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Original Article

Correlative Study between Body Mass Index and Hypotension in Obese Patients Undergoing Cesarean Section under Spinal Anaesthesia

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Abstract

Background: Prevalence of obesity is increasing the worldwide with rapid changes in dietary habits. Obese pregnant patients tend to labor abnormally with a tendency to either need instrumental or cesarean section delivery. They are also at risk when superimposed with diabetes and pre-eclampsia. Obese pregnant patients are an anesthetic risk directly related to maternal mortality and morbidity. They are considered as a high-risk group by the anesthetists even during their antenatal care.

Materials and Methods: A total of 126 pregnant patients undergoing cesarean section under spinal block in the Department of Obstetrics and Gynecology were included in this study. The patients were divided into two groups; Group A consisted of women with body mass index (BMI) less than 30 kg.m^2 and Group B with BMI more than 30 kg.m^2. Before spinal block, noninvasive blood pressure recording was done thrice at 5 min intervals to obtain an average basal systolic blood pressure (SBP). Hypotension was defined as a fall in SBP of 25-30% of the baseline or below 85-90 mmHg. The incidence of pregnancy diabetes and hypertension was recorded. Episodes of hypotension, mean fall in SBP, volume of crystalloids used and amount of vasopressors used were observed in the main groups as well as subgroups of Group B.

Results: A total number of 126 patients were included and divided into two groups of 63 each (Group A: Non-obese and Group B: Obese). The incidence of gestational diabetes among the Group A patients was 5/63 (07.93%), and in Group B it was 19/63 (30.15%) which was significant statistically with $P = 0.017$. Mean episodes of Hypotension during the spinal block in Group A were 3.06 ± 1.33 compared to 5.46 ± 1.72 episodes in Group B which was statistically significant with $P = 0.00001$. The use of vasopressors was smaller in Group A; 2.91 ± 1.04 when compared to Group B; 6.17 ± 1.12 and it was significant with $P = 0.00001$.

Conclusion: The obese pregnant patients have higher risk of developing hypotension after spinal anesthesia for cesarean section. This study sample showed that pregnant patients with BMI more than 30 kg.m^2 were a risk factor for developing hypotension after spinal anesthesia undergoing cesarean section. The numbers of hypotension episodes were more, and the amount of vasopressors used was more. The results indicate that the techniques of anesthesia used in such patients should be improved to avoid consequences in the mother and the newborn.

Key words: Pregnancy, obesity, Body mass Index, Hypotension, Cesarean section, Spinal anaesthesia and Spinal anaesthetics

INTRODUCTION

The WHO considers obesity as a worldwide phenomenon especially among women and categorized it based on the association of body mass index (BMI) and comorbidities. It classified obesity as overweight ≥25 kg.m^2, pre-obese 25-29.9 kg.m^2, and obese Classes 1, 2, and 3 ranging from 30 to 34.9 kg.m^2, 35 to 39.9 kg.m^2 and ≥40 kg.m^2, respectively.[1] The maternal morbidity in pregnant women increases due to comorbid diabetes, hypertension,[2] and respiratory disorders such as asthma and sleep apnea, thromboembolic phenomenon, cardiomyopathy,[3] higher incidence of cesarean sections, and higher number of urinary infections, and surgical wound infections.[4,5] The obese pregnant women have a limited physiological reserve due to obesity being

