ANALYSIS OF MATERNAL AND FETAL OUTCOME IN SPINAL VERSUS EPIDURAL ANESTHESIA FOR CESAREAN DELIVERY IN SEVERE PRE-ECLAMPSIA

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ABSTRACT

AIM

Our primary aim is to analyze of maternal and fetal outcome in spinal versus epidural anesthesia for cesarean delivery in severe pre-eclampsia.

MATERIALS AND METHODS

Sixty parturients (60) with severe pre-eclampsia posted for cesarean section were randomized into two groups of thirty (30) each for either spinal anesthesia that is group S or epidural anesthesia that is group E. Spinal group (group S, n=30) received 10mg (2ml) of 0.5% of hyperbaric bupivacaine solution intrathecally in left lateral decubitus or sitting position at L3-4 lumbar space with 25G quincke-babcock spinal needle. Patients received 6l/min of oxygen through Hudson's face mask throughout the surgery. In Epidural group (group E, n=30), after thorough aseptic precautions, an 18G Tuohy's epidural needle inserted at the L3-4 lumbar space with the patient in lateral decubitus or sitting position. Three ml of 1.5% lidocaine with was given as a test dose. After ruling out any intrathecal injection of the drug, initially 8ml of 0.5% isobaric bupivacaine given and the vitals monitored. Then 3ml top-ups of the same bupivacaine solution is given in a graded manner slowly, simultaneously checking the height of block. A blockade upto T4 to T6 is required. Vitals are carefully monitored and oxygen is provided 6l/min throughout the procedure and surgery. Blood pressure (systolic, mean, diastolic), pulse rate, oxygen saturation are recorded immediately after giving anesthesia, every minute for first 10mins, then every 3mins for the rest of the surgery. Then vitals are also noted post-operatively for the first 24hrs. Apgar score after 1 and 5 minutes, of the newborn baby is also recorded. Other parameters noted were incidence and duration of hypotension or hypertension both intra-operatively and post-operatively, any usage of vasopressors (ephedrine) and its dose, convulsions, renal failure, pulmonary edema, requirement for ICU stay and the number of days in the mother, and the incidence of fetal demise.

CONCLUSION

In conclusion, although the incidence of hypotension and ephedrine requirement was slightly more frequent in the spinal group than in the epidural group, we found evidence that supports the use of spinal anesthesia in severely pre-eclamptic patients.

KEYWORDS

Maternal; Fetal; Spinal; Epidural; Caesarean; Severe pre-eclampsia.

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INTRODUCTION: Pre-eclamptic toxemia is a multi-system disorder that is characterized by endothelial cell dysfunction as a consequence of abnormal genetic and immunologic mechanisms. Although understanding of the pathophysiology of pre-eclampsia has improved, management has not changed significantly over the years.[1] Currently, the safety of regional anaesthesia techniques is well established and they provide better obstetrical outcome when chosen properly.[2]

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Thus, regional anaesthesia is extensively used for obstetric management in women with pre-eclampsia.[1]For the past 50yrs pre-eclamptic toxemia has been one of the commonest causes of pregnancy related death, being second only to pulmonary embolism. It is also a leading cause of maternal and foetal morbidity and mortality worldwide;[3] approximately 63,000 women die every year because of maternal hypertension syndromes pre-eclampsia and eclampsia.[4] Epidural anaesthesia was the regional anaesthesia of choice until pencil point needles were introduced.[2] Epidural anaesthesia has long been considered the optimal anaesthetic technique in severe pre-eclampsia for its stable hemodynamics,[5] optimization of uteroplacental perfusion[6] and ability to titrate the administration of local anaesthetic and intravenous fluids to achieve the desired level of blockade without precipitous decrease in maternal blood pressure, but disadvantages like longer onset time,

