2].

Shivering linked to spinal and epidural anesthesia is common, affecting about 56.7% of patients. Shivering is associated with increased oxygen consumption, lactic acidosis, CO_2 production, and metabolic rate by up to 400%. Therefore, shivering may affect patients with reduced cardiac and pulmonary reserves. The best way to prevent intra- and post-operative shivering-stimulated increase in hemodynamics and metabolic demands is to prevent shivering in the first originating place [1].

Dexmedetomidine is a selective α_2-adrenoceptor agonist with strong effects on the central nervous system (CNS) **[3].** Ketamine is a competitive N-Methyl-D – aspartate [NMDA] receptor antagonist. It had been shown to prevent post- anesthesia shivering. However, a few studies were present to describe the efficacy of ketamine to prevent post-anesthesia shivering [4].

In addition, shivering interferes with hemodynamic monitoring (e.g., heart rate, blood pressure, and oxygen saturation) [5]. Shivering is a significant problem for anesthesiologists, especially during transurethral resection of the prostate [TURP]. Shivering may impair the surgeon's ability to visualize prostate tissue, and could be increased probability of the urethral, bladder, and rectal injury. Shivering prolongs the operative time, and may also lead to severe complications [6].

Magnesium sulfate [$MgSO_4$] has anti-shivering actions but it may augment the rate of cooling due to its vasodilator actions. Furthermore, it has possible neuroprotective actions and data suggested that the neuroprotective actions of hypothermia may be increased with the use of $MgSO_4$.Although intravenous [IV] $MgSO_4$ reduce shivering after general anesthesia (GA), there are no information on perioperative IV $MgSO_4$ in the management of shivering with regional anesthesia [7,8].

THE AIM OF THE WORK

The aim of the current work was to assess the effect of intraoperative dexmedetomidine, ketamine and magnesium sulfate to prevent shivering during trans-urethral prostatectomy under spinal anesthesia. The primary outcome was the shivering properties. The secondary outcomes include the degree of sedation, hemodynamic changes, and post-operative analgesia.

PATIENTS AND METHODS

This study was a single-blind, randomized clinical trial. It was carried out at the department of anesthesia and intensive care, Al-Azhar Faculty of Medicine [Damietta]. It was completed during the period from March 2021 to September 2021. It included 80 patients [a convenient sample], ages between 40-75 years, BMI <32 kg/m^2 with normal coagulation profile, American Society of Anesthesiologists [ASA] physical status I-II, scheduled for transurethral resection of the prostate, were enrolled in the study.

The exclusion criteria were 1] any significant coexisting disease, including severe renal or hepatic disease, thyroid disease, Parkinson's disease, dys-autonomia, Raynaud's syndrome, cardiopulmonary disease, or cerebrovascular disease requiring blood transfusion during surgery, 2] history of alcohol use or allergy to the agents to be used, 3] any contraindication to regional anesthesia, such as local infection or bleeding disorder or allergy to local anesthetic, 4] Body mass index > 35kg/m^2 and 5] patient refusal.

All eligible participants were submitted to a detailed history, physical examination, and vital data was recorded. The operative room temperature was kept at 21 to 22°C. The irrigation and IV fluids were infused at room temperature and given without warming. All patients were covered with surgical drapes (one layer) over their chest, thighs, and calves during surgery and then one cotton blanket used to cover the entire body after operation. No other heating devices were used. A core temperature below 36.5°C was considered as hypothermia. Before SA, each patient received 10 mL/kg/hr of Ringer's lactate solution over half an hour. The infusion rate was then decreased to 2 mL/kg/hr. Under complete asepsis, anesthesia was started in the sitting position at L3-4 or L4-5 interspaces. A three ml of hyperbaric bupivacaine 0.5% was injected by a 25-gauge spinal needle. Supplemental oxygen was administered intraoperatively by the face mask. Then patients were classified to the next groups: Group D: 20 patients received dexmedetomidine diluted to a volume of 50 ml by normal saline. It was given IV bolus of dexmedetomidine 1 mg/kg administered by a syringe pump over a 10 minutes' period followed by an infusion of 0.4 mg/kg/h during the surgery. Group K: 20 patients received IV ketamine 0.5 mg/kg, diluted to 50 mL in saline. Group M included 20 patients received an IV bolus of $MgSO_4$ 80 mg/kg via syringe pump over a 30-minutes period. This was followed by an infusion of two grams/hour during the intraoperative period. MgSO4 was diluted to a volume of 50 mL and prepared in coded syringes by an anesthesiologist. Group C included 20 healthy individuals who received a volume of 50 ml of normal saline followed by IV normal saline infusion.

