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Research Article

The Relationship between Abdominal Circumference and Columna Vertebralis Length with Intraoperative Hypotension in Cesarian Cases with Spinal Anesthesia

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Abstract

Introduction: *Most pregnant women develop varying degrees of abdominal hypertension due to the enlarged uterus . Increased abdominal circumference and shorter columna vertebralis length have been found to be associated with increased with increased abdominal pressure and an enlarged uterus. We hypothesized that this was associated with the incidence of hypotension after spinal anesthesia. We conducted this study to investigate the relationship between abdominal circumference and columna vertebralis length and intraoperative hypotension in cesarean section operations under spinal anesthesia.*

Materials And Methods: *This study was conducted in Gazi Yaşargil Training and Research Hospital, Obstetrics and Gynecology annex building as a prospective observational study after ethics committee approval. Patients who were 18 years of age or older, had elective cesarean section under spinal anesthesia, had ASA (American Society of Anesthesiologists) I-II, were over 150 cm tall, and had a term (37-42 weeks) singleton pregnancy were included in the study. High-risk pregnancies (placenta previa, abruptio placenta, eclampsia, preeclampsia), multiple pregnancies, patients with additional disease related to other systemic diseases including cardiovascular disease, patients with spinal anesthesia contraindications, and a total of 102 patients were included in the study. Abdominal circumference, columna vertebralis lengths, and symphysis-fundus distance were measured after the patients' name-surname, protocol number, age, height, weight, body mass index, gestational week, and parity values were recorded. The patients were seated and the standard 11 mg Heavy Marcaine injection rate was 1 mL/sec to each patient with a 26 G – 27 G Quincke spinal needle through the L3-L4 interspinous space. After the procedure, the patients were placed on the operating table in the supine position and the operating table was deviated 10 degrees to the left. Heart rate, mean arterial pressure and saturation were recorded as 1 minute values. Afterwards, the 3rd minute, 5th minute, 10th minute, 15th minute and 30th minute values were recorded. Sensory block examination was evaluated with pinprick test and motor block levels were evaluated with modified Bromage scoring and recorded. A decrease of 30% from the systolic blood pressure value measured before spinal anesthesia or a*

decrease in the systolic blood pressure value below 90 mmHg was considered as hypotension and 10 mg of ephedrine was administered simultaneously to all patients with hypotension. After surgery, newborn APGAR score, newborn weight, time to zero Bromage score, time until sensory blockage regressed to T10, and presence of nausea and vomiting were recorded.

Results: *A significant correlation was found between the length of the vertebral column and the level of sensory block in patients after spinal anesthesia. There is a significant relationship between the length of the columna vertebralis and the time elapsed until the sensory block level regresses to T10. There was no correlation between abdominal circumference and and symphysis fundus distance and hypotension. However, a significant relationship was found between abdominal circumference and nausea.*

Conclusion: *There are multiple mechanisms associated with intraoperative hypotension after spinal anesthesia. Abdominal circumference and columna vertebralis length are important parameters for measuring and providing prediction.*

Key Words: *Abdominal circumference, Columna vertebralis, Cesarean section, Hypotension, Spinal anesthesia*

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Introduction And Purpose

Spinal anesthesia is the most commonly used form of anesthesia in obstetric surgery (1). The incidence of hypotension occurring during spinal anesthesia varies between 55% and 90% (2). Spinal anesthesia, in addition to being an easy and fast induction, surpasses general anesthesia by not having any significant effect on the fetus. However, physiological changes that occur during pregnancy have led to increased sensitivity to local anesthesia (3).

The spread of local anesthetics in the subarachnoid space determines the level of sympathetic blockade. High levels of sensory blockade after spinal anesthesia increase the incidence of hypotension in pregnant women (4). Lumbosacral cerebrospinal fluid (CSF) volume is a crucial determinant of the spread of drug injected into the subarachnoid space (5).