patchy block with conversion to general anaesthesia are also seen. Previous data showed that spinal anaesthesia was controversial in severe eclampsia[7] because of anticipated potential risks of profound cardiovascular instability, pulmonary oedema, possibly from fall in cardiac output,[8] and the consequent recourse to IV fluids and vasopressor agents, suggested that it was not a technique to be recommended. However, there is growing support for the use of spinal anaesthesia in the past decade on the basis of results of more recent studies,[9, 10, 11] clinical experience, the recent advent of pencil point needles and newer local anaesthetic agents. Spinal anaesthesia, which is quick to perform, takes less time to be effective and failure rate is less than epidural and also the incidence of hemodynamic complications especially hypotension is not that significant compared to that in pregnant patients without severe pre-eclampsia. In most of the obstetric centers spinal anaesthesia is now being used as anaesthesia of choice for severe pre-eclamptic patients as well.[12,13,14,15] In our center we have been using both the techniques, but spinal anaesthesia is being practiced in 90% of the patients for caesarean delivery in severe pre-eclamptic patients without any contraindications for regional anaesthesia. In this study, spinal and epidural anaesthetic techniques are compared for the maintenance of haemodynamics, incidence of complications, and overall maternal and foetal outcome.

AIMS AND OBJECTIVES OF THE STUDY: Our primary aim is to analyze of maternal and foetal outcome in spinal versus epidural anaesthesia for caesarean delivery in severe pre-eclampsia. As regional anaesthesia is the choice of anaesthesia in pregnant women, the two techniques namely spinal and epidural anaesthesia have advantages and disadvantages in patients with severe pre-eclampsia. In this study the hemodynamic variables like the systolic blood pressure, diastolic blood pressure, mean blood pressure, change in heart rate, Apgar scoring as well as post-operative complications, intensive care admissions, hospital stay are compared in the mothers and newborn in both the groups for the analysis of overall maternal and foetal outcome. Apgar scoring in the newborn in the first and fifth minute is collected and compared between both the groups for the foetal and newborn outcome. The results would be collected in terms of the above said variables and statistically analyzed as to which of the techniques is superior in terms of incidence of significant complications, maintenance of haemodynamics, ease of administration and overall better maternal and foetal outcome.

MATERIALS AND METHODS: Sixty parturients (60) with severe pre-eclampsia posted for caesarean section were randomized into two groups of thirty (30) each for either spinal anaesthesia that is group S or epidural anaesthesia that is group E. Patients are parturients with the inclusion criteria of severe pre-eclampsia that is blood pressure of >160/110 mm hg, proteinuria >5g/24hrs, with any one of the associated symptoms of severe pre-eclampsia as headache, visual disturbance, epigastric pain, hyper-reflexia, pedal oedema, dizziness or vomiting. Exclusive criteria were, patients with cardiovascular and pulmonary disease/manifestations, diabetes, thyroid disorders, HELLP syndrome, <34 weeks gestational age, foetal bradycardia, and any contraindications of regional anaesthesia including patients refusal, severe haemorrhage, coagulopathy and sepsis.

In the antepartum management all patients received magnesium sulphate as a seizure prophylaxis. Previous antihypertensive drugs with which the parturients according to the institute protocol were treated, like methyldopa, nicardipine / nifedipine, labetalol are recorded. Demographic data like name, weight, height, hospital admission number, are recorded pre-operatively. After taking informed written consent, a wide bore intravenous cannula is secured and, all patients received 10-15ml/kg of ringer lactate crystalloid solution as co-loading while preparing to administer the respective anaesthesia All the monitors like, ECG, Pulse oximetry, Automated non-invasive blood pressure are connected to the patient and all the baseline readings were recorded pre-operatively. Spinal group (group S, n=30) received 10mg (2ml) of 0.5% of hyperbaric bupivacaine solution intrathecally in left lateral decubitus or sitting position at L3-4 lumbar space with 25G quincke-babcock spinal needle. Patients received 6l/min of oxygen through Hudson's face mask throughout the surgery. In Epidural group (group E, n=30), after thorough aseptic precautions, an 18G Tuohy's epidural needle inserted at the L3-4 lumbar space with the patient in lateral decubitus or sitting position. Then the epidural space is identified using loss of resistance to air technique and the catheter introduced and fixed at 8-10cms. Three ml of 1.5% lidocaine with was given as a test dose. After ruling out any intrathecal injection of the drug, initially 8ml of 0.5% isobaric bupivacaine given and the vitals monitored. Then 3ml top-ups of the same bupivacaine solution is given in a graded manner slowly, simultaneously checking the height of block. A blockade upto T4 to T6 is required. Vitals are carefully monitored and oxygen is provided 6l/min throughout the procedure and surgery. Blood pressure (systolic, mean, diastolic), pulse rate, oxygen saturation are recorded immediately after giving anaesthesia, every minute for first 10mins, then every 3mins for the rest of the surgery. Then vitals are also noted post-operatively for the first 24hrs. Apgar score after 1 and 5 minutes, of the newborn baby is also recorded. Other parameters noted were incidence and duration of hypotension or hypertension both intra-operatively and post-operatively, any usage of vasopressors (ephedrine) and its dose, convulsions, renal failure, pulmonary oedema, requirement for ICU stay and the number of days in the mother, and the incidence of foetal demise. We hypothesized that the lowest MAP would have to be at least 10 mm Hg less in the spinal group than in the epidural group to be clinically significant and result in adverse neonatal effect. The statistical null hypothesis of no difference in the lowest MAP between the 2 groups was tested against the alternative hypothesis of 10 mm Hg difference. An unpaired Student's t-test was used to test the significance of the means of all the parameters.