Monitoring: Continuous monitoring of hemodynamic parameters was maintained for all patients in all groups with noninvasive multiparameter monitor and readings were recorded every 10 minutes for 60 minutes and at 1, 2, 4, 8, 16, and 24 hours postoperatively. The following

parameters were also noted in all cases.

Anesthesia time, defined as time taken from spinal puncture to final dressing of patients.

Surgery time was calculated from the first entry to the final one**.**

The level of irrigation fluid during transurethral resection of the prostate [TURP] does not exceed 60 cm above the patient level.

Onset of action: the efficacy of the technique was assessed every 5 minutes in the first 30 minutes after administration of local anesthetic agent by the onset time of sympathetic recording warming at the dermatomes blocked and cold sensitivity, was tested with a gel bag that was kept in a freezer and applied to a five-centimeter diameter area for three seconds. Sensory testing was performed by pin prick, and motor testing by modified Bromage scale.

Shivering was graded on a 5- grade scale; 0 for no shivering, 1 for piloerection or peripheral vaso-constriction but without observable shivering, 2 for muscular activity in only one muscle group, 3 for muscular activity in more than one group of muscles but not generalized, and 4 for shivering involving the entire body. The shivering incidence and severity were documented at 10 minutes' intervals during the operation and in the recovery room. If scores were three or greater at 15 minutes after SA, the prophylaxis was regarded as ineffective, and 25 mg of pethidine was administered through an intravenous route, as a rescuer drug. The degree of sedation was graded on a 5- point scale: 1 for fully awake and oriented patient, 2 for drowsy, 3 for closed eyes that respond (open) to commands, 4 for closed eyes that open with mild physical stimulation, and 5 for closed eyes and unresponsive to mild physical stimulation. Postoperative pain was graded on visual analogue scale at 4 hours' interval up to 24 hours.

Postoperative complication: the presence of any complications and their frequency are listed such as nausea, vomiting, shoulder pain, urinary retention, headache, or any other neurologic complain.

Statistical analysis:

Analysis of data was completed by the Statistical Program for Social Science, version 20 [SPSS Inc., Chicago, IL, USA]. Quantitative parameters were expressed by their means and standard deviations. Qualitative parameters were presented in their relative number and percentage. To compare quantitative variables between groups, one-way analysis of variance [ANOVA] with post-hoc analysis was completed. The student "t" test, was done when appropriate. Categorical parameters were compared by Chi-square [X^2] or Fisher's exact test when appropriate. A probability value < 0.05 is considered significant

RESULTS

Regarding the demographic data, there is no significant difference between the studied groups. The majority of patients were ASA Class-I [70.0%, 75.0%, 55% and 60% of control, D, K and M groups, respectively]. However, there was a statistically significant variance between study groups regarding the duration of analgesia and anesthesia [Table 3]. When post Hoc analysis was performed, the duration of anesthesia and analgesia were significantly longer in D, K and M groups when compared to the control group. In addition, they were significantly longer in D and K groups when compared to M Group [Table 1].