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superadded to pregnancy[5] and the physiological reserve is proportional to the duration of obesity before pregnancy. The status of prevalence of obesity in India is that it has reached an epidemic proportion, affecting 5% of the country's population.[6] Saha and Saha[7-9] submitted in their National Family Health Survey that there is an increased trend towards overweight or obesity in Indian women from 10 in 1998-9 to 14.6 in 2005. Among the Indian states that topped the list of rates of obesity were Punjab (30.3% males and 37.5% females), Kerala (24.3% males and 34% females), and Goa (20.8% males and 27% females).[10] Obesity also results in neonatal consequences such as increased rate of congenital anomalies, stillbirths, and macrosomia, birth weight more than 4500 g, and intrauterine growth retardation.[11] The relatively less frequent complications include shoulder dystocia and stillbirth.[12] Spinal, epidural, or combined anesthesia are widely used in obstetrics, both for cesarean section and labor analgesia.[13-15] Hypotension after spinal anesthesia is directly related to greater mortality[16] and even more so in obstetric patients especially in obese individuals. The incidence besides being greater is associated with serious maternal-fetal consequences, with the spectrum ranging an increased incidence of nausea and vomiting to fetal hypoxia due to changes in uteroplacental blood flow with consequent fetal acidosis.[17,18] Hypotension after administration of regional anesthesia is defined as systolic blood pressures <85-90 mm Hg or a decrease of more than 25-30% from the pre-anesthetic basal systolic value.[19,20] In the light present review of literature a study was conducted with an aim to evaluate and correlate the incidence of hypotension in obese pregnant women with BMI >30 kg.m^{-2} undergoing cesarean section under spinal anesthesia.

- Aim of the study: To evaluate and correlate the incidence of hypotension in obese pregnant women with BMI >30 kg.m^{-2} undergoing cesarean section under spinal anesthesia
- Type of study: A prospective comparative cross-sectional study
- Period of the study: November 2013 to October 2015
- Institute of study: Sree Avittam Thirunal Hospital, Government Medical College, Thiruvananthapuram, Kerala.

MATERIALS AND METHODS

A total of 126 pregnant patients undergoing cesarean section under spinal block in the Department of Obstetrics and Gynecology (OBG) were included in this study. The patients were divided into two groups; Group A consisted of women with BMI <30 kg.m^2 and Group B with BMI more than 30 kg.m^2. Institutional Ethical Committee clearance was obtained, and committee approved consent letter was used in this study.

Inclusion Criteria

1. Pregnant women aged 25-40 years were included
2. Full term pregnant women (more than 35 weeks gestational age) were included
3. Patients with BMI ≤29.9 kg.m^{-2} were included in Group A
4. Patients with BMI ≥30 kg.m^{-2} were included in Group B.

Exclusion Criteria

1. Pregnant women aged below 25 and above 40 years were excluded
2. Patients with <35 weeks gestational age were excluded
3. Patients on doses of anticoagulants that contraindicated spinal anesthesia, thrombocytopenia, bleeding disorders, maternal cardiomyopathy, history of coagulopathy, twin pregnancy, and those who refused to participate in the study were excluded
4. Patients with previous history of anesthetic complications were excluded.

WHO classification based on BMI was used in patients in this study.[1] Thorough medical examination was done after eliciting detailed history related to all systems. Before spinal block, noninvasive blood pressure recording was done thrice at 5 min intervals to obtain an average systolic basal blood pressure (SBP) to guide the anesthetist in administering vasopressors during the procedure. Pulse rate and oximetry were continuously recorded. Ringer's lactate infusion started at the same time of anesthesia was administered for a total of 10 ml/kg^{-1} until delivery. For spinal block, 15 mg of 0.5% hyperbaric bupivacaine was used. For spinal block 12.5 -15mgof 0.5% hyperbaric bupivacaine was used (depending upon height of the patient). For sedation 1.5 to 2 mg of midazolam was administered slow intravenously. In 80 seconds, the uterus was dislocated, the blood pressure was measured every 2 min, volume of crystalloids infused and total doses of vasopressors administered were recorded. Hypotension was defined as a fall in SBP of 25-30% of the basal blood pressure or fall to below 85-90 mmHg. In the presence of hypotension, the anesthesiologist administered a bolus of 6 mg of mephentrine or 6 mg of ephedrine, whichever considered appropriate. All anesthesia techniques, doses, and conduction followed the standard textbook descriptions. All the data were recorded in a printed pro forma, and standard statistical methods were used to analyze them.

