

## Original Research Article

# Efficacy of dexmedetomidine in the prevention and treatment of postanesthetic shivering after cesarean section

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### Abstract

**Purpose:** To assess the efficacy of dexmedetomidine in the prevention and treatment of postanesthetic shivering in cesarean section.

**Methods:** A total of 144 pregnant women who underwent anesthesia for cesarean section between March and December 2022 were randomly divided into the study group ( $n = 72$ ) and control group ( $n = 72$ ). The pregnant women were given combined spinal-epidural anesthesia. Following childbirth, those in the study group were given dexmedetomidine, while those in the control group were given normal saline. The dose of spinal anesthesia was administered based on the following criteria: intraoperative infusion, atropine usage, ephedrine usage, intraoperative bleeding, intraoperative dosage, mean arterial pressure, heart rate, blood oxygen saturation, incidence of shivering, and sedation score. Incidence of adverse reactions were recorded and compared between the two groups.

**Results:** Intraoperative infusion volume, bleeding volume, levels of atropine and ephedrine usage, and spinal anesthesia dose were similar between the two groups ( $p > 0.05$ ). At 10 min post-treatment, the study group had lower mean arterial pressure, heart rate and incidence of postanesthetic shivering, as well as higher postoperative sedation score than the control group. Compared with the control group, the study group had slightly higher incidence of pregnancy-related adverse reactions, but the difference was non-significant.

**Conclusion:** Dexmedetomidine has good efficacy in preventing and treating postanesthetic shivering in cesarean section patients. However, further clinical trials are required prior to its adoption in clinical practice.

**Keywords:** Dexmedetomidine, Cesarean section, Postanesthetic shivering, Spinal anesthesia, Sedation score

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## INTRODUCTION

Shivering is the most common complication of intraspinal anesthesia during cesarian section.

Shivering is observed in over 57% of pregnant women undergoing cesarean section, and its occurrence follows a seasonal pattern in which it is observed predominantly in autumn and winter

[1,2]. Studies have shown that shivering in pregnant women after a cesarean section may lead to increased intraocular and intracranial pressure, subjective feeling of severe discomfort, reduced quality of life, and increased carbon dioxide production due to anaerobic respiration [3]. If not treated in time, these changes may result in severe acidosis and gradual reduction in resistance to infection, which are unfavorable for full postoperative recovery [4]. Different combinations of medications have been investigated in the prevention and treatment of shivering after cesarean section, but none of these regimens have demonstrated promising outcomes [5]. However, studies have reported that the use of dexmedetomidine during cesarean section effectively prevented postanesthetic shivering [6]. Therefore, the present study aims to evaluate the efficacy of dexmedetomidine in alleviating postanesthetic shivering in 144 pregnant women undergoing cesarean section in this hospital.

## SUBJECTS AND METHODS

### General data

A total of 144 pregnant women who underwent cesarean section with anesthesia between March and December, 2022 in Dazhou Hospital of Integrated Traditional Chinese and Western Medicine, Dazhou, China were randomized into study (n = 72) and control groups (n = 72). There were no significant differences in the general

patient profile, including weight and age between the two groups ( $p > 0.05$  Table 1). Ethical approval was obtained from the Medical Ethics Committee of Dazhou Hospital of Integrated Traditional Chinese and Western Medicine (approval no. 2021-052), and the study complied with international guidelines for human studies [7]. Informed consent was obtained from all patients.

### Method of anesthesia

All subjects were required to stop food intake for about 8 h and to stop fluid intake for about 6 h prior to the cesarean section. A venous access was established after entry into the operating room and the room temperature was controlled at around 25 °C. Continuous monitoring was performed on subjects who showed changes in vital signs. All subjects were given spiral-epidural anesthesia. Specifically, an epidural puncture was made in the third and fourth intervertebral space until the subarachnoid space was reached. When the cerebrospinal fluid was aspirated into the syringe, 1.5 mL of 0.75 % bupivacaine hydrochloride and 0.5 mL of 10 % glucose mixture was injected, followed by withdrawal of the puncture needle. Then cesarean section was performed on the subjects. Once the fetus was safely delivered, 10 mL of PBS containing dexmedetomidine (0.5 µg/kg) was given to the women in the study group, while 10 mL of normal saline was given to those in the control group via intravenous drip.

