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HEMODYNAMIC CHANGES ASSOCIATED WITH SPINAL ANESTHESIA FOR CESAREAN DELIVERY IN SEVERE PREECLAMPSIA

By

Mahmoud El-Sayed Rashad Turkey, Abd El-Nasser Ahmed Hussein and Ali Abdallah Al-Kumity

Anesthesiology and Intensive Care Department, Faculty of Medicine, Al-Azhar University

*** Corresponding author:** Mahmoud El Sayed Rashad,

E-mail: turkeymahmoud808@gmail.com

ABSTRACT

Background: Sever pre-eclampsia is defined as a disorder that occurs in pregnancy which manifests as hypertension and proteinuria with at least one maternal organ dysfunction involvement.

Objectives: To determine how pre-eclampsia affects maternal hemodynamics during cesarean delivery after spinal anesthesia.

Patients and Methods: This prospective randomized study was carried out on 30 normotensive females and 30 pre-eclamptic females admitted to Hospital for elective cesarean section using spinal anesthesia. The study was conducted in the Obstetrics Department of Al-Azhar University Hospitals, from January 2019 till December 2019.

Results: Incidence of hypotension after spinal anesthesia in group A (normotensive) was 66.7% and in group B (preeclampsia) was 30%. The total dose of Ephedrine required to correct hypotension when it happen mean dose ± SD in group A was 9.83 ± 9.30 and in group B was 3.00 ± 5.15. Neonatal outcomes (APGAR score and umbilical artery blood gases) were comparable. There was increased incidence of headache and blurring of vision among severe preeclampsia parturient.

Conclusion: Incidence of hypotension after spinal anaesthesiawas less frequent and less severe in preeclampsia patients and required lower dose of ephedrine than normotensive population. There was increased incidence of headache and blurring of vision among severe preeclampsia parturient. No difference in neonatal outcome between normotensive and severe preeclampsia population following spinal anesthesia.

Keywords: Hemodynamic, Spinal Anesthesia, Cesarean Delivery, Severe Preeclampsia.

INTRODUCTION

Features of severe preeclampsia include: Blood pressure > 159/109 mm Hg on two occasions at least 6 hrs. Apart, proteinuria of ≥5 g protein in 24-hr urine specimen or dipstick reading of ≥3+ on two samples taken at least 4 hrs. apart, oliguria (<500 mL in 24 hrs.), pulmonary edema or cyanosis, abnormal liver function, right upper quadrant or epigastric pain, cerebral disturbances and thrombocytopenia *(Tranquilli et al.,2013)*. In women with severe disease, the goal is detection of the development of organ dysfunction.

Pre-eclampsia remains an important cause of hypertensive acute pulmonary edema in pregnancy. There are a number of commonly associated clinical symptoms (breathlessness, orthopnea,

agitation, and cough) and signs (tachycardia, tachypnea, crackles and wheeze on chest auscultation, cardiac S3 gallop, and decreased oxygen saturation) *(Taydeet al., 2018).*

The use of spinal anesthesia in pre-eclamptic pregnant woman is of considerable benefit, as these patients present particular hazards with general anesthesia, such as concerns for rapid airway control and cerebral blood flow alterations during induction of general anesthesia and intubation *(Turneret al., 2010).* However, the incidence of hypotension is high during spinal anesthesia for CS and it may approach values up to 95% *(Banerjeeet al., 2010).*

Hypotension during spinal anesthesia for cesarean delivery is a result of decreased vascular resistance due to sympathetic blockade and decreased cardiac output due to blood pooling in blocked areas of the body *(Liguoriet al., 2012).* Hypotension occurring during Cesarean section or following regional anesthesia is treated by careful fluid therapy and vasopressors, such as phenylephrine or ephedrine, which should be given very cautiously and in much smaller doses than those used in non-pre-eclamptic patients due to the exaggerated vasoconstrictor response in parturient suffering from pre-eclampsia *(Cotoia et al., 2017).* Three prospective trials have demonstrated that pre-eclamptic parturient experience less frequent and less sever hypotension and require smaller doses of vasopressors than normotensive controls after initiation of spinal anesthesia *(Henkeet al., 2013).*

The present work aimed to determine how pre-eclampsia affects maternal hemodynamics during Cesarean section after spinal anesthesia.