In pregnant women, pressure on the inferior vena cava (IVC) by the gravid uterus causes the lumbar vein and vertebral artery to dilate around the spinal cavity (6) and the subarachnoid space to shrink with decreased CSF. This may increase the cephalad spread of intrathecally administered drug. However, many variables have been suggested to influence the ultimate spread of sensory blockade, such as height, weight, patient body mass index, and fetal weight, but the roles of these factors are controversial (7).

The size of the gravid uterus may affect local anesthetic dissemination by affecting the pressure in the subarachnoid space and thus affecting sympathetic blockade (8). Symphysiofundal distance (SFD) and abdominal circumference (AC) measure the size of the gravid uterus and have classically been used to assess fetal growth during pregnancy. SFD and AC measurements provide an indirect measure of the degree of IVC compression that may affect lumbosacral CSF volume. High abdominal pressure is one of the factors affecting the spread of local anesthetic agents in the cephalad (9).

Most pregnant women have developed varying degrees of abdominal hypertension due to an enlarged uterus (9, 10). However, measuring abdominal pressure is impractical and attempts to do so may increase the risk of infection. Previous studies have shown associations between larger abdominal circumference and higher abdominal pressure (11) and level of sensory blockade (12).

We hypothesized that increased abdominal circumference and short columna vertebralis length, previously found to be associated with increased abdominal pressure and enlarged uterus, are

associated with an increased incidence of hypotension after spinal anesthesia. The aim of this study is to evaluate the relationship between abdominal circumference and columna vertebralis length and the incidence of intraoperative hypotension in cesarean section cases with spinal anesthesia.

Materials and Methods

This study was conducted as a prospective observational study in the Gynecology and Gynecology annex building of Gazi Yaşargil Training and Research Hospital, after receiving ethics committee approval. Patients who were 18 years of age and older, had an elective cesarean section with spinal anesthesia, were ASA (American Society of Anesthesiologists) I- II, were over 150 cm tall, and had a term (37-42 weeks) singleton pregnancy were included in the study. High-risk pregnancies (placenta previa, abruptio placenta, eclampsia, preeclampsia), multiple pregnancy, patients with comorbidities related to other systemic diseases including cardiovascular disease, and patients with spinal anesthesia contraindications were excluded from the study, and a total of 102 patients were included in the study.

Patients taken to the operating room preoperative room were informed about the study. Name- surname, protocol number, age, height, weight, body mass index, gestational week, and parity values of the patients who signed the consent form and met the criteria were recorded. The patients whose information was recorded were taken to the operating table. Abdominal circumference and columna vertebralis lengths were measured with a non-flexible tape measure in the sitting position of the patients placed on the operating table. Abdominal environment; It was measured from the lower level of the umbilicus. Columna vertebralis length was recorded by measuring the distance from protuberantia occipitalis externa to sacral hiatus. Then, the patients were stretched and the symphsiofundal distance was measured from the upper edge of the uterine fundus to the upper edge of the pubic symphysis. The patients were placed in a sitting position again, three-channel electrocardiography, pulse oximetry and blood pressure monitoring were performed, and the first values were recorded. All preoperative patients received 10 ml/kg intravenous fluid loading.

Spinal anesthesia was performed on patients in a sitting position. The area where spinal anesthesia would be applied was surgically sterilized with a solution containing povidone- iodine, and after it was covered with a surgical sterile drape, the spinal needle was duly advanced using a spinal needle (26 G - 27 G) from the L3-

L4 level. After clear CSF was seen, no aspiration or barbituration was performed. Standard 11 mg Heavy Marcaine injection rate was administered to each patient at a rate of 1 mL/sec. After the procedure, the patient was placed on the operating table in a supine position and the operating table was deviated 10 degrees to the left. Heart rate, mean arterial pressure and saturation were recorded as 1st minute values. Afterwards, the 3rd minute, 5th minute, 10th minute, 15th minute and 30th minute values were recorded. During postoperative follow-up, measurements were continued every 15 minutes.

Sensory block examination in patients was performed with the pinprick test. Level measurements at the 1st minute, 5th minute, 15th minute and 30th minute were recorded. Motor block levels were evaluated with modified Bromage scoring.