**Table 1:** General and surgical conditions of the two groups (mean ± SD)

Variable		Study group (n = 72)	Control group (n = 72)	t/ $\chi^2$ value	P-value
Age (year)		31.22 ± 3.23	30.97 ± 4.02	0.411	0.681
Weight (kg)		67.22 ± 4.32	66.94 ± 4.55	0.379	0.706
Height (cm)		166.53 ± 4.23	166.23 ± 4.94	0.406	0.686
Gestational age (week)		38.72 ± 1.39	38.58 ± 1.44	0.594	0.554
Gravida (number)		1.51 ± 0.50	1.54 ± 0.50	0.36	0.719
ASA class	Class I	30 (41.67%)	33 (45.83%)	0.254	0.614
	Class II	42 (58.33%)	39 (54.17%)		
Surgery time (min)		65.23 ± 6.35	64.97 ± 6.21	0.248	0.804
Education level [n(%)]	High school and below	34 (47.22%)	31 (43.06%)	0.267	0.874
	College and university	31 (43.06)	33 (45.83)		
	Postgraduate	7 (9.86)	8 (11.11)		
Residence	Nonlocals	3 (4.17)	2 (2.78)	0.207	0.649
	Locals	69 (95.83)	70 (97.22)		
Gestational diabetes	Yes	12 (16.67)	11 (15.28)	0.052	0.820
	No	60 (83.33)	61 (84.72)		
Gestational hypertension	Yes	14 (19.44)	13 (18.06)	0.046	0.831
	No	58 (80.56)	59 (81.94)		
Gestational thyroid disease	Yes	7 (9.72)	8 (11.11)	0.074	0.785
	No	65 (90.28)	64 (88.89)		
Gestational anemia	Yes	8 (11.11)	9 (12.50)	0.067	0.796
	No	64 (88.89)	63 (87.50)		

## Evaluation of parameters/indices

### Intraoperative parameters

Spinal anesthesia dose, intraoperative infusion volume, frequency of atropine and ephedrine use, intraoperative bleeding volume, and intraoperative dose were assessed and recorded for all patients.

### Shivering score

Shivering was graded based on Wrench scale [8] as follows: 1) Grade 0: No shivering observed; 2) Grade 1: Piloerection, peripheral vasoconstriction, and peripheral cyanosis without visible muscular activity; 3) Grade 2: Visible muscle activity confined to one muscle group; 4) Grade 3: Visible muscle activity in more than one muscle group; 5) Grade 4: Gross muscular activity involving the entire body.

### Vital signs

Heart rate, mean arterial pressure, and blood oxygen saturation were recorded before surgery and at 10, 20 and 30 min after dexmedetomidine treatment.

### Incidence of adverse reactions

The incidence of bradycardia, nausea, vomiting, and blood pressure decrease were recorded.

### Sedation score

Postoperative sedation was graded using the Ramsay sedation score as follows: 1) Grade 0: Restless, anxious or agitated; 2) Grade 1: Tranquil and co-operative; 3) Grade 2: Lethargic, responding to commands only; 4) Grade 3: Asleep but arousable; 5) Grade 4: Sluggish

response to stimulus; 6) Grade 5: No response to loud auditory stimulus.

### Statistical analysis

Data were statistically analyzed using SPSS 20.0. Measured data are expressed as mean as  $\text{mean} \pm \text{SD}$  and compared using Student's *t*-test. Count data were expressed as percentage (%) and compared using Chi square test.  $P < 0.05$  was considered statistically significant.

## RESULTS

### Intraoperative parameters

There were no significant differences in intraoperative infusion volume, bleeding volume, frequency of atropine and ephedrine use, and spinal anesthesia dose between the two groups ( $p > 0.05$  Table 2).