PATIENTS AND METHODS

This prospective randomized and controlled study was carried out on 30 severely preeclamptic females and 30 normotensive females. The study was conducted in the Obstetrics Department of Al-Azhar University Hospitals (Al-Hussein and Bab-AlShaarya), Cairo, Egypt, from January 2019 till December 2019. After approval from ethical committee, an informed consent was obtained from all patients.

All data of the patients should be confidential with secret code and private file for each patient.

Inclusion criteria:

- Age: 18 - 40 years
- Severely Pre-eclamptic females, severe pre-eclampsia is defined as hypertension (BP> 159/109), proteinuria (urinary protein excretion of greater than 5 gm per day) and oliguria (urine output <500 ml in 24 hours) with at least one maternal organ dysfunction.

Exclusion criteria:

- Patient refusal.
- Age: <18 years.
- Obese patients with BMI > 35 Kg/m2.
- Preterm delivery.
- Patients with contraindication to spinal anesthesia.
- Patients in active labour.
- Chronic illness e.g. chronic hypertension, renal failure.

- Congenital anomalies of the fetus.

Preoperative assessment:

- History (medical and surgical).
- Physical examination.
- Laboratory investigations (CBC, renal function tests, liver function tests. coagulation profile).

Premedication:

- Slow IV infusion of 50 mg Ranitidine and 10 mg Metoclopramide.
- For seizure prophylaxis, Mgso4 will be given to all severely pre- eclamptic patients, loading dose 4 gm. over 30 minutes followed by 1 gm /hour.

Anesthetic technique:

The parturient was allocated into one of two equal groups (n=30), a normotensive group (A) and severe preeclampsia group (B). All was received colloid (500 ml hydroxethyl starch) as a coload via wide bore (18 Gauge) cannula within 5-10 minutes during induction of spinal anesthesia. Standard monitoring with electrocardiography, automated non-invasive arterial pressure (NIAP) measurement, and pulse oximetry will be performed. Systolic arterial pressure (SAP), mean arterial pressure (MAP) and diastolic arterial pressure (DAP) was monitored. Baseline values were recorded in the supine position.

Spinal anesthesia was induced with a total of 10 mg of 0.5% hyperbaric bupivacaine and 25 µg fentanyl (total volume 2.5 ml) at the L3–4 interspace in the sitting position then the patient returned immediately to the supine position with left lateral tilt.

Hypotension defined as decrease in systolic blood pressure (SAP) below 30% of baseline in severe preeclampsia group and below 30% or developing manifestations of hypotension e.g. nausea and vomiting, and bradycardia defined as decrease in HR below 55 beat / minute.

Ephedrine boluses of 5 or 10 mg were given to correct hypotension and atropine (0.01 mg/kg) was given to correct bradycardia.

Data collection:

- **Demographic data:** (age, weight, height, BMI, Gestational age).
- **Hemodynamic data:**

  - Heart rate, systolic, diastolic and mean arterial blood pressure pre and post spinal injection (1 minute after spinal injection then every 2.5 minute till delivery of the baby then every 5 minute till the end of surgery).

  - Dose of Ephedrine required correcting hypotension.

  - Doses of Atropine required correcting bradycardia.

  - Oxygen saturation using pulse oximeter reading recorded every 5 minutes.

  - Apgar score at 1 and 5 min will be recorded.

  - Umbilical artery blood gases.

  - Other data collection: headache, vomiting, respiratory distress (Dyspnea or Bradypnea), pulmonary edema and blurring of vision.

Primary outcome:

To compare incidence of hypotension after spinal anesthesia in severely

preeclamptic parturient versus normotensive control.