RESULTS

A total of 126 patients attending the Department of OBG, Government Medical College Hospital were divided into

two groups based on their BMI. Patients with ≤30 kg.m^{-2} are grouped as "A" and patients with BMI ≥30 kg.m^{-2} were grouped as "B". The incidence of gestational diabetes among the Group A patients was 5/63 (07.93%), and in Group B it was 19/63 (30.15%) which was significant statistically with $P = 0.017$ ($P = 0.05$ taken as significant) (Table 1). The incidence of gestational hypertension among the Group A patients was 10/63 (15.87%), and in Group B it was 22/63 (34.92%) which was significant statistically with $P = 0.031$ ($P = 0.05$ taken as significant) (Table 1). Mean episodes of hypotension during spinal block in Group A were 3.06 ± 1.33 compared to 5.46 ± 1.72 episodes in Group B which was statistically significant with *P* value 0.00001 (Table 1). The mean fall in SBP among the Group A patients was 22.62 ± 2.06 mmHg and in Group B it was 29.59 ± 6.44 mmHg and it was significant statistically (*P* at 0.00001) (Table 1). However, the incidence of hypotension independent of the number of episodes or their severity was 85.71% in Group A, and 90.47% in Group B. Overall, the episodes of hypotension during spinal block were smaller in Group A than in Group B. The mean volume of crystalloids used in Group A was 1288 ± 169.62 ml, and in Group B it was 1624.83 ± 166.62 ml, and the difference was significant statistically with $P = 0.00001$ (*P* significant at 0.05). The use of vasopressors was smaller in Group A; 2.91 ± 1.04 when compared to Group B; 6.17 ± 1.12 and it was significant with $P = 0.00001$ (Table 1).

In the subgroups of Group B, the mean SBP was 27.42 ± 5.50 mmHg in patients with BMI ≥30-34.9 kg.m^2, 26.50 ± 3.12 mmHg in patients with BMI 35-39.9 kg.m^2 and 31.44 ± 6.12 mmHg in patients with BMI 31.44 ± 6.12. The data were not significant statistically (*P* at 0.761 and 0.832, respectively) (Table 2).

Table 1: The incidence of comorbidities and mean values of SBP, episodes of hypotension and volumes of crystalloids and vasopressors used in the study and control groups (*n*=63)

Observation	Group A	Group B	*P* value
Gestational diabetes (%)	05 (07.93)	19 (30.15)	0.017
Gestational hypertension (%)	10 (15.87)	22 (34.92)	0.031
Mean episodes in hypotension	3.06±1.33	5.46±1.72	0.00001
Mean fall in SBP mm/Hg	22.62±2.06	29.59±6.44	0.00001
Mean volume of crystalloids used (mL)	1288.32±169.62	1624.83±166.62	0.00001
Mean amount of vasopressors used	2.91±1.04	6.17±1.12	0.00001