### Pre-treatment shivering score

There was no significant difference in the incidence of pre-treatment shivering between the two groups ( $p > 0.05$ ; Table 3).

### Changes in vital signs

There were no significant differences in preoperative vital signs between the two groups ( $p > 0.05$ ). However, patients in the study group had significantly lower average arterial pressure and heart rate at 10 min post-treatment ( $p < 0.05$ ), but not at other time points, than patients in the control group. Moreover, blood oxygen saturation was similar across all time points among patients in both groups ( $p > 0.05$ ; Table 4).

**Table 2:** Comparison of intraoperative parameters (mean  $\pm$  SD, n, %)

Group	N	Spinal anesthesia dosage (mg)	Intraoperative infusion volume (mL)	Atropine use	Ephedrine use	Intraoperative bleeding volume (mL)	Intraoperative dosage (mL)
Study	72	9.76 $\pm$ 2.57	1310.22 $\pm$ 122.12	6 (8.33%)	7 (9.72%)	330.22 $\pm$ 23.35	18.72 $\pm$ 1.21
Control	72	9.11 $\pm$ 1.21	1280.99 $\pm$ 111.19	4 (5.56%)	6 (8.33%)	328.15 $\pm$ 24.04	18.40 $\pm$ 1.11
<i>t</i> or $\chi^2$ value	--	1.941	1.502	0.4299	0.0846	0.524	1.654
<i>P</i> -value	--	0.054	0.135	0.5121	0.7712	0.601	0.100

**Table 3:** Pre-treatment shivering score (n, %)

Group	Shivering classification				Incidence of shivering
	Class 0	Class 1	Class 2	Class 3	
Study	51 (70.83%)	8 (11.11%)	4 (5.56%)	9 (12.5%)	21 (29.17%)
Control	47 (65.28%)	5 (6.94%)	14 (19.44%)	6 (8.33%)	25 (34.72%)
$\chi^2$ value	—				0.511
<i>P</i> -value	—				0.474

**Table 4:** Comparison of vital signs at different time points between the two groups (mean  $\pm$  SD, n = 72)

Parameter	Group	Preoperative	10min post-treatment	20min post-treatment	30min post-treatment
Heart rate (beat/min)	Study	92.74 $\pm$ 8.17	76.94 $\pm$ 5.44	88.47 $\pm$ 9.39	89.33 $\pm$ 8.19
	Control	92.96 $\pm$ 8.67	88.31 $\pm$ 5.77	88.97 $\pm$ 9.07	89.63 $\pm$ 7.94
	t value	—	0.156	12.166	0.324
P-value	—	0.875	< 0.001	0.745	0.823
Mean arterial pressure (mmHg)	Study	81.65 $\pm$ 11.27	72.39 $\pm$ 11.49	83.94 $\pm$ 13.14	83.92 $\pm$ 11.21
	Control	82.09 $\pm$ 11.68	81.32 $\pm$ 11.07	83.07 $\pm$ 11.08	83.85 $\pm$ 11.16
	t value	—	0.230	4.749	0.429
P-value	—	0.818	< 0.001	0.668	0.970
Blood oxygen saturation (%)	Study	97.71 $\pm$ 0.43	97.64 $\pm$ 0.79	97.97 $\pm$ 0.86	97.65 $\pm$ 0.48
	Control	97.86 $\pm$ 0.56	97.86 $\pm$ 0.68	97.74 $\pm$ 0.80	97.69 $\pm$ 0.50
	t value	—	1.803	1.791	1.661
P-value	—	0.074	0.075	0.099	0.625

**Table 5:** Comparison of postanesthetic shivering {(n, %), N = 72}

Group	Grade 0	Grade 1	Grade 2	Grade 3	Grade 4	Total incidence
Study	69 (95.83%)	2 (2.78%)	1 (1.39%)	0 (0)	0 (0)	3 (4.17%)
Control	54 (75%)	10 (13.9%)	6 (8.32%)	1 (1.39%)	1 (1.39%)	18 (25%)
X <sup>2</sup> value	12.543					
P-value	< 0.001					