Bromage Scale

0. There is no motor block, the leg can be lifted easily.
1. Partial block, hip cannot be moved, foot and knee joints can be moved.
2. Full block limit, only ankle can be moved

Complete block, no movement in the ankle.

Surgery was started after sensory block and motor block developed and the sensory block level reached the T4 dermatome level.

A 30% decrease from the systolic blood pressure value measured before spinal anesthesia or a systolic blood pressure value below 90 mmHg was considered hypotension, and all patients with hypotension were given 10 mg ephedrine simultaneously. A heart rate of 50/min was considered bradycardia and the patients were atropinized. Patients were given 10-15 ml/kg/h crystalloid solution during the intraoperative period.

After surgery, newborn APGAR score, newborn weight, time until Bromage Score reached zero, time until sensory block decreased to T10, and presence of nausea and vomiting were recorded.

The data obtained in our study were evaluated on a computer using the SPSS 24.0 for Windows statistical package program. Independent Samples t-test and Chi Square tests analyzes were used in the evaluation, and One Way Anova was used to compare more than two groups. $p<0.05$ was considered significant.

Table 1. Demographic data of patients.

	Mean±STD	Minimum	Maximum	Number
Age	29.3±5.8	19	42	102
Body Mass İndex	29.99±4.03	22.2	44.4	102
Pregnancy week	38.06±0.52	37	39	102
Parity	3.24±1.15	1	8	102
Abdominal Circumference	109.05±8.01	89	128	102
Columna Vertebralis Length	64.47±3.65	58	72	102
Symphysiofundal Distance	31.05±2.73	24	40	102
Operation Time	29.88±3.62	23	35	102
Newborn weight (gram)	3176±356	2350	4150	102
Time until sensory block regresses to t10	101.45±13.32	80	130	102
Time until Bromage score reaches 0	179.85±27.12	120	240	102
Mean arterial pressure before anesthesia	97.25±9.27	79	118	102
Heart rate before anesthesia	96.56±12.83	72	130	102
Saturation before anesthesia	98.93±1.22	95	100	102
1st minute mean arterial pressure	86.18±12.9	57	129	102
1st minute heart rate	95.53±15.47	67	151	102
1st saturation	99.01±1.47	89	100	102
3rd minute mean arterial pressure	78.01±15.76	48	122	102
3rd minute heart rate	90.53±19.36	65	149	102
3rd saturation	98.98±1.4	94	105	102
5th minute mean arterial pressure	79.92±14.99	41	114	102
5th minute heart rate	89.43±15.58	55	150	102
5th saturation	97.86±9.92	95	100	102
10th minute mean arterial pressure	83.69±11.61	54	111	102
10th minute heart rate	90.19±13.07	57	123	102
10th saturation	98.71±2.66	92	100	102
30th minute mean arterial pressure	88.09±8.37	66	114	102
30th minute heart rate	91.06±10.89	72	127	102
30th saturation	99.16±1.76	84	100	102

Results

All 102 patients who agreed to be included in the study were included in the study. No patients were excluded from the study. Demographic data of the patients are available in Table 1. In Table 2 below, data on intraoperative complications are available.

Table 2. Intraoperative Complications.

Complication	n	%
Nausea		
Yes	28	22.5
No	74	72.5
Vomiting		
Yes	7	6.9
No	95	93.1
1st minute hypotension		
Yes	3	29
No	99	97.1
3rd minute hypotension		
Yes	22	21.6
No	80	78.4
5th minute hypotension		
Yes	17	16.7
No	85	83.3
10th minute hypotension		
Yes	6	5.9
No	96	94.1
30th minute hypotension		
Yes	0	0
No	102	100

In our study, the relationship between abdominal circumference, columna vertebralis and symphysiofundal distances and hypotension in cesarean section cases under spinal anesthesia were grouped separately and examined in detail.

When Table 3 is examined, the mean arterial pressure values measured at the 1st minute, 3rd minute, 5th minute and 10th minute were lower in patients with larger abdominal circumference. But this was not statistically significant ($p>0.05$).