Regarding the mean arterial pressure, studied groups revealed a non-significant difference at the induction of anesthesia, 10 minutes after induction, and at post-operative 2, 4, 8, 16, and 24 hours. However, there was a statistically significant difference at 20, 30, 40, 50 and 60 minutes after induction. It was in the form of a significant decrease dexmedetomidine group when compared to other groups, followed by the magnesium sulfate, ketamine and the control group. In addition, there was a progressive reduction of blood pressure from induction to the end of surgery. Then, it started to increase but did not reach the baseline values at the end of follow up in all groups [Table 2]. Hear rate showed no significant difference between groups at induction, at 10, 40, 50 and 60 minutes after induction, and at all postoperative times. However, there was a significant reduction in dexmedeto-midine group when compared to other groups, at 20 and 30 minutes after induction [Table 2].

Regarding temperature, there was a significant difference between groups at 30 and 40 minutes after induction of anesthesia. The lowest tempered at 30 and 40 minutes was recorded among magnesium sulfate group, followed by the control group, ketamine and finally dexmedetomedine group. However, there was no significant difference at all other times of follow up [Table 2].

Regarding shivering, there was a significant decrease of shivering in treatment groups when compared to the control group. The lowest rate of shivering was registered with dexmedetomedine [10.0%], followed by ketamine [15.0%], magnesium sulfate [25.0%], while it was 55% in the control group [Table 3]. Degree of sedation demonstrated a statistically significant difference between the different studied groups regards degree sedation with p-value <0.001 as Dexmedetomidine has more sedation effect than ketamine, Mg sulfate and the control group [Table 3].

As regards the assessment of postoperative pain using VAS, there was a statistically significant difference among different studied groups regards VAS for pain with p-value <0.05, as in Dexmedetomidine group, there is an increase of VAS followed by decrease at 4 hours of operation while Mg sulfate group shows an increase of VAS score for pain at 2, 4 hours, then started to decrease at 16 hours. Ketamine group had an increase of VAS score

for pain at 2 hours, and 4 hours then started to decrease at 8, 16, and 24 hours, in the other hand, the control group showed a continuous increase of VAS for pain after surgery [Table 3].

As regards adverse effects, there was a statistically significant increase of hypotension and bradycardia in dexmedetomidine than other groups [Table 4].

Table [1]: Demographic data, ASA class and duration of anesthesia and analgesia among groups

		Control	Dexmedetomidine	Ketamine	Mg Sulfate	F [p]
		N=20	N=20	N=20	N=20	
Age, years		49±5.5	48±5.1	48 ±4.6	45±5.0	0.207
Weight, Kg		78±4.6	80±5.7	78±4.9	80±6.2	0.10
Height, Cm		176±2.9	176±6.3	176±5.7	173±2.7	0.055
ASA classification	I	14[70.0%]	15 [75.0%]	11 [55.0%]	12 [60.0%]	0.36
	II	6 [30.0%]	5 [25.0%]	9 [45.0%]	8 [40.0%]	
Duration of analgesia [h]		3.5±0.7	5.3±0.9	5.0±0.5	4.0±0.9	**<0.001***
Duration anesthesia [h]		2.2±0.31	3.4±33	3.0±0.55	2.5±0.45	**<0.001***

Quantitative data were expressed as mean±SD [range] and compared using one-way analysis of variance [ANOVA]

Table [2]: Comparison between groups regarding mean arterial blood pressure over study period