**Table 6:** Comparison of postoperative sedation score {(n, %), N = 72}

Group	Grade 0	Grade 1	Grade 2	Grade 3	Grade 4
Study	0 (0.00%)	33 (44.44%)	10 (13.89%)	28 (38.89%)	0 (0.00%)
Control	38 (52.78%)	34 (47.22%)	0 (0.00%)	0 (0.00%)	0 (0.00%)
X <sup>2</sup> value	78.012				
P-value	0.000				

**Table 7:** Comparison of intraoperative adverse reactions {(n, %), N = 72}

Group	Decreased blood pressure	Bradycardia	Nausea and vomiting	Total incidence
Study	7 (9.72%)	6 (8.33%)	1 (1.39%)	14 (19.44%)
Control	6 (8.33%)	4 (5.56%)	2 (2.78%)	12 (16.67%)
X <sup>2</sup> value	—			
P-value	—			

### Postanesthetic shivering after treatment

The study group had significantly lower incidence of postanesthetic shivering than the control group ( $p < 0.05$ ; Table 5).

### Postoperative sedation score

The study group had significantly higher postoperative sedation score and better sedation than the control group ( $p < 0.05$ ; Table 6).

### Intraoperative adverse reactions

The study group had slightly but non-significantly higher incidence of pregnancy-related adverse reactions than the control group ( $p > 0.05$ ; Table 7).

## DISCUSSION

Cesarean section is an important advancement in modern medicine and a common procedure for childbirth in pregnant women. This surgical approach provides a safer delivery and substantially reduces the pain suffered by pregnant women during natural childbirth, thus increasing the safety and health of mothers and infants [9]. However, like other types of surgery, anesthesia is required during cesarean section, which results in varying levels of postanesthetic shivering and various complications in pregnant women following the operation [10].

Although the mechanism involved in shivering is unclear, it is speculated to be associated with sympathetic nerve block and mental stress in pregnant women. It has been reported that

dexmedetomidine can impact circulation, such as causing abnormal fluctuations in blood pressure and heart rate, and these effects are inevitably related to the dose of the drug [11]. The administration of a low dose of dexmedetomidine leads to a decrease in blood pressure, whereas a high dose causes short-term bradycardia and high blood pressure in pregnant women. Despite the fact that the bleeding symptoms are pathologically unstable, they are still manageable and are resolved by immediate drug intervention [11]. Therefore, continuous monitoring of the vital signs and strict dose control are required in pregnant women receiving dexmedetomidine.

Dexmedetomidine induces a state of natural sleep in pregnant women in which the patients are able to wake and respond to the doctor's instructions and return to sleep once the stimulus is removed [12]. The advantages of dexmedetomidine are that the drug exerts neuroprotective and sedative effects without significantly inhibiting respiration. As a result of improvements in medication use and techniques, the anesthesia approaches for cesarean section have also improved. Dexmedetomidine has demonstrated promising anesthetic outcomes during surgery and increased the satisfaction of pregnant women and their families [13]. The anesthetics sedate pregnant women, but still allow them to maintain their physical functions while asleep. Regardless of the dose injected, the concentration of dexmedetomidine remains relatively high in the body, which allows deep vein anesthesia and hence local anesthesia. The sedative and analgesic effects of these medications are complicated, hence the clinical dose of such drugs, including dexmedetomidine, should be greatly reduced. Dexmedetomidine is more effective than other anesthetics, as it reduces pain and improves the quality of life of pregnant women [14].

Although dexmedetomidine provides sedation and analgesia during cesarean section, it still affects the heart rate of pregnant women. Therefore, surgical stress response must be further reduced to ensure that the patient can recover from anesthesia as soon as possible. The common adverse symptoms in patients receiving dexmedetomidine are decreased blood pressure and bradycardia [15]. As advances in medical techniques and treatment approaches continue to advance, the adverse reactions of dexmedetomidine have also gradually reduced. Nonetheless, the complexity in the mechanism of action of dexmedetomidine should not be overlooked, and safe and effective use of the drug remains the key focus in clinical applications.