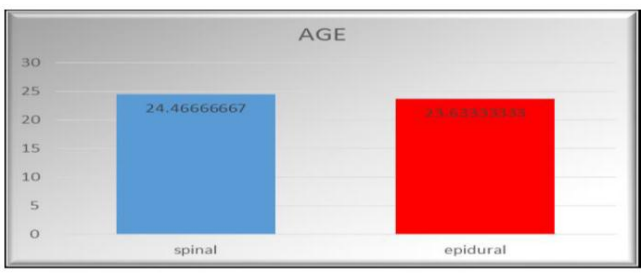
OBSERVATIONS AND RESULTS:

DEMOGRAPHIC DATA:

A) AGE: The mean age in the spinal group is 24.4667 as compared to 23.6333 in the epidural group. The following are the statistical data of the two groups.

	Spinal	Epidural
Mean	24.46	23.63
Standard deviation	4.27	3.29
Observations	30	30
P value	0.400812	

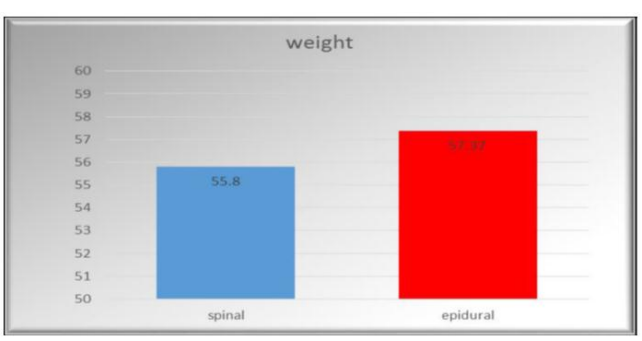
The p value calculated by unpaired student t test is more than 0.05 that is for 95% confidence limits. Hence, age distribution in both the groups is comparable.



B) WEIGHT: The mean weight in the spinal group is 55.8 as compared to 57.37 in the epidural group. The following are the statistical data of the two groups.

	Spinal	Epidural
Mean	55.8	57.36
Standard deviation	4.78	5.33
Observations	30	30
P value	0.235862	

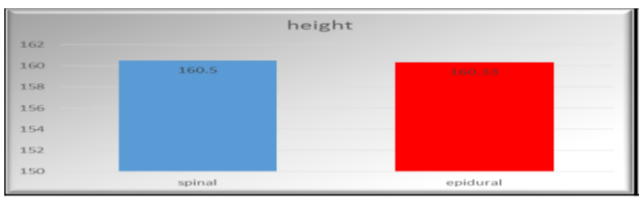
The p value calculated by unpaired student t test is more than 0.05 that is for 95% confidence limits. Hence, weight distribution in both the groups is comparable.



C) HEIGHT: The mean height in the spinal group is 160.5 as compared to 160.33 in the epidural group. The following are the statistical data of the two groups.