		Control	Dexmedetomidine	Ketamine	Mg Sulfate	p
		N=20	N=20	N=20	N=20	
Mean arterial Pressure	Baseline	85.9±3.8	86.8±3.7	86.7±4.6	85.6±4.1	0.74
	At 10 minutes	85.0±3.2	84.1±2.3	85.9±4.6	84.8±3.7	0.68
	At 20 minutes	80.9±7.2	76.8±6.6	83.8±5.5	79.9±7.0	***0.012****
	At 30 minutes	82.4±3.9	77.2±4.9	83.9±4.4	80.8±4.7	***<0.001****
	At 40 minutes	82.4±3.5	77.9±3.2	83.7±4.6	81.1±4.2	***<0.001****
	At 50 minutes	83.1±3.4	78.4±2.4	83.3±4.5	81.8±4.1	***<0.001****
	At 60 minutes	82.7±3.2	79.4±1.6	83.2±4.7	82.1±3.2	***0.002****
	After 1h	83.4±3.7	79.9±2.3	83.4±4.0	82.2±2.8	***0.005****
	After 2h	82.9±3.3	80.3±2.5	83.0±4.6	82.7±3.5	0.06
	After 4h	83.1±2.7	81.5±3.0	82.9±4.4	83.4±3.6	0.310
	After 8h	82.9±3.0	82.2±2.3	83.2±4.5	83.5±3.9	0.713
	After 16 h	83.7±2.9	82.0±2.1	83.5±4.6	83.7±4.3	0.371
	After 24	83.4±3.1	82.3±2.5	83.4±4.5	84.3±3.7	0.368
Hear rate	At 10 minutes	80.8±3.6	81.5±2.4	81.2±2.6	80.2±3.6	0.61
	At 20 minutes	73.7±7.0	69.2±9.3	77.0±2.5	74.2±9.5	0.017*
	At 30 minutes	74.4±6.4	70.8±7.1	75.5±2.5	75.0±5.9	0.049*
	At 40 minutes	75.7±5.8	73.1±4.9	75.7±2.3	75.7±3.2	0.15
	At 50 minutes	76.6±4.7	75.3±3.5	76.8±2.4	76.3±2.8	0.55
	At 60 minutes	77.6±3.5	76.6±2.7	77.7±1.6	77.1±2.6	0.56
	After 1h	78.2±2.7	78.1±1.7	78.6±1.6	77.4±3.4	0.52
	After 2h	79.3±1.7	78.5±2.0	79.0±1.5	78.3±2.4	0.39
	After 4h	79.6±1.5	78.8±1.6	78.8±1.6	79.2±2.4	0.43
	After 8h	79.6±1.7	78.7±1.9	79.2±1.6	79.2±2.5	0.54
	After 16 h	79.5±1.9	78.7±2.3	79.4±1.7	79.8±2.6	0.40
	After 24	80.1±1.7	78.5±1.9	80.0±2.0	79.5±2.2	0.06
Temperature	Baseline	36.98±0.17	37.01±0.17	37.01±0.17	36.98±0.14	0.87
	At 10 minutes	36.69±0.22	36.81±0.16	36.74±0.14	36.82±0.16	0.06
	At 20 minutes	36.57±0.37	36.76±0.23	36.71±0.22	36.64±0.31	0.17
	At 30 minutes	36.64±0.30	36.86±0.12	36.70±0.22	36.69±0.25	***0.029****
	At 40 minutes	36.72±0.24	36.89±0.11	36.78±0.17	36.71±0.17	***0.020****
	At 50 minutes	36.83±0.13	36.87±0.13	36.83±0.12	36.77±0.12	0.21
	At 60 minutes	36.83±0.11	36.91±0.12	36.86±0.10	36.83±0.12	0.07
	After 1h	36.87±0.11	36.86±0.16	36.85±0.14	36.81±0.11	0.55
	After 2h	36.85±0.10	36.85±0.14	36.86±0.15	36.86±0.11	0.99
	After 3h	36.86±0.09	36.89±0.14	36.85±0.19	36.82±0.14	0.49
	After 6h	36.89±0.13	36.85±0.15	36.85±0.19	36.87±0.13	0.78
	After 12 h	36.92±0.13	36.86±0.12	36.84±0.17	36.88±0.12	0.25
	After 24	36.92±0.17	36.87±0.12	36.86±0.16	36.89±0.14	0.51