Likewise, in the group with larger abdominal circumference, the time until sensory block decreased to T10 was longer, but was not significant.

Table 3. Relationship Between Abdominal Circumference and Intraoperative Data.

	Group 1 ≤ (109 cm) Mean±STD	Group 2 (>109 cm) Mean±STD	p
Time until sensory block regresses to t10	99.4±13.67	103.67±12.69	0.92
Time until Bromage score reaches 0	178.02±28.15	181.84±26.11	0.47
Mean arterial pressure before anesthesia	96.51±8.82	98.06±9.76	0.4
Heart rate before anesthesia	95.79±11.77	97.39±13.97	0.53
Saturation before anesthesia	99.09±1.16	98.76±1.28	0.13
1st minute mean arterial pressure	86.94±13.91	85.35±11.08	0.53
1st minute heart rate	95.04±15.66	96.06±15.41	0.74
1st saturation	99.15±1.11	98.86±1.78	0.39
3rd minute mean arterial pressure	80.09±14.52	75.76±16.86	0.2
3rd minute heart rate	90.66±19.04	90.39±19.89	0.94
3rd saturation	98.92±1.28	99.04±1.54	0.97
5th minute mean arterial pressure	80.13±13.32	79.69±16.75	0.66
5th minute heart rate	89.25±16.12	89.63±15.13	0.9
5th saturation	98.79±1.86	96.86±14.19	0.7
10th minute mean arterial pressure	84.47±10.4	82.84±12.85	0.48
10th minute heart rate	89.98±12.4	90.41±13.88	0.87
10th saturation	98.92±1.29	98.47±3.6	0.8
30th minute mean arterial pressure	88.96±8.4	87.14±8.3	0.1
30th minute heart rate	91.7±10.77	90.37±11.09	0.34
30th saturation	99.23±1.01	99.08±2.32	0.73
Total n(%)	**53(52)**	**49(48)**	**102**

(Group 1: Patients with an abdominal circumference of 109 cm and less than 109 cm. Group2: Patients with an abdominal circumference of more than 109 cm. n: Number of patients.).

Table 4 shows the relationship between sensory block level measurements and abdominal circumference, and no significant difference was found.

Table 4. Relationship Between Abdominal Circumference and Sensory Block.

Sensory Block Level	Group 1 (≤109 cm) n(%)	Group 2(>109 cm) n(%)	p
1st			
T6	0(0)	1(2)	0.49
T8	15(28.3)	16(32.7)	
T10	38(71.7)	32(65.3)	
5th			
T4	0(0)	1(2)	0.055
T5	15(28.3)	16(32.7)	
T6	38(71.7)	32(65.3)	
15th			
T4	32(60.4)	36(73.5)	0.17
T5	21(39.6)	12(24.5)	
T6	0(0)	1(2)	
30th			
T4	3(5.7)	13(26.5)	
T5	25(47.2)	17(34.7)	0.08
T6	13(24.5)	15(30.6)	
T8	12(22.6)	4(8.2)	

(Group 1: Patients with an abdominal circumference of 109 cm and less than 109 cm. Group2: Patients with an abdominal circumference of more than 109 cm. n: Number of patients.).

In Table 5, abdominal environment and intraoperative complications were examined, and a significant relationship was found with nausea with a p value of <0.05.

Table 5. Relationship Between Abdominal Circumference And İntraoperative Complications.

Complication	Group 1 (≤109 cm) n(%)	Group 2 (>109 cm) n(%)	p
Nausea			
Yes	8(15.1)	20(40.8)	0.04
No	45(48.9)	29(59.2)	
Vomiting			
Yes	20(3.8)	5(10.2)	0.19
No	51(96.2)	44(89.8)	
1st minute hypotension			
Yes	1(1.9)	2(4.1)	0.51
No	52(98.1)	47(95.9)	
3rd minute hypotension			
Yes	6(11.3)	16(37.2)	0.09
No	47(88.7)	33(67.3)	
5th minute hypotension			
Yes	6(11.3)	11(22.4)	0.13
No	47(88.7)	38(77.6)	
10th minute hypotension			
Yes	2(3.8)	4(8.2)	0.34
No	51(96.2)	45(91.8)	
30th minute hypotension			
Yes	0(0)	0(0)	*
No	53(100)	49(100)	

(Group 1: Patients with an abdominal circumference of 109 cm and less than 109 cm. Group2: Patients with an abdominal circumference of more than 109 cm. n: Number of patients.).