	Spinal	Epidural
Mean	160.5	160.333
Standard deviation	6.1	4.6
Observations	30	30
P value	0.905263	

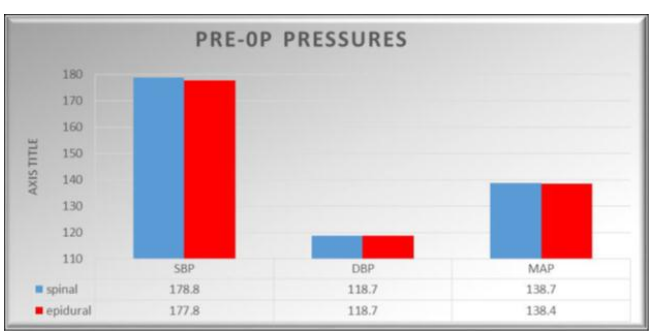
The p value calculated by unpaired student t test is more than 0.05 that is for 95% confidence limits. Hence, height distribution in both the groups is comparable.



D) PRE-OPERATIVE BLOOD PRESSURES: The pre-operative blood pressures that is systolic, diastolic, and mean arterial are recorded in all the patients and compared. The following are the statistical data.

	Mean±Standard Deviation	P value
Systolic blood pressure	178.83+11	0.69
Diastolic blood pressure	118.66+7.26	0.98
Mean blood pressure	138.71+7.56	0.85

The pre-operative blood pressure values have a p value of > 0.05, so they are not statistically significant. Therefore the parameters are comparable.

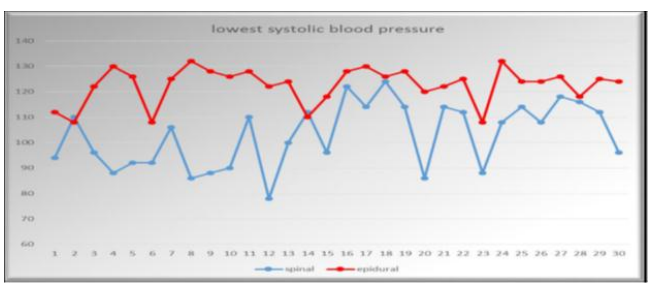


E) LOWEST SYSTOLIC BLOOD PRESSURE: The lowest systolic blood pressures are compared between both the groups from the time of induction of anaesthesia to the end of surgery. The following are the results.

	Spinal	Epidural
Mean	103.27	117.1
Standard deviation	12.3	13.22
Observations	30	30
P value	0.0001	

As the p value is < 0.05, the difference in the systolic blood pressure changes is significant. The fall in systolic blood pressure in the spinal group is more compared to those in the epidural group. The fall in the systolic blood pressure is even more prominent in the pre-delivery phase that is from induction to delivery period. The spinal group also required relatively more number of ephedrine (vasopressor) doses compared to the epidural group. But the hypotension was easily treatable and also of short duration being less than one minute (< 1min).

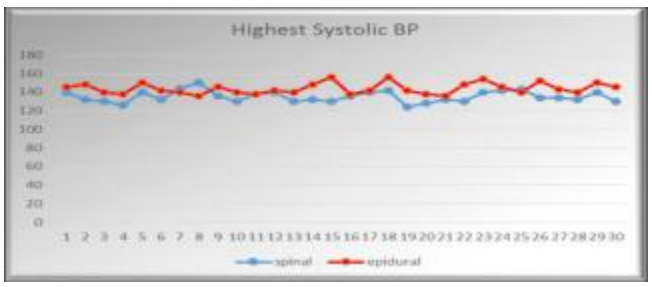
Intravenous ephedrine	**Spinal (No. Of patients)**	**Epidural (No. Of patients)**
Predelivery	12	6
Total ephedrine use (mg)	36 mg	18mg
Use of ephedrine		



F) HIGHEST SYSTOLIC BLOOD PRESSURE: The highest systolic blood pressures are compared between both the groups from the time of induction of anaesthesia to the end of surgery. The following are the results.

