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Baseline Heart Rate as a Predictor of Post-Spinal Hypotension in Patients Undergoing a Caesarean Section

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Abstract

Background: Although spinal anesthesia is generally well tolerated, hypotension is a common adverse effect of subarachnoid block in some patients. In pregnant women, it was demonstrated that sympathetic activity is increased as compared with that of not pregnant women.

Aim of study: To determine whether preoperative heart rate is a predictor for post spinal hypotension or not in obstetric patients.

Methods: A prospective trial study that was conducted in the Obstetrics operating room at Al-Imamain Al-Kadhmain and Baghdad Teaching Hospitals, Baghdad, Iraq for a period of 12 months from Nov. 2019 to Nov. 2020. It involved 100 healthy full term pregnant women scheduled for elective C/S under spinal anesthesia. Baseline systolic, diastolic, mean arterial pressure, and heart rate were recorded. Blood pressure was monitored with an automated cuff blood pressure monitor at three-minute intervals until 30 minutes then every five minutes.

Results: In this study, 55% of study patients complained from hypotension after spinal anesthesia. mean of baseline HR was significantly higher in patients who developed post spinal hypotension than that in those who didn't. The cut point of baseline HR was 92 beats/mint., so baseline HR > 92 beats/mint. is predictive for post spinal hypotension. Requirement of ephedrine was significantly higher in hypotensive patients who had baseline HR > 92 than that in those who had baseline HR ≤ 92.

Conclusion: Preoperative heart is a good predictor for post spinal hypotension in pregnant women underwent cesarean section under spinal c anesthesia.

Keywords: Spinal anesthesia, heart rate, hypotension, cesarean section, Iraq.

Introduction

The first case of spinal anesthesia in humans was performed by August Bier in 1898 using the local anesthetic cocaine [(1)] Spinal anesthesia provides excellent operating conditions for surgery below the umbilicus. More recently, spinal anesthesia has been used in surgery above the umbilicus [(2)].

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Spinal anesthesia is the standard anesthetic technique for performing Cesarean sections to prevent complications related to airway management during general anesthesia, such as intubation failure or aspiration [3]. Morbidity and mortality directly related to anesthesia for cesarean delivery has decreased in past decades to 1.7 per million [4].

Although spinal anesthesia is generally well tolerated, hypotension is a common adverse effect of subarachnoid block in some patients [5,6]. Systemic hemodynamics are modulated by autonomic nervous system (ANS) [7]. In pregnant women, it was demonstrated that sympathetic activity is increased as compared with that of no pregnant women[8-10]. Hypotension during spinal anesthesia is mainly a result of decreased systemic vascular resistance after blockade of preganglionic sympathetic fibers [11]

When severe hypotension persists, it may lead to serious complications, such as loss of consciousness, cardiovascular collapse, and ischemia in organs. Furthermore, prolonged maternal hypotension may cause reduced uterine placental blood flow and fetal distress, which may result in bradycardia, hypoxia, and acidosis in the fetus[12,13]. Hypotension as a result of anesthesia can be prevented to some extent with prophylactic ephedrine[14]. pelvic tilt and intravascular volume expansion. However, none of the currently available strategies effectively prevent hypotension caused by spinal anesthesia[15].

Aim of study: To determine whether preoperative heart rate as predictor for post spinal hypotension in obstetric patients.

Patients and Methods

This was a cross-sectional study that was conducted in the Obstetrics operating room at Al-Imamain Al-Kadhmain and Baghdad Teaching Hospitals, Baghdad, Iraq for a period of 12 months from Nov. 2019 to Nov. 2020.

This study involved 100 full term pregnant women scheduled for elective C/S under spinal anesthesia of a physical status of American Society of Anesthesiology (ASA) II.

Exclusion criteria: Patients refusal; Multiple pregnancy; complicated pregnancy (pre eclampsia, placenta accrete…);Patients with contraindication to spinal anesthesia; Patient with Cardiovascular disease; Patient with Thyroid disease; Morbidly obese patient.

A. Detailed thorough history (socio-demographic variables, previous medical, surgical, and drug history).

B. Complete physical examination.

C. Duration of surgery was recorded.

D. Baseline systolic, diastolic, mean arterial pressure (MAP), and heart rate were recorded by calculating the average of three independent readings taken every minute in the lateral position.

E. Patient's peripheral oxygen saturation and temperature were monitored. Basal values were recorded.

Prior to the induction of spinal anesthesia, normal saline (500 ml) preload solution was administered IV for all patients.

patient where put in the sitting position, exposure was done, full aseptic technique with povidone iodine sterilization.

