

Clinical Study on the Effects of Different Positions on Supine Hypotensive Syndrome in Cesarean Section after Lumbar Anesthesia

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Abstract: Objective : To explore the effects of different positions on supine hypotensive syndrome in cesarean section after lumbar anesthesia. **Methods:** 600 full-term parturient were randomly divided into 4 groups. The patented positioning pads (patent number: ZL 2017 2 0618886.5) in our department was used when the left-leaning position was placed. The parturient lied in a supine position for anesthesia, and then the group of positioning pads was placed after turning into the lateral position. The parturient were divided into group A (supine position), group B (left-leaning to 10 °), group C (left-leaning to 20 °), and group D (30 °). Observation index: Main index: Comparison of maternal blood pressure changes and neonatal blood gas analysis in the supine position without using position pad and with the use of patent positioning pads in different tilt angles (10°, 20°, 30°). Minor index: 1) the use and frequency of vasoactive drugs, whether a left-leaning operating bed or uterine displacement is required; 2) the selffeeling of the parturient; 3) newborn's Apgar scores of 1 minute, 5 minutes, and 10 minutes after birth; 4) whether the obstetrician can perform the operation smoothly in the corresponding left leaning position. **Results:** The blood pressure at the supine position after anesthesia, the beginning of surgery and the time when the newborn was delivered in group A and group B were significantly different from those in group C ($P<0.05$). There were significant differences at different timings in group A and group B, and the decline was more significant at the supine position after anesthesia, the beginning of surgery and the time when the newborn was delivered ($P<0.05$). The pH of blood gas of newborns in group A, group B and group C was between 7.25 and 7.37, and there was no

significant difference among the three groups ($P>0.05$).

Conclusion: The use of positioning pads can prevent the adverse effects of supine hypotensive syndrome on parturient and newborns to a certain extent.

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1 Introduction

The term supine hypotensive syndrome (SHS) was first proposed by Howard et al. in 1953. It is mainly that women in late pregnancy have symptoms similar to cyclic shock when they adopt the supine position, which can be relieved by switching their position to the lateral position. Its clinical features mainly include dizziness, nausea, vomiting, chest tightness, pale, cold sweats, rapid heartbeat, and varying degrees of blood pressure decline. Serious cases can be life-threatening. When switched to the lateral position, the above symptoms are reduced or disappeared^[1-3].

The supine hypotensive syndrome mainly occurs in parturient in the third trimester of pregnancy. It is generally considered to be mainly related to the position of the parturient. The uterus is enlarged in the third trimester of pregnancy, so when the supine position is taken, the enlarged pregnant uterus can compress the inferior vena cava, hinder the return flow of the inferior vena cava and pelvic veins, decrease the volume of venous blood, and reduce the cardiac activity, which caused a series of shocks due to the decreased blood pressure. Clinical findings show that parturient with abnormal uterine enlargement, such as multiple

pregnancy and amniotic fluid hypertrophy, are more likely to suffer from the syndrome, and its occurrence is related to the compression of inferior vena cava^[3].

In terms of imaging showing, recent MRI also confirmed that the full-term parturient can almost compress the inferior vena cava completely in the supine position^[4]. However, more than 90% of full-term pregnant parturient are asymptomatic and hemodynamically stable in the supine position, proving that a compensation mechanism exists under physiological conditions, but this compensation mechanism will be weakened after nerve axis block. Current clinical practice and guidelines suggest that for parturient receiving selective spinal anesthesia with axonal block, a left-leaning position of 12°-15° should be adopted. However, magnetic resonance imaging suggests that compared with the supine position, the volume of the inferior vena cava is slightly increased but not obvious with a full-term maternal left-leaning position of 15°; the volume of the inferior vena cava can be significantly increased with the left-leaning position of 30°^[4].

Despite various assessments were taken, the effect of lower extremity blood reflux and decreasing blood pressure on uterine placental perfusion is unclear, and the effect on neonatal outcome is unknown. A recent study showed that maternal supine position is associated with fetal stillness and the reduction of fetal heart rate variability^[5].

Therefore, further research on SHS is needed to assess and improve maternal and newborn outcomes. In the past two years of clinical practice, the application of our department's utility model patented positioning pads (patent number: ZL 2017 2 0618886.5) can improve the supine hypotensive syndrome to a certain extent. To this end, we intend to study the effects of different left-leaning positions on the supine hypotensive syndrome in parturient undergoing cesarean section after intrathecal anesthesia.