Symphysiofundal distance created two groups according to its average value (31 cm) and was classified as Group 1 and Group 2.

When the data were examined, it was determined that the symphysiofundal distance did not make a significant difference.

Columna vertebralis length was divided into 3 groups considering previous studies (17).

Table 6. Relationship Between Symphysiofundal Distance and An Intraoperative Data.

Group 1 (≤31 cm) Mean±STD	Group 2(>31 cm) Mean±STD	p	p
101.02±13.09	102.05±13.77	0.8	0.8
179.66±26.06	180.12±28.83	0.82	0.82
97.42±10.24	97.02±7.86	0.83	0.83
96.14±13.79	97.14±11.52	0.69	0.69
98.9±1.3	98.98±1.12	0.93	0.93
84.37±12.15	88.65±13.61	0.98	0.98
94.86±15.7	96.44±15.28	0.61	0.61
98.98±1.69	99.05±1.11	0.75	0.75
79.92±16.23	75.4±14.88	0.22	0.22
91.88±20.64	88.67±17.51	0.94	0.94
98.98±1.16	98.98±1.69	0.96	0.96
81.19±14.9	78.19±15.11	0.44	0.44
90.8±15.96	87.56±15.02	0.9	0.9
96.97±12.97	99.09±1.21	0.2	0.2
84.05±11.61	83.19±11.74	0.48	0.48
91.07±12.83	88.98±13.44	0.87	0.87
98.61±2.99	98.84±2.15	0.61	0.61
88.81±7.48	87.09±9.47	0.78	0.78
92.2±11.45	89.49±9.99	0.26	0.26
99.02±2.19	99.35±0.87	0.6	0.6
59(57.8)	43(42.2)	102(100)	102(100)

(Group 1: Patients with Symphysiofundal Distance 31 cm and less than 31 cm. Group2: Patients with Symphysiofundal Distance greater than 31 cm, n: Number of patients).

Table 7. Relationship Between Symphysiofundal Distance and Sensory Block.

Sensory Block Level	Group 1 (≤31 cm) n(%)	Group 2(>31 cm) n(%)	p
1st			
T6	1(1.7)	0(0)	0.6
T8	19(32.2)	12(27.9)	
T10	39(66.1)	31(72.1)	
5th			
T4	29(49.2)	14(32.6)	0.12
T5	25(42.4)	27(62.8)	
T6	5(8.5)	2(4.7)	
15th			
T4	39(66.1)	29(67.4)	0.69
T5	19(32.2)	14(32.6)	
T6	1(1.7)	0(0)	

(Group 1: Patients with Symphysiofundal Distance 31 cm and less than 31 cm. Group2: Patients with Symphysiofundal Distance greater than 31 cm, n: Number of patients).

Table 8. Relationship Between Columna Vertebralis Length and Intraoperative Data.