Spinal anesthesia achieved by intrathecal injection of 12.5 mg (2.5 ml of 0.5%) hyperbaric bupivacaine through spinal needle (25-gauge) was inserted between L3-L4, or L4-L5 intervertebral space to achieve the level of insensibility at T4-T5 dermatomes.

Patients were placed in supine position with left pelvic tilt to avoid aortocaval compression and Oxygen Five L/min was administered via face mask.

Blood pressure was monitored with an automated cuff blood pressure monitor at three-minute intervals until 30 minutes then every five minutes.

Hypotension was considered when there is more than 20% decline from baseline MAP or the systolic blood pressure below 100 mmHg and this was managed with ephedrine (5 mg at incremental doses).

The data analyzed using Statistical Package for Social Sciences (SPSS) version 25. The data presented as mean, standard deviation and ranges. Categorical data presented by frequencies and percentages.

Independent t-test (two tailed) was used to compare the continuous variables accordingly. Receiver operating characteristic (ROC) curve analysis was used for prediction of baseline HR as a predictor for post spinal hypotension. A level of P – value less than 0.05 was considered significant.

All patients were verbally informed about the study and they were asked the permission to be part of the study. All personal information was kept anonymous. Data were exclusively used for the sake of this study.

Administrative approval was granted from the Scientific Council of Iraqi Board of Anesthesia and Intensive Care.

Results

The total number of study patients was 100 pregnant women. All of them were undergone C/S under spinal anesthesia and were evaluated for the role of baseline HR in prediction of post-spinal hypotension.

Results in table (1): shows the means of baseline of vital signs. Mean of HR was 101.16 beats/mints.; MAP was 93.19 mmHg; temp was 36.94 °C; and SPO2 was 97.58%.

Table 1: Means of baseline of vital signs.

Baseline vital signs	Mean ± SD	Range
HR (beats/mint)	101.16 ± 14.1	71.0 – 128.0
MAP (mmHg)	93.19 ± 6.5	80.6 – 103.8
Temp (°C)	36.72 ± 0.61	36.5 – 37.8
SPO2 (%)	97.58 ± 1.3	95.0 – 99.0

Table 2: Distribution of study patients by the occurrence of post spinal hypotension at different times

Post spinal hypotension	No. (n= 100)	Percentage (%)
Immediate after anesthesia	5	5.0
After 3 mints.	41	41.0
After 6 mints.	45	45.0
After 9 mints.	28	28.0
After 12 mints.	15	15.0
After 15 mints.	6	6.0
After 18 mints.	6	6.0
After 21 mints.	0	0
After 24 mints.	3	3.0
After 27 mints.	0	0
After 30 mints.	2	2.0
After 35 mints.	0	0
After 40 mints.	2	2.0
	n= 47	
After 45 mints.	2	3.5
	n= 17	
After 50 mints.	2	11.8
After 55 mints.	0	0

We noticed that hypotension was occurred in 41% of patients after three mints and 45% after six mints, then the prevalence was decreased with time.

Table 3: Comparison in baseline HR between patients who developed post spinal hypotension and those who didn't

	Post spinal hypotension		
Baseline HR (beats/mint.)	Yes Mean ± SD	No Mean ± SD	P – Value
	100.2 ± 14.4	91.02 ± 12.1	0.001

We noticed that mean of baseline HR was significantly higher in patients who developed post spinal hypotension than that in those who didn't (100.2 versus 91.02 beats/mint., P = 0.001).

Table 4: Comparison in age, height, weight and duration of surgery between patients who developed post spinal hypotension and those who didn't

	Post spinal hypotension		
Variable	Yes	No	P – Value
	Mean ± SD	Mean ± SD	
Age (Year)	26.14 ± 3.6	26.84 ± 3.5	0.327
Height (cm)	160.47± 5.38	161.26 ± 4.88	0.324
Weight (kg)	68.35 ± 6.21	67.43 ± 4.96	0.446
Duration of surgery (mint.)	44.72 ± 4.1	46.86 ± 14.8	0.353

No statistical significant differences (P ≥ 0.05) in these parameters between patients who developed post spinal hypotension and those who didn't.

Table 5: Comparison in ephedrine requirement between patients who had baseline HR ≤ 92 and those who had baseline HR > 92

	Baseline HR		
Ephedrine (mg)	**≤ 92**	**> 92**	**P – Value**
	Mean ± SD	**Mean ± SD**	
	1.75 ± 2.8	4.78 ± 4.5	0.001

We noticed that the requirement of ephedrine was significantly higher in hypotensive patients who had baseline HR > 92 than that in those who had baseline HR ≤ 92 (4.78 versus 1.75 mg, P= 0.001).