2 Research content and methods

2.1 Research object

The parturients who underwent cesarean section in our hospital from January 2017 to December 2019 were

selected.

2.2 Inclusion criteria and Exclusion criteria

Full-term parturients with the age of 18-35, grade ASAI-II. This study was conducted with the informed consent of patients and their families and approved by the hospital's clinical research ethics committee.

Parturients with contraindications of intraspinal anesthesia, inability to cooperate with the completion of intraspinal anesthesia effectively, accompanied by functional impairment of important organs such as heart, lung, liver, kidney, and a history of mental illness.

Rejection criteria: The upper plane of anesthesia after spinal anesthesia is not at T6-T8 level; the condition of spinal canal anesthesia is not good, and drugs of sedation or analgesia should be supplemented; blood loss during operation > 20% of blood volume; severe complications such as amniotic fluid embolism and eclampsia.

2.3 Case grouping

600 cases are planned to be divided into four groups according to the random number table. 150 patients in group A did not use the positioning pad, 150 patients in group B used the 10° positioning pad, 150 patients in the group C used the 20° positioning pad, and 150 patients in the D group used the 30° positioning pad.

2.4 Anesthesia implementation and monitoring

Fluid infusion: Participating parturients were injected with compound sodium chloride injection, implemented crystal co-loading, and the infusion volume was 20 ml/kg^[6].

2.5 Anesthesia puncture and administration

After entering the room, instructed the parturient to lie down with the supine position and placed the ECG monitor; then switched the parturient into the left-leaning position and puncture position before the intraspinal anesthesia. Selected L2-3 or L3-4 space for puncture. After reaching the subarachnoid space, injected an equal proportion of anesthetic (0.75% bupivacaine 1.5ml + cerebrospinal fluid 1.5 ml). The injection time was 10±3 seconds. The time of epidural tube was controlled within 5 minutes (Figure 1).



Figure 1. Positioning pad placement (with positioning pad and patent certificate)

After completing the anesthesia, the parturient was placed a patented positioning pad on the right hip to the back before lying down, and left leaned for 10°, 20°, 30°.

2.6 Observation index

Main index: 1) Compare maternal blood pressure changes in supine position without using a position pad and with the use of patent positioning pads in different tilt angles (10°, 20°, 30°) 2) Compare the changes in blood gas analysis of the newborn in supine position without using a position pad and with the use of patent positioning pads in different tilt angles (10°, 20°, 30°).

Minor index: 1) the use and frequency of vasoactive drugs, whether a left-leaning operating bed or uterine displacement is required; 2) the consciousness of the parturient (unconscious, weak consciousness, feeling like leaning slightly, feeling like falling into bed; 3) Newborn's apgar scores of 1 minute, 5 minutes, and 10 minutes after birth; 4) whether the obstetrician can perform the operation smoothly in the corresponding left leaning position(no effect, weak effect, slight effect, severe effect).

2.7 Data statistics and analysis

Data statistics and analysis are implemented in R language; repeated measurement data are analyzed by variance within and between groups; measurement data are first tested for normality, and if satisfied, described

by means±standard deviation. Comparison between groups is performed by analysis of variance or Chi-square; otherwise, the median, minimum, and highest values are used, and the rank sum test is used; $P < 0.05$ indicates a statistical difference.

3 Results

In 3 cases study of group D, all 3 parturient had a strong sense of falling into bed, and obstetricians were unable to carry out the operation normally. Then these parturient were excluded in group D. The basic characteristics of maternal groups in groups A, B, and C were significantly different in age, BMI, abdominal circumference, gestational age, amniotic fluid index, fluid input, bleeding, and urine volume. The basic characteristics of maternal groups in groups A, B, and C were significantly different in age, BMI, abdominal circumference, gestational age, amniotic fluid index, fluid input, bleeding, and urine volume. Combined diseases mainly included pregnancy-induced hypertension, cholestasis during pregnancy, gestational diabetes, etc. The average gestational week with cholestasis during pregnancy was 37.8 weeks (37.8±0.7). The average time from the beginning of the operation to fetal delivery in group C was 7.5 min (7.5±1.2). The average time was longer than that of group A and group B, but there was no significant difference between the three groups.