	Group 1 (≤62 cm) Mean±STD	**Group 2(63-66 cm) Mean±STD**	**Group 3(>67cm) Mean±STD**	**p**
Time until sensory block regresses to t10	97.6±13.14	102.58±13.54	105±12.24	0.04
Time until Bromage score reaches 0	173.82±25.34	185.13±28.1	180±27.29	0.14
Mean arterial pressure before anesthesia	98.35±9.46	96.66±9.57	96.77±8.85	0.7
Heart rate before anesthesia	97.35±14.88	97.08±11.18	95±12.59	0.73
Saturation before anesthesia	98.85±1.14	98.92±1.14	99.03±1.12	0.88
1st minute mean arterial pressure	87.29±14.17	84.13±11.83	87.5±12.8	0.5
1st minute heart rate	96.53±18.25	93.76±12.6	96.63±15.66	0.8
1st saturation	98.62±2.13	99.21±1.01	99.2±0.88	0.58
3rd minute mean arterial pressure	78.29±18.98	78.55±14.17	77±14.06	0.92
3rd minute heart rate	90.97±21.21	89.79±19.69	90.97±17.24	0.95
3rd saturation	98.76±1.47	98.79±1.29	99.47±1.38	0.18
5th minute mean arterial pressure	76.85±16.87	83.34±13.96	79.07±13.51	0.23
5th minute heart rate	89.85±20.55	90.58±12.19	87.5±13.01	0.71
5th saturation	95.71±17.04	98.58±1.51	99.4±0.89	0.04
10th minute mean arterial pressure	83.41±13.36	85.76±9.89	81.37±11.43	0.3
10th minute heart rate	89.56±15.71	89.95±9.97	91.2±13.62	0.87
10th saturation	98.85±1.35	98.66±2.25	98.6±4.01	0.48
30th minute mean arterial pressure	89.44±9.74	87.84±6.76	86.87±8.61	0.42
30th minute heart rate	98.79±13.27	90.66±8.68	89.6±10.51	0.65
30th saturation	98.82±2.8	99.24±0.88	99.16±1.76	0.59
Total n(%)	**34(33.3)**	**38(37.3)**	**30(29.4)**	**102(100)**

(Group 1: Patients with Columna Vertebralis Length 62 cm and less than 62 cm, Group 2: Patients with Columna Vertebralis Length 63-67 cm, Group 3: Patients with Columna Vertebralis Length greater than 67 cm, n: Number of patients).

When Table 9 is examined, the time until the sensory block decreases to T10 differed significantly between the groups ($p<0.05$). As the length of the columna vertebralis increases, the time until the level drops to T10 increases. Likewise, according to the data obtained when Table 9 was examined, the relationship between the length of the vertebral column and the sensory block level was found to be significant at the 5th minute ($p<0.05$). The number of patients whose sensory block reached T4 at the 5th minute was found to be higher in those with short vertebralis column length.

Table 9. Relationship Between Columna Vertebralis Length and Sensory Block.

Sensory Block Level	Group 1 (<62 cm) n(%)	Group 2(63-66cm) n(%)	Group 3(>67cm) n(%)	p
1st				
T6	0(0)	1(2.6)	0(0)	
T8	17(50)	8(21.1)	6(20)	0.29
T10	17(50)	29(76.3)	24(80)	
5th				
T4	21(61.8)	15(39.5)	7(23.3)	
T5	12(35.3)	20(52.6)	20(66.7)	0.04
T6	1(2.9)	3(7.9)	3(10)	
15th				
T4	22(64.7)	26(68.4)	20(66.7)	
T5	12(35.3)	11(28.9)	10(33.3)	0.74
T6	0(0)	1(2.6)	0(0)	
30th				
T4	4(11.8)	7(18.4)	5(16.7)	
T5	12(35.3)	17(44.7)	13(43.3)	0.52
T6	9(26.5)	11(28.9)	8(26.7)	
T8	9(26.5)	3(7.9)	4(13.3)	

(Group 1: Patients with Columna Vertebralis Length 62 cm and less than 62 cm, Group 2: Patients with Columna Vertebralis Length 63-67 cm, Group 3: Patients with Columna Vertebralis Length greater than 67 cm, n: Number of patients).

Discussion

Intraoperative complications are an important determinant of mortality and morbidity. Intraoperative hypotension, which occurs especially during cesarean section in pregnant women, is a serious complication associated with maternal nausea-vomiting and fetal hypoxia. This issue, which anesthesiologists should know with all its mechanisms, forms the basis of our study.