Discussion

In the present work, 45% of patients after six mints and 41% after three mints had hypotension. then the prevalence was decreased with time. In the same manner, Shehata et al study in 2019, reported that MAP measured a significant change in MAP over time during the study. MAP shows a significant decrease after fluid loading, after 15 minutes, after 30 minutes in comparison to MAP at baseline [16]. Furthermore, this study revealed that 55% of patients complained from hypotension after spinal anesthesia. A higher results observed in Shitemaw et al study in 2020, as observed from the total pregnant mothers who underwent CS under spinal anesthesia, that incidence of hypotension was 64% [17]. A lower results observed in Joshi et al study in 2018, in which thirty-nine patients out of 100 underwent CS under spinal anesthesia, developed hypotension (39%), of whom 27 were in those with HR>90 bpm (group 2) (50.9%) and 12 patients with HR <90 bpm (group 1) (25.5%) [18]. Also, Bishop et al study in 2017, reported a lower results, when the overall incidence of hypotension in patients underwent CS under SA was 30.4%[19]. The differences in the rate of incidences among above studies may have related to the sample size and to the fact that incidence of hypotension is difficult to quantify owing to inconsistencies in the definitions used across studies. In the current study, mean of baseline HR was significantly higher in patients who developed post spinal hypotension than that in those who didn't (100.2 versus 91.02 beats/mint, P= 0.001).

In comparison to Joshi et al study in 2018, a similar results observed, they reported that the higher the baseline HR, higher the risk of developing hypotension during spinal anesthesia. The incidence of hypotension was significant between patients with HR > 91 and others with rate < 91 BPM (P = 0.0260) [18].

The current results are comparable to khan et al study in 2010, by correlating higher pre-operative HR and development of post-spinal hypotension. They found out that incidence of hypotension was more in group with HR >91 bpm (31.82%) than patients with HR <90 bpm (11.86%) with P value of <0.001 [20]. Furthermore, Bishop et al study in 2017, reported a similar finding. They observed that preoperative HR was a predictive of hypotension in elective or emergency CS, in which high pre-operative HR was significantly increased incidence of hypotension after spinal anesthesia [19].

On the other hand, Frölich and colleagues observed in their study in 2002 that subjects with a baseline HR rate greater than 90 bpm had an 83% chance (positive predictive value) of developing marked hypotension after SA and patients with a HR less than 90 bpm had a 75% chance (negative predictive value) of not developing marked hypotension. Choosing a HR of 80 bpm as cut-off, the positive predictive value was 18% (chance of developing hypotension) with a 52% negative predictive value [21].

The current study revealed no statistical significant differences in age and duration of surgery between patients who developed post spinal hypotension and those who didn't (P ≥ 0.05). Similarly, Joshi and colleagues in their study in 2018, found no significant relation between age and duration of operation between group 1 (patients having a HR <90 bpm) and group 2 (patients having a HR >90 bpm) [18].

Another study observed a different results, as Bishop and colleagues in the study done in 2017, found that advanced maternal age was significantly increase the risk of hypotension following spinal anesthesia for CS (P=0.002) [19].It seems from other studies, that reduction in cardiac reserve and changes in baroreceptor and sympathetic nervous system responses may play certain roles in increasing the risk of hypotension as the age of participants increase [22].

The current study noticed that requirement of ephedrine was significantly higher in hypotensive patients who had baseline HR > 92 than that in those who had baseline HR ≤ 92 (4.78 versus 1.75 mg, P= 0.001). An agreement observed in Joshi et al study in 2018, as observed that use of ephedrine was significantly greater in hypotensive patients with HR > 91 BPM than those with HR < 91 BPM (mean 3.9 ± 0.45 vs 4.34 ± 0.45, P = 0.0148) [18]. An agreement observed in a study conducted by Frölich and colleagues in 2002, as found that a significant positive correlation in baseline HR and ephedrine requirements (P=0.005). With increasing HR, the ephedrine requirement and the incidence of hypotension increased [21]. Prophylactic fluid preloading and presence of mechanical compressor can have determined different dosage used in each study.

Conclusion

Preoperative heart rate is a good indicator for post spinal hypotension in pregnant women underwent cesarean section under spinal anesthesia, as well as Ephedrine requirements can be predicted by assessment of baseline heart rate.

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