Secondary outcome:

- To determine ephedrine dose required to correct hypotension.
- To detect APGAR score and umbilical artery blood gases after spinal anesthesia.
- To detect incidence of headache, vomiting, respiratory distress, pulmonary edema and blurring of vision.

Statistical analysis:

Data management and statistical analysis were performed using the Statistical Package for Social Sciences (SPSS) version 20.Numerical data were summarized using means and standard deviations or medians and ranges. Data were explored for normally using Kolmogrov-Smirnov test and Shapiro-Wilk test. Categorical data were summarized as percentages. Comparisons between the 2 groups with respect to normally distributed numeric variables were done using the Independent t-test. Non normally distributed numeric variables were compared by Mann-Whitney test. For categorical variables, differences were analyzed with (X2)(chi square) test and Fisher's exact test when appropriate. P-values <0.05 were considered significant.

RESULTS

There was no statistically significant difference between two groups regarding their demographic data where p-vale was >0.05 **(Table 1)**.

Table (1): Comparison between two groups regarding their Demographic data

Groups / Demographic data	Normotensive group (N=30)				Severe preeclampsia group (N=30)				T-test
	Range		Mean	SD	Range		Mean	SD	P-value
Age (years)	21	37	28.7	4.34	20	39	28.93	4.59	0.842
BMI	25.4	33.3	29.73	1.89	24.7	33.7	30.03	2.36	0.588
GA (wks)	36	39	37.53	0.86	36	39	37.3	0.88	0.310

There was a highly statistically significant difference between two groups regarding DBP data where p-vale was <0.001 **(Table 2)**.

Table (2): Comparison between two groups regarding DBP (mmHg)

Groups / DBP (mmHg)	Normotensive group (N=30)			Severe preeclampsia group (N=30)			T-test
	Mean	±	SD	Mean	±	SD	P-value
Baseline	63.6	±	5.75	98.62	±	8.78	<0.001
1 min. after spinal	50.7	±	8.87	85.35	±	5.05	<0.001
2.5 min. after spinal	52.5	±	5.47	90.47	±	9.21	<0.001
5 min. after spinal	51.4	±	9.66	89.21	±	9.57	<0.001
7.5 min. after spinal	53.8	±	6.92	83.81	±	6.91	<0.001
10 min. after spinal	54.34	±	9.76	81.34	±	5.65	<0.001
12.5 min. after spinal	54.6	±	7.33	80.38	±	6.46	<0.001
15 min. after spinal	55.89	±	9.21	80.62	±	7.05	<0.001
17.5 min. after spinal	56.43	±	6.47	81.4	±	7.55	<0.001
At delivery	58.12	±	7.18	82.5	±	5.11	<0.001
5 min. after delivery	58.22	±	5.91	81.48	±	8.85	<0.001
10 min. after delivery	59.69	±	5.11	80.62	±	8.85	<0.001
15 min. after delivery	61.47	±	5.82	78.6	±	7.44	<0.001

There was a highly statistically significant difference between two groups regarding SBP data where p-vale was <0.001 **(Table 3)**.

Table (3): Comparison between two groups regarding SBP (mmHg)

Groups / SBP(mmHg)	Normotensive group (N=30)			Severe preeclampsia group (N=30)			T-test
	Mean	±	SD	Mean	±	SD	P-value
Baseline	128.7	±	5.54	169.6	±	5.56	<0.001
1 min. after spinal	115.6	±	6.21	155.52	±	5.11	<0.001
2.5 min. after spinal	120.3	±	8.41	160.74	±	7.67	<0.001
5 min. after spinal	118.45	±	9.91	157.3	±	9.94	<0.001
7.5 min. after spinal	119.7	±	7.20	155.8	±	5.96	<0.001
10 min. after spinal	121.12	±	7.44	156.12	±	8.87	<0.001
12.5 min. after spinal	115.62	±	6.26	154.6	±	8.68	<0.001
15 min. after spinal	112.9	±	5.89	151.9	±	6.86	<0.001
17.5 min. after spinal	111.15	±	7.50	152.12	±	9.53	<0.001
At delivery	109.8	±	6.45	153.3	±	5.05	<0.001
5 min. after delivery	108.1	±	10.5	154.7	±	9.69	<0.001
10 min. after delivery	108.6	±	7.91	152.65	±	5.63	<0.001
15 min. after delivery	110.5	±	8.62	150.1	±	9.87	<0.001