Measuring intra-abdominal pressure is an invasive and impractical procedure. H.Sugerman et al. showed in their study that there is a direct proportion between abdominal circumference and intra-abdominal pressure (13). In our study, we used abdominal circumference measurement because it can be easily measured in every hospital and by all personnel. We divided the patients participating in our study into two groups, those with an abdominal circumference of 109 cm and less than 109 cm constituted Group 1, and those with an abdominal circumference greater than 109 cm constituted Group 2. We found that in Group 2, which had a larger abdominal

circumference, the time until the sensory block decreased to T10 was longer than the other group. However, this was not statistically significant.

We showed that there was no significant difference between the two groups in terms of the development of intraoperative hypotension after anesthesia according to abdominal circumference. In a similar study conducted by P. Thomard et al. in 2018, they showed that there was no difference in abdominal circumference measurement between the two groups in terms of hypotension (14). However, both in our study and in the study by P. Thomard et al., it was found that the mean arterial pressure values measured after anesthesia were lower in the group with a larger abdominal circumference.

Abdominal circumference is positively related to abdominal pressure. High abdominal pressure has been shown to cause high spinal anesthesia and hypotension (9). A study was conducted by

Khan et al. in which they measured the intra-abdominal pressure before and after birth in pregnant women undergoing cesarean section at term, and the intra-abdominal pressure before birth was found to be 22 mmHg and 16 mmHg after birth. This difference, which is considered significant, is due to the uterine content (15). However, we did not measure abdominal pressure in this study. Therefore, we conclude that the decrease in mean arterial pressure in our study is due to larger abdominal circumference, which may be the result of an enlarged uterus causing aortocaval compression or increased abdominal pressure. A limitation of this study was the lack of abdominal pressure data that could be used to explain the mechanism of this finding. Contrary to our expectations, symphsiofundal distance measurement did not show a significant relationship with the level of sensory blockade. Kim et al reported that Symphsiofundal distance and cerebrospinal pressure were not significantly related to the level of sensory blockade (16). In our study, we did not find a significant relationship between symphsiofundal distance and intraoperative hypotension.

The length of the columna vertebralis in an adult male is 73-76 cm, and in a female this length is 7-10 cm less (17). In our study, patients were divided into three groups according to the length of the vertebralis column. An important factor affecting the spread of spinal anesthesia is the length of the vertebral column. Zhou et al found that there was an inversely positive relationship between columna vertebralis length and cephalad spread (11). In our study, the time until the sensory block level decreased to T10 was found to be statistically

significant ($p<0.05$). Again, when the results of our study were examined, the level of sensory block was found to be higher in those with shorter vertebralis column length.

When we think logically, we can predict that the longer the vertebralis column, the less spread it will have to the cephalad when an equal dose of bupivacaine is applied. Hartwell et al found a significant relationship between the spread of spinal anesthesia and vertebral column length in term pregnant women (18). In our study, we reached results that support this.

The association of hypotension and nausea is known. While 28 of the 102 patients in our study had nausea, only 7 of the patients with nausea had vomiting. All patients with nausea were accompanied by hypotension. However, nausea was not observed in every patient with hypotension. Kang et al reported that the incidence of intraoperative emetic symptoms during spinal anesthesia for cesarean delivery was correlated with the development of hypotension (19). In our study, a statistically significant relationship was found between abdominal circumference and nausea. ($p<0.05$) Nausea was observed in more patients in the group with larger abdominal circumference.

Conclusion

There are multiple theories for the mechanism of intraoperative hypotension following spinal anesthesia (2). Likewise, there are multiple factors that affect intraoperative hypotension (3, 4). In our study, we found that there was an inverse relationship between abdominal circumference and mean arterial pressure after spinal anesthesia. We found that as the abdominal circumference increased, the measured mean arterial pressures were lower. A positive correlation was also found between columna vertebralis length and sensory block level. However, no significant relationship was found between symphysiofundal distance measurement and intraoperative complications.

Limitations

Our study also has some limitations. More patients could have been included in the study. No invasive measurements were made for abdominal pressure. Since measurements are made manually, there may be different results between people measuring. However, in our study, we made measurements by a single person.

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