	Spinal	**Epidural**
Mean	135.23333	144.0333
Standard deviation	6.1	5.8
Observations	30	30
P value	0.000000371	

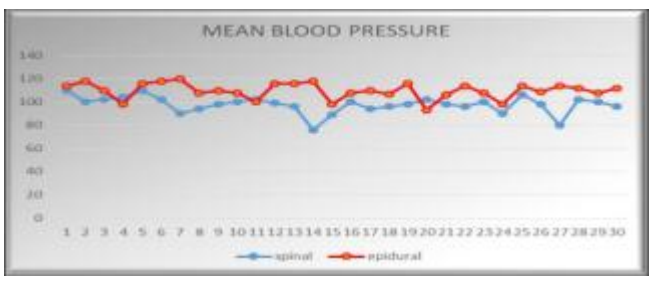
Even the p value of the means of the highest systolic blood pressure is < 0.05. so the difference of pressures between the two groups is significant. That is the spinal group patients had lower rise in systolic pressures after initial fall when compared to epidural group. But the epidural group patients had their systolic blood pressures maintained at higher levels requiring lesser amount of vasopressor dose.



G) MEAN BLOOD PRESSURE: The average mean arterial blood pressures recorded in both the groups shows a higher values in the epidural group than the spinal group. The following are the data.

	Spinal	**Epidural**
Mean	97.6	109.9
Standard deviation	7.3	6.9
Observations	30	30
P value	0.00000001	

The p value derived using unpaired student t test, which is < 0.05 clearly shows that the difference between the two groups is significant.



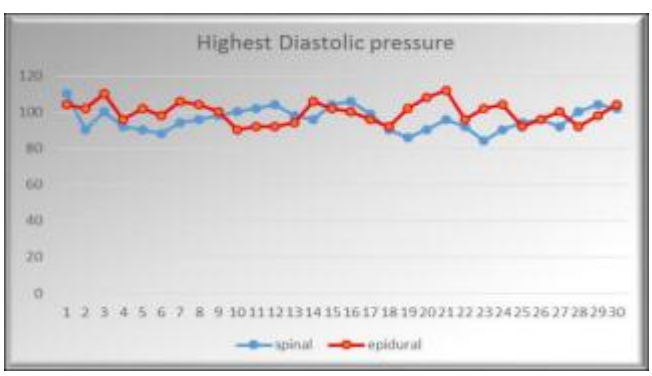
H) HIGHEST AND LOWEST DIASTOLIC BLOOD PRESSURE: The average highest and lowest diastolic blood pressures are compared between both the groups. The spinal group had a higher fall in diastolic pressures even in the period between induction of anaesthesia and delivery than those in the epidural group. Epidural group showed better maintenance. The following are the data.

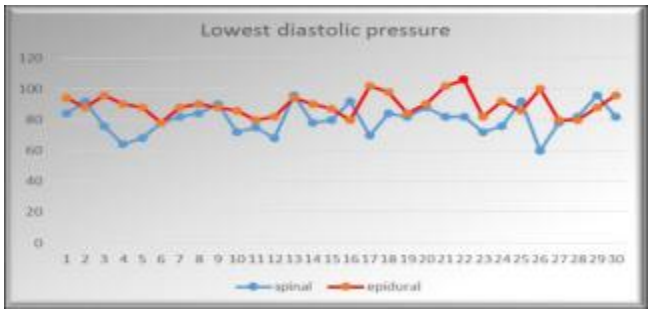
HIGHEST:

	Spinal	**Epidural**
Mean	96.1	99.7333
Standard deviation	6.34	5.84
P value	0.02466584	

LOWEST:

	Spinal	**Epidural**
Mean	80.17	89.5
Standard deviation	9.13	7.37
P value	0.0000574	



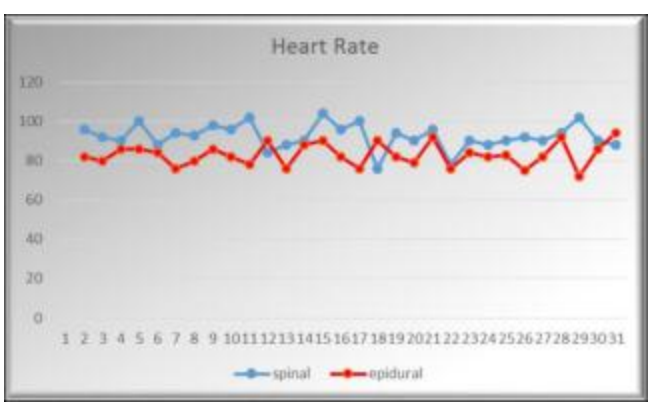


As the p values derived from unpaired student t test is < 0.05, the difference seen in the groups in both the parameters is significant. But we can also see that average lower pressures seen in spinal group are relatively higher than those usually seen in normal healthy parturient.