Table [3]: Outcome among studied groups

		Control	Dexmedetomidine	Ketamine	Mg Sulfate	Test	p
		N=20	N=20	N=20	N=20		
Shivering		**11[55.0%]**	**2[10.0%]**	**3[15.0%]**	**5[25.0%]**	***12.59***	***0.006****
Shivering grade	0	9[45.0%]	18[90.0%]	17[85.0%]	15[75.0%]	16.75	0.16
	1	2[10.0%]	1[5.0%]	0[0.0%]	1[5.0%]		
	2	4[20.0%]	1[5.0%]	2[10.0%]	2[10.0%]		
	3	3[15.0%]	0[0.0%]	1[5.0%]	2[10.0%]		
	4	2[10.0%]	0[0.0%]	0[0.0%]	0[0.0%]		
Degree of Sedation	1	8 [40.0%]	2 [10.0%]	0 [0.0%]	0 [0.0%]	***69.4***	***<0.001****
	2	12 [60.0%]	2 [10.0%]	1 [5.0%]	16 [80.0%]		
	3	0 [0.0%]	16 [80.0%]	13 [65.0%]	4 [20.0%]		
	4	0 [0.0%]	0 [0.0%]	6 [30.0%]	0 [0.0%]		
	5	0 [0.0%]	0 [0.0%]	0 [0.0%]	0 [0.0%]		
Visual analogue Scale	At 1h	1 [1-2]	1 [1-2]	1 [1-2]	1 [1-2]	0.01	0.985
	At 2h	3 [2-5]	3 [2-4]	2 [1-3]	3 [1-4]	5.7	0.001*
	At 4h	4 [2-6]	2 [2-4]	3 [2-4]	4 [2-5]	12.0	<0.001*
	At 8h	4 [2-6]	2 [2-4]	2 [2-3]	4 [2-5]	11.9	<0.001*
	At 16 h	3 [2-5]	2 [2-4]	2 [2-4]	3 [2-4]	4.5	0.006*
	At 24	4 [2-5]	2 [1-3]	1 [1-3]	2 [2-4]	29.9	<0.001*

Table [4]: Adverse events developed with each group

	Control	Dexmedetomidine	Ketamine	Mg sulfate	test	Sig.
	N=20	N=20	N=20	N=20		
Nausea	5 [25.0%]	2 [10.0%]	4 [20.0%]	2 [10.0%]	3.8	0.283
Vomiting	2 [10.0%]	0 [0.0%]	0 [0.0%]	0 [0.0%]	6.2	0.104
Bradycardia	3[15.0%]	7[35.0%]	0 [0.0%]	4 [20.0%]	***8.65***	***0.034****
Hypotension	3[15.0%]	8[40.0%]	1[5.0%]	4[20.0%]	***8.12***	***0.043****

DISCUSSION

Shivering is a common complaint in patients undergoing TURP under spinal anesthesia and it not only affects the comfort of the patient but also increases oxygen consumption and difficulty of monitoring of the patients. The findings showed that increased body metabolism during shivering can lead to myocardial ischemia [9]. Thus, prevention of intra- and/or post-operative shivering is of utmost importance.

Many drugs were tried for prophylaxis against spinal anesthesia-associated shivering in TURB. However, no consensus exists about the efficacy and safety of the drugs. The ideal drug had not established yet. The current work compared intravenous administration of dexmedeto-medine, ketamine and magnesium sulfate, as a possible drug prophylaxis against SA-associated shivering.

Results revealed that, the most effective drug for prevention of shivering was dexmedetomedine [10.0%] followed by ketamine [15.0%] and magnesium sulfate [25.0%]. The control group [received no drugs] showed the highest level of shivering [55.0%]. There was a significant difference between study groups and the control group. However, dexmedetomidine was associated with a higher incidence of hypotension and bradycardia [the conditions responded to medical therapy and associated with no major adverse events]. Additionally, dexmedetomedine and other drugs are associated with lower postoperative pain.

These results are in line with Omar *et al.* [10], where the control group had significantly higher incidence of shivering [60.0%] than magnesium sulfate [17.4%] and dexmedetomedine [14.3%] groups [p-value <0.001]. The difference between dexmedetomidine and the magnesium sulfate groups was statistically non-significant.