Anesthesia-induced shivering is observed in about 65 % of patients undergoing cesarean section. Surgical pain and anesthesia-induced suppression are the major causes of shivering and directly impact spinal reflexes and sympathetic nerve activities [16]. Shivering causes the body to consume oxygen and generate carbon dioxide, which leads to a persistent increase in the heart rate and blood glucose. In addition, shivering results in complications, e.g., acidosis, which poses a direct risk to the life and health of pregnant women [17]. Physiological and pathological shivering are the two main forms of shivering. Physiological shivering occurs when the indoor temperature is low and the body suffers from severe pain. In this case, excessive intervention is not required, and the symptom is relieved and disappears after a certain period of time. However, when shivering is caused by non-physiological factors, changes in the vital signs of pregnant women must be closely monitored. Once pathological shivering is confirmed, specific measures should be implemented based on the patient's actual conditions.

Perioperative dexmedetomidine use reduces stress-induced neuroendocrine responses, effectively inhibits the excitation of sympathetic transmission in renal nerves, and controls the secretion of antidiuretic hormones and atrial peptides. Furthermore, the drug stabilizes blood flow, regulates the thermoregulatory center of the brain, reduces the shivering threshold, controls the spinal fluid level by inhibiting body temperature changes, and ensures the effectiveness of transmitted signals [18]. Shivering has been shown to be associated with nervousness and anxiety. Dexmedetomidine helps pregnant women enter into a comfortable state, and eliminates unnecessary external interferences, which together enhances its therapeutic effect in intraoperative shivering [19,20].

Spinal anesthesia and lumbar and epidural anesthesia are the primary anesthesia approaches used for cesarean section. While no special treatment is required for physiological shivering, pathological shivering causes pain in pregnant women. The association between shivering and pain in turn leads to severe symptoms (e.g. increased intracranial and intraocular pressure) and aggravated pain during cesarean section [19,20]. If a pregnant woman has coronary heart disease, shivering may increase the risks of other problems, which can impact anesthesia monitoring during surgery. Dexmedetomidine is a common anesthetic and anesthesia approach for cesarean section. It

effectively lowers the incidence of shivering, prevents neuroendocrine disorder, and eliminates the occurrence of other symptoms in pregnant women. Since dexmedetomidine induces moderate sedation in pregnant women, it reduces muscle tremors, decreases anxiety and tension, thereby fundamentally ensuring the comfort of the patient during delivery.

This study investigated the efficacy of dexmedetomidine in alleviating postanesthetic shivering in 144 pregnant women undergoing cesarean section between March and December, 2022. The results showed that patients in the study group received significantly lower atropine and ephedrine doses but similar intraoperative infusion volume, bleeding volume, and spinal anesthesia dose compared with those in the control group. Furthermore, while vital signs were similar among patients in the two groups before surgery, average arterial pressure and heart rate were significantly different at 10 min post-surgery, though there were no significant differences in these two parameters at other time points between the two groups.

Likewise, blood oxygen saturation was comparable in the two groups of patients at all time points. In addition, patients in the study group had significantly lower incidence of postanesthetic shivering, but higher postoperative sedation score and better sedation than those in the control group. Though, the incidence of pregnancy-related adverse reactions was non-statistically significant between the two groups.

## CONCLUSION

Dexmedetomidine is effective in the clinical prevention and treatment of postanesthetic shivering in pregnant women undergoing caesarean section. However, further clinical trials are required to validate these findings.

## DECLARATIONS

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None provided.

### Funding

None provided.

### Ethical approval

None provided.

## Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

## Conflict of Interest

No conflict of interest associated with this work.

## Contribution of Authors

We declare that this work was done by the authors named in this article and all liabilities pertaining to claims relating to the content of this article will be borne by the authors. Yi Wang and Xianjie Zhang designed the study and carried it out, including data collection and analysis. They interpreted the data, prepared the manuscript for publication and reviewed the draft of the manuscript. Both authors read and approved the manuscript for publication.

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