A highly statistically significant difference between two groups regarding MBP data where p-vale was<0.001 **(Table 4)**.

Table (4): Comparison between two groups regarding MBP (mmHg)

MBP(mmHg) \ Groups	Normotensive group (N=30)			Severe preeclampsia group (N=30)			T-test
	Mean	±	SD	Mean	±	SD	P-value
Baseline	98.6	±	6.08	133.6	±	6.94	<0.001
1 min. after spinal	82.7	±	7.41	125.3	±	7.16	<0.001
2.5 min. after spinal	85.2	±	8.55	124.4	±	5.92	<0.001
5 min. after spinal	83.4	±	7.70	121.15	±	8.68	<0.001
7.5 min. after spinal	86.32	±	8.04	119.62	±	9.32	<0.001
10 min. after spinal	86.7	±	9.46	118.7	±	5.25	<0.001
12.5 min. after spinal	84	±	8.53	117.5	±	5.14	<0.001
15 min. after spinal	83.84	±	5.61	116.09	±	5.14	<0.001
17.5 min. after spinal	83.62	±	9.96	117.4	±	5.87	<0.001
At delivery	82.7	±	7.92	115.12	±	9.85	<0.001
5 min. after delivery	84.26	±	8.81	116.7	±	8.46	<0.001
10 min. after delivery	85.31	±	7.94	117.4	±	8.94	<0.001
15 min. after delivery	86.05	±	7.60	114.6	±	6.53	<0.001

A statistically significant difference between two groups regarding Hypotension data where p-vale was <0.05 **(Table 5)**.

Table (5): Comparison between two groups regarding Hypotension

Hypotension \ Groups		Normotensive group (N=30)		Severe preeclampsia group (N=30)		Total	
		N	%	N	%	N	%
Yes		20	66.7	9	30.0	29	48.3
No		10	33.3	21	70.0	31	51.7
Total		30	100.0	30	100.0	60	100.0
Chi-square	X^2	8.076					
	P-value	0.004					

There was highly statistically significant difference between two groups regarding total dose of ephedrine data where p-vale was <0.001 while was no statistically significant difference in total dose of atropine where p-vale was >0.05 **(Table 6)**.

Table (6): Comparison between two groups regarding Total dose of Ephedrine and Atropine

Drugs \ Groups	Normotensive group (N=30)					Severe preeclampsia group (N=30)					
	Range		Mean	SD	Median	Range		Mean	SD	Median	P-value
Total dose of Ephedrine	0	30	9.83	9.30	9.50	0	18	3	5.15	0.00	<0.001**
Total dose of Atropine	0	1	0.07	0.22	0.00	0	0.50	0.02	0.09	0.00	0.254

A highly statistically significant difference between two groups regarding Headache and Blurring of vision data where p-vale was <0.001 **(Table 7)**.

Table (7): Comparison between two groups regarding their Complications

Groups / Complications	Normotensive group (N=30)		Severe preeclampsia group (N=30)		Chi-square	
	N	%	N	%	X^2	P-value
Headache	0	0.0	12	40.0	15.000	<0.001**
Blurring of vision	0	0.0	6	20.0	6.667	0.010*
Vomiting	9	30.0	7	23.3	0.341	0.559
Respiratory distress	0	0.0	1	3.3	1.017	0.313

There was no statistically significant difference between two groups regarding Fetal acidosis where p-vale was >0.05 **(Table 8)**.