Table 1. Demographic characteristics of each group before operation

groups	group A	group B	group C	ANOVA
cases	139	142	135	
age	27.8±6.5	28.2±7.5	29.1±8.2	NS
BMI(kg/m ²)	25.5±8.9	24.2±9.2	23.1±8.1	NS
abdominal girth	92.2±10.1	94.3±9.5	93.6±8.9	NS
combined disease(%)	12.1	13.6	15.2	NS

Continued table 1

groups	group A	group B	group C	ANOVA
Gestational age(week)	38.5±1.2	39.1±1.5	38.9±1.6	NS
amniotic fluid index	13.5±2.9	12.9±2.1	13.1±3.0	NS
fluid input(ml)	1359.5±102.5	1269.2±109.4	1298.6±112.8	NS
Bleeding(ml)	462.6±56.8	475.2±62.9	483.8±70.5	NS
time of the beginning of the operation to fetal delivery(min)	6.8±1.1	7.0±0.9	7.5±1.2	NS
urine volume(ml)	189.1±32.6	185.6±30.9	196.5±40.2	NS
use of vasoactive drug(case /%)	62(44.6)	45(31.7)	29(21.5)	<i>P</i> <0.05

Note: ANOVA means analysis of variance; NS means no significant statistical difference.

Blood pressure, heart rate (Figure 2, Figure 3) and the use of vasoactive drugs (Table 1) of the parturient in group A, group B, and group C when entering the room, lying supine after anesthesia (with the left-leaning positioning pad), at the beginning of surgery, at the delivery moment of the fetus, at 5 and 10 minutes after delivery, and at the time of leaving the operating room. There was no significant difference in blood pressure and heart rate between the 3 groups when entering the room. The blood pressure of the A, B groups after supine anesthesia, beginning the surgery and the delivery of the fetus were significantly different from those of the C group. There were significant differences at various time points in group A and group B. The decline was more obvious after supine anesthesia, at the beginning of surgery, and when the fetus was delivered. There were no differences in heart rate between groups B and C at all time points. In group A, the heart rate at the time of lying supine after anesthesia and at the beginning of the operation was significantly different than when entering the room. There was no significant difference in heart rate among the three groups. There were significant differences in the use of vasoactive drugs between the three groups. The proportion of vasoactive drugs required in group A was significantly higher than that in group C. Of the 136 cases using vasoactive drugs, 109 (80.1%) were treated with m-hydroxylamine, the other 27 (19.9%) were treated with ephedrine, and 5 were treated with m-hydroxylamine 4 times, all in group A. Group B was used up to 3 times / case, and only 1 case in group C was used twice and all of which were meta-hydroxylamine.

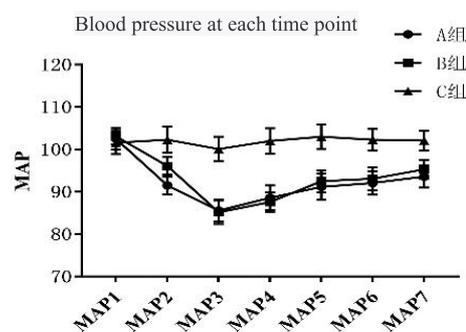


Figure 2. Blood pressure

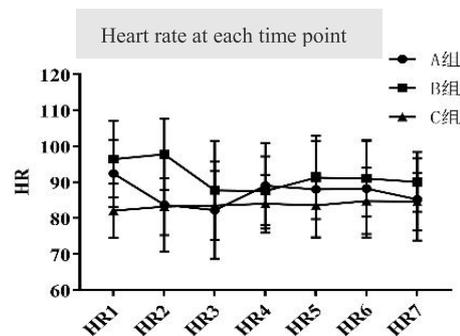


Figure 3. Heart rate

The blood gas analysis pH of newborns in group A, group B, and group C was between 7.25 and 7.37, and there was no significant difference between the three groups (Table 2). 13 cases (9.6%) of newborns in group A had mild abnormalities after birth, and 2 of them (1.5%) continued to 5 minutes. Apgar scores were normal in all three groups in 10 minutes. Parturient and obstetricians were able to complete the operation consistently after using 10° (group B) and 20° (group C) positioning pads. Among them, 48 cases (34.5%) in

group C were reported by obstetricians to have serious influence on the operation.