Usta *et al.* [11] studied the prophylactic actions of IV dexmedetomidine on shivering. They reported that dex-medetomidine infusion markedly decrease the incidence and severity of shivering, with no major adverse consequences. These results agree with the current study.

In addition, Moawad *et al.* [12] investigated the effect

of adding dexmedetomidine to bupivacaine and found that it markedly decreased the incidence and intensity of shivering in patients undergoing TURP. In a study by Sachidananda *et al*. [13], an intravenous prophylactic use of $MgSO_4$ and tramadol effectively decrease shivering and its gravity during cesarean section under SA.

Zhou *et al*. [14] study evaluates the safety and efficacy of the prophylactic ketamine use to prevent post-anesthesia shivering and reported that ketamine markedly decreased the incidence of post anesthetic shivering when compared to placebo.

Mason and Lerman [15] reported anti-shivering action in the dexmedetomidine group of their study. The shivering reduction might be ascribed to the action of dexmedetomidine [11], that could inhibit the heat regulating center through activation of α_2-adrenergic receptors, and reduction of temperature threshold of shivering [16], and suppress the afferent temperature information at the spinal level.

Megalla and Mansour [17] observed that dexmedeto-midine produced a fast and effective shivering control in 100% of patients compared to 92% in the nalbuphine group and 32% in the placebo group. They observed a significant difference only when dexmedetomidine and nalbuphine groups were compared to placebo group.

On the other side, Botros *et al*. [18] compared the preventive effects of infused placebo, 1 µg/kg of dexmedetomidine and 8 mg of ondansetron on the post-SA shivering in 120 patients submitted to diverse surgeries of the lower body and found that IV dexmedetomidine and ondansetron were equally effective in reduction of the incidence of post-SA shivering, as placebo. These results contradict to the current study and this could be attributed to different sample size, different inclusion and exclusion criteria. In addition, they included all surgeries on the lower body while we only included those of TURP.

Omar *et al*. [10] reported similar results of a significant decrease of temperature in Mg sulfate than the dexmedetomidine group, and in both groups than the control group.

Our results agree with that of Makhni *et al*. [19] who observed a significant reduction of postoperative pain scores in dexmedetomidine than Mg sulfate group [p <0.001].

In addition, Javahertalab *et al*. [20] reported a significant difference in pain among the three groups at recovery, and 2-, 4-, 6-, and 12-hours post operation, with a lower score in the dexmedetomidine group than others at all times.

Nikoubakht *et al*. [21] reported that, there was a significant difference among the groups regarding pain intensity during the recovery and at 2, 4, 6, 12, and 24 hours after surgery. However, there were no significant differences between ketamine and dexmedetomidine regarding the severity of pain.

In the current study, dexmedetomidine has a more sedative effect than ketamine, Mg sulfate and the control groups. Similarly, Houssein *et al*. [22] study showed that deep sedation was recorded in group D as 36.67% of group D had grade 4 sedation compared to 23.33% in group K after 10 minutes [P=0.048].

Regarding hemodynamics, our results go in line with Moawad *et al.* [12] study which was included 80 patients scheduled for TURP under spinal anesthesia to explore the dexmedetomidine role in shivering reduction and prevention and found statistically marked increase of hypotension in dexmedetomidine than the control group.

Also, the same was reported by Dehkordy *et al*. [23] study which was conducted on 40 patients underwent emergency surgical procedures to estimate the effect of dexmedetomidine and Ketamine on incidence and severity of postoperative sore throat and found a statistically significant reduction of diastolic blood pressure in dexmedetomidine than Ketamine group.

Zhou *et al*. [14] study concluded that Ketamine reduced the incidence of hypotension compared with placebo.

In short, dexmedetomidine has a helpful action as an anti-shivering and sedating agent during SA without any major adverse effects. Thus, dexmedetomidine infusion is a good choice during spinal anesthesia to decrease shivering.

Conflict of interest:

Authors declare that, there was no conflict of interest

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