Table (8): Comparison between two groups regarding their Fetal Acidosis

Fetal acidosis / Groups		Normotensive group (N=30)		Severe preeclampsia group (N=30)		Total	
		N	%	N	%	N	%
Normal		26	86.7	24	80.0	50	83.3
Acidosis		4	13.3	6	20.0	10	16.7
Total		30	100	30	100	60	100
Chi-square	X^2	0.480					
	P-value	0.488					

DISCUSSION

The current study was conducted on30 severely preeclamptic females and 30 normotensive females. It was aimed to determine how pre-eclampsia affects maternal hemodynamics during Cesarean section after spinal anesthesia.

Regarding demographic data showed no statistically significant differences between the two groups.

We found that incidence of hypotension after spinal anesthesia in group A (normotensive) was 66.7% and in group B (preeclampsia) was 30%.

These results went in line with that of *Goel et al. (2018)* who found that the incidence of hypotension, as defined by a 30% decrease in mean BP, is less in patients with severe preeclampsia undergoing spinal anesthesia for cesarean delivery, as compared with healthy parturient. In addition, the magnitude of the decrease in mean BP is smaller in severely preeclamptic patients. Also our results were similar to the follow up study of *Henkeet al. (2013)* as they demonstrated that the incidence of clinically relevant hypotension (decrease in MAP to < 70%) leading to ephedrine treatment was lower in the severely preeclamptic group compared with the preterm group (24.4% versus 40.8%).

Dyer et al. (2010) showed results against ours. They concluded that spinal anesthesia in severe preeclampsia was associated with significant decrease in MAP and systemic vascular resistance from the time of adoption of the supine position until the end of surgery, however there is insignificant changes in CO. This study has relatively small sample size (n =15) also CVP was not measured in this study.

The mean ephedrine requirement of the normotensive group (27.9+/-11.6 mg) was significantly greater (P<0.01) than that of the preeclamptic group (16.4+/-15.0 mg)and it was similar to the study of *Cartyet al. (2010).* The preeclamptic patients had a less frequent incidence of clinically significant hypotension, which was less severe and required less ephedrine *(Chaudharyet al., 2011).*

Regarding complications including headache, blurring of vision, vomiting and respiratory distress (bradypnea or distress), we found that incidence of headache in group B was 40% and incidence of blurring of vision was 20%. While incidence of vomiting and respiratory distress were comparable.

Regarding neonates, APGAR score showed no statistically significant differences between the two groups at 1 min & 5 min.

These results went in line with the results of *Henke et al. (2013),* they reported comparable APGAR score in both groups.

CONCLUSION

Incidences of hypotension after spinal anesthesia are less frequent and less severe in preeclampsia patients and require lower dose of ephedrine than normotensive population. There was increased incidence of headache and blurring of vision among severe preeclampsia parturient. No difference in neonatal outcome between normotensive and severe preeclampsia population following spinal anesthesia.

REFERENCES

1. **Banerjee, A., Stocche, R. M., Angle, P. and Halpern, S. H. (2010):** Preload or coload for spinal anesthesia for elective Cesarean delivery: a meta-analysis. Canadian Journal of Anesthesia/Journal canadiend' anesthésie, 57(1): 24-31.
2. **Carty, D. M., Delles, C., and Dominiczak, A. F. (2010):** Preeclampsia and future maternal health. Journal of hypertension, 28(7):1349-1355.
3. **Chaudhary, S., and Salhotra, R. (2011):** Subarachnoid block for caesarean section in severe preeclampsia. Journal of Anesthesiology, Clinical Pharmacology, 27(2):169-172.
4. **Cotoia, A., Mirabella, L., Raimondo, P. and Cinnella, G. (2017):** Complications of regional anesthesia. In Management and Therapy of Late Pregnancy Complications Springer, Cham.p. 265-293.
5. **Dyer, R. A., Reed, A. R., van Dyk, D., Arcache, M. J., Hodges, O., Lombard, C. J. and James, M. F.(2010):** Hemodynamic effects of ephedrine, phenylephrine, and the co administration of phenylephrine with oxytocin during spinal anesthesia for elective cesarean delivery. Obstetric Anesthesia Digest, 30(3): 160-163.
6. **Goel, L., Cordeiro, R., and Goel, M. (2018):** Intraoperative requirement of Phenylephrine for spinal anesthesia, with comparison of hemodynamic parameters between severe pre-eclamptic and normotensive parturients for elective caesarean section: A prospective study. Indian Journal of Clinical Anaesthesia, 5(1):125-128.
7. **Henke, V. G., Bateman, B. T. and Leffert, L. R. (2013):** Spinal anesthesia in severe preeclampsia. Anesthesia& Analgesia, 117(3):686-693.