Table 2. Newborn's blood gas analysis and scores of 1 minute, 5 minutes, and 10 minutes of newborns in groups A, B, and C; maternal and obstetrician evaluation

groups	group A	group B	group C	P value
blood gas analysis(PH)	7.30±0.04	7.34±0.02	7.35±0.02	NS
abnormal Abgar score after birth(case)				P<0.05
1 minute	13	6	2	
5 minutes	2	0	0	
10 minutes	0	0	0	
maternal evaluation(case)				P<0.05
unconscious	/	46	10	
week consciousness	/	72	38	
feeling like leaning slightly	/	19	83	
feeling like falling into bed	/	5	8	
obstetrician evaluation				P<0.05
no effect	/	8	0	
weak effect	/	19	12	
slight effect	/	106	79	
severe effect	/	9	48	

4 Discussion

In this study, it was found that 20°left-leaning of the positioning pad could not only alleviate the degree of blood pressure decline at the time of lying supine after anesthesia, at the beginning of operation and 1, 5 and 10 minutes after delivery of fetus, but also reduce the use of vasoactive drugs during the operation, and improve the Apgar score after birth. There was no significant difference in the effect of the supine position or the left-leaning position on the blood gas pH of the newborn; the left-leaning 20°position had a serious impact on part of the operation of the obstetrician.

This study shows that the positioning pad has good practicability for parturient and obstetricians. Before using patent position pads in our department, all parturient were lying supine after anesthesia. When considering the possibility of supine hypotensive syndrome, such as dizziness, vomiting, pale face, etc., the left-leaning operating bed with the assistance of vasoactive drugs will usually be used or the obstetricians will assist in shifting the uterus. Which can relieve the majority of symptoms of supine hypotensive syndrome in a short time. Relevant studies have pointed out that it is difficult to achieve a left-leaning position of 15° by tilting the operating bed. Jones *et al*^[7] observed 16 anesthesiologists who performed elective cesarean

section and found that anesthesiologists generally overestimated the angle when tilting the operating bed. At the same time, it was found that the vast majority of obstetricians (97%) had difficulty accepting a left-leaning position at 15°during the operation. At the same time, about 76% of parturients expressed discomfort with tilt and were worried about adverse events such as falling bed^[8]. In this study, the majority of parturients and obstetricians accepted a left-leaning position at 10°; most parturients had no significant discomfort, and about 34.5% of obstetricians said that it would seriously affect the operation with a left-leaning position at 20°.

MRI examination found that inferior vena cava obstruction can be alleviated only at 30°left-leaning, and the inferior vena cava volume did not improve significantly at left-leaning of 15°^[4]. However, in this study, the case number of vasoactive drugs used by parturients decreased gradually from the supine position to the left-leaning angle of 10°and 20°. There was a significant difference between left-leaning angle of 20°and the supine position. This imaging and clinical analysis of the differences may be related to the pathogenesis of SHS. The pathogenesis of SHS has two theories at present: insufficient collateral circulation or abnormal autonomic nerve response^[9, 10]. Some studies have used heart rate variability as an index for measuring autonomic nerve function in women with

SHS, and there is no significant difference compared with asymptomatic maternal group, so it is speculated that collateral circulation may play a more important role in SHS than autonomic nerve function^[3, 10, 11].

Although many studies have explored whether maternal blood pressure is directly related to uterine placental perfusion pressure, it is not completely clear at present^[12-14]. In this study, the blood pressure of group A decreased before the delivery of the fetus, there was no significant difference in blood gas pH after birth of the newborn, and the Apgar score at 1 minute had a certain effect, but there were no significant effects at 5 minutes and 10 minutes. It is speculated that the fetus can compensate through adaptive behavior within a certain range to maintain the balance of oxygen needs. Other studies have suggested that compared with the left-leaning position, it may have a negative impact on the fetus even without the symptoms of maternal anesthesia and hypotension. The supine sleeping position could be associated with stillbirth in the third trimester^[13, 15-17]. Therefore, when undergoing cesarean section, using a position cushion to keep the parturients in a left-leaning position can improve the newborn's Apgar score and outcome.

There are still some shortcomings in this study: first, the perioperative maternal blood pressure is affected by a variety of factors, and using it to measure the improvement of inferior vena cava compression with the positioning pad has certain limitations. And as an indirect index, it has certain shortcomings compared with direct measurement such as nuclear magnetic resonance. However, as an index reflecting cardiac output and peripheral resistance, blood pressure is simple, objective and timely, and has irreplaceable clinical practical value. Second, the positioning pads may be affected by factors such as parturient weight, hardness of the operating bed, and using time, resulting in errors in the left-leaning angle during use. The relevant interference factors should be considered when selecting the material of positioning pads to minimize the angle error. However, in this study, there was no statistically significant difference in parturient weight between groups, and there was still good homogeneity in the position cushions.

In summary, the use of positioning pads can prevent the adverse effects of supine hypotensive syndrome on parturients and newborns to a certain extent.

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