SBP: Systolic blood pressure

DISCUSSION

As a result of physiological weight gain during pregnancy especially in those with pre-existing obesity experience a limited respiratory reserve. In supine position, cardiovascular and respiratory embarrassment occurs due to diminished lung volumes and capacities and ventilation-perfusion ratio. Aortocaval compression due to bulky uterus adds on the cardiac workload. Spinal anesthesia is the most common regional block used in cesarean sections.[21] The higher incidence of hypotension observed in obese parturient women might be due to the greater extension of a higher sympathetic blockade caused by compression of the subarachnoid space by the gravid uterus and preganglionic sympathetic blockade,[22] leading to reduced sympathetic tone of the arterial circulation, and peripheral arterial vasodilatation. During and after labor there is a significant increase in cardiac output, reaching up to 75% above pre-pregnancy levels.[14,18] In this study, the mean fall in SBP among the Group A patients was 23 ± 6.2 mmHg, and in Group B it was 31 ± 3.12 mmHg, and it was significant statistically ($P = 0.43$). For every increase in 100 g of adipose tissue in obese pregnant women the cardiac output increases by 50 mL/min^{-1}.[18,23] There is also hypervolemic circulation during pregnancy leading to hypertrophy of left ventricle followed by gradual myocardial dilation against the sustained increase in blood pressure generated by the hypervolemic state, occasionally leading to systolic dysfunction.[18] On the other hand, pre-gestational hypertension could be exacerbated resulting increase in baseline heart rate and cardiac output, which can lead to diastolic dysfunction.[18] The incidence of gestational diabetes among the Group A patients was 5/63 (07.93%), and in Group B it was 19/63 (30.15%) which was significant statistically with $P = 0.024$ ($P = 0.05$ taken as significant). Obese pregnant women are susceptible to cardiac contractility defects and conductivity of the cardiac electric stimulus due to hyperinsulinemia and insulin resistance resulting in fat deposits that might be also seen in the myocardium.[14,18] In the subgroups

Table 2: The episodes of hypotension and SBP in the obese subgroups (*n*=63)

Observation	BMI ≥30-34.9 kg.m^2	BMI 35-39.9 kg.m^2	BMI ≥40 kg.m^2	*P* value
Mean SBP	27.42±5.50	26.50±3.12	31.44±6.12	0.761
Mean episodes of hypotension	6.80±2.1	7.12±3.20	7.98±1.10	0.832

SBP: Systolic blood pressure, BMI: Body mass index

of Group B, the mean SBP was 27.42 ± 5.50 mmHg in patients with BMI ≥30-34.9 kg.m^2, 26.50 ± 3.12 mmHg in patients with BMI 35-39.9 kg.m^2, and 31.44 ± 6.12 mmHg in patients with BMI 31.44 ± 6.12. The data were not significant statistically (P = 0.761 and 0.832, respectively). To an anesthetist obesity and pregnancy represents many risk factors such as delayed gastric emptying time, airway inaccessibility, unpredictability in spinal blockade especially during emergency cesarean sections. The last mentioned risk factor is due to reduce cerebrospinal fluid which is inversely proportional to the increased BMI.[18,24,25] In this study, mean volume of crystalloids used in Group A was 1342 ± 378 ml, and in Group B it was 1712 ± 538 ml, and the difference was significant statistically with P = 0.043 (P significant at 0.05). Nani and Torres concluded from their study that prophylactic measures against occurrence of hypotension in obese parturient are little effective as the regulation of the vascular tonus especially venous is more important than maintenance of the venous return altered by aorto-cava compression. The lack of statistical significance in the number of hypotensive episodes and the severity of hypotension among overweight, obese, and morbidly obese patients; i.e., maybe aorto-cava compression is less important than possible metabolic and cardiovascular alterations associated to the increased BMI.[26] The mean episodes of hypotension during spinal block in Group A were 6.21 ± 2.34 compared to 8.42 ± 3.6 episodes in Group B which was statistically significant with P = 0.038 (Table 1) in this study. In this study, the use of vasopressors was smaller in Group A; 4.88 ± 2.50 when compared to Group B; 7.46 ± 4.10 and it was significant with P value at 0.048. Sometimes the profound hypotension in morbidly obese patients may be refractory to measures such as intravenous vasopressors and intravenous crystalloids and may require intensive care admission, resuscitation, and monitoring. For optimal care, antepartum screening and evaluation by anesthesiologists is warranted.[27-29]

CONCLUSIONS

The obese pregnant patients have a higher risk of developing hypotension after spinal anesthesia for cesarean section. This study sample showed that pregnant patients with BMI more than 30 kg.m^2 were a risk factor for developing hypotension after spinal anesthesia undergoing a cesarean section. The number of hypotension episodes were more, and the amount of vasopressors used was more. The results indicate that the techniques of anesthesia used in such patients should be improved to avoid consequences in the mother and the newborn.

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