8. **Liguori, G. A. (2012):** Hemodynamic complications. Complications in Regional Anesthesia and Pain Medicine, 59 (6): 847-847.

9. **Tayde, P. V., Ansari[1], A., Loutfy[1], I. and Sharma, H. (2018):** Management of Perioperative Pulmonary Edema in a Case of Preeclampsia for Cesarean Section. Journal of Anaesthesia and Critical Care Case Reports, 4(2): 15-17.

10. **Tranquilli, A. L., Brown, M. A., Zeeman, G. G. Dekker, G., and Sibai, B. M. (2013):** The definition of severe and early-onset preeclampsia. Statements from the International Society for the Study of Hypertension in Pregnancy (ISSHP). Pregnancy Hypertension: An International Journal of Women's Cardiovascular Health, 3(1): 44-47.

11. **Turner, J. A. (2010):** Diagnosis and management of pre-eclampsia: an update. International Journal of Women's Health, 2: 327-328.

التغيرات الديناميكية الدموية المصاحبة للتخدير النصفي خلال الولادة القيصرية في حالات تسمم الحمل الشديد

محمود السيد رشاد تركي، عبدالناصر أحمد حسين، علي عبدالله الكميتي

قسم التخدير والرعاية المركزة، كلية طب الأزهر

خلفية البحث: يعرف تسمم الحمل بأنه الإضطراب الذي يحدث في الحمل بعد عشرين أسبوعا والذي يظهر بهإرتفاع بضغط الدم وبروتين بالبول بالإضافة الي خلل بأجهزة الأم (واحدة على الأقل).

الهدف من البحث: تحديد كيفية تأثير تسمم الحمل علي ديناميكا الدم بعد التخدير النصفي أثناء الولادة القيصرية.

المريضات وطرق البحث: تم إجراء هذه الدراسة على 60 سيدة تم تحضيرهن للولادة القيصرية غير الطارئة، وتم تقسيمهن إلمجموعتين متساويتين: مجموعة سوية ضغط الدم (أ) ومجموعة تسمم الحمل الشديدة (ب). ولقد تمت الدراسة بمستشفيات جامعة الأزهر بالقاهرة في الفترة ما بين يناير 2019 إلى ديسمبر 2019.

نتائج البحث: نسبة حدوث انخفاض ضغط الدم بعد التخدير النصفي في المجموعة (أ) (سوية ضغط الدم) هي 66.7 ٪، وفي المجموعة الثانية (تسمم الحمل) 30٪، النتائج الوليدية (نتيجة الابجر وغازات الدم من الشريان السري) قابلة للمقارنة.

الإستنتاج: حالات انخفاض ضغط الدم بعد التخدير النصفي هي أقل تواترا وأقل حدة في المرضيات الائي يعانين من تسمم الحمل، وتتطلب أقل جرعة من الايفيدرين من سوية ضغط الدم،كما وجد أن هناك زيادة في حدوث الصداع وعدم وضوح الرؤية بين مريضات تسمم الحمل شديدة،كما لا فرق في نتائج حديثي الولادة بين مريضات تسمم الحمل الشديد وسوية الضغط بعد التخدير النصفي.