I) HEART RATE: The average heart rates recorded in both the groups shows a higher mean values in the spinal group than the epidural group. The following are the data.

	Spinal	Epidural
Mean	92.3	83.03
Standard deviation	6.4	5.7
P value	0.000000192	

As the p value derived from the unpaired student t test is < 0.05, the difference in the means of heart rates of the two groups is significant. The epidural group shows better maintenance of heart rates especially during induction of anaesthesia.



J) APGAR SCORE: Apgar scoring was done at first minute (1min), and at the end of fifth minute (5min) for all the newborns in both the groups.

APGAR SCORE	SPINAL (n = 30)	EPIDURAL (n = 30)
1 min	9 (median)	9 (median)
5 min	10 (median)	10 (median)
< 7 at 1 min	5 (17%) ˣ	8 (27%) ˣ
< 7 at 5 min	1 (3.3%) ˣ	1 (6.6%) ˣ

ˣ = n (%)

NICU ADMISSION	SPINAL (n = 30)	EPIDURAL (n = 30)
n	5	5

Apgar scores and neonatal intensive care admissions were similar in both the groups. The proportion of newborns with 1-min Apgar score < 7 was 27% in the epidural group as compared with 17% in the spinal group. The proportion of newborns with 5-min Apgar scores < 7 was 7% in the epidural group as compared with 2% in the spinal group (95% confidence limits). There is no significant difference between both the groups in terms of neonatal outcome.

K) MATERNAL POST-OP COMPLICATIONS:

	Spinal	Epidural
Hypotension	2	2
Hypertension	2	4
Seizures	--	--
Renal failure	--	--
Pulmonary edema	--	--
ICU stay (No. Of days)	3 (1)	4(1)

Post-op maternal complications were similar in both the groups showing no statistical difference in the incidence. Epidural group patients had the advantage of better post-op pain relief and better post-op blood pressure control.

DISCUSSION: This study shows that spinal anaesthesia for caesarean delivery in severely pre-eclamptic patients causes slightly more hypotension than does epidural anaesthesia. The duration of hypotension, however, was short and there was no difference in neonatal status. All the hemodynamic parameters like the systolic, diastolic and the mean arterial blood pressures were significantly lower in the spinal group than those in the epidural group as measured using the unpaired student t test. Even the heart rate was less fluctuating in the epidural group when compared to the spinal group which may be because of the faster onset of anaesthesia or precisely the autonomic and sensory blockade. In the previously published prospective study by Wallace et al.[9] (13) comparing general (n _ 26), epidural (n _ 27), and CSE (n _ 27) anaesthesia for caesarean delivery in severely pre-eclamptic patients, the mean lowest SAP and DAP values after CSE technique were, 110 and 60 mm Hg compared to the lowest SAP and DAP values in the spinal group (102.8 and 80.1 mm Hg) in our study.

However, the mean lowest SAP and DAP in the epidural group of our study were higher than in the epidural group of their study (122.6 and 89.5 mm Hg versus 110 and 59 mm Hg, respectively) which could be explained by higher block in their study as well as our graded epidural technique. The hypotension seen in the spinal group was most prominent in the pre-delivery period that is from the time of induction of spinal subarachnoid block till the delivery which is crucial for

the survival of the baby. Even though this is theoretically true, in this study we found out that the fall in systolic blood pressure was not as severe as we normally see in the healthy parturient for caesarean delivery. Clinically significant hypotension was defined as the need for ephedrine (systolic BP decrease to <100 mm Hg in healthy parturients or 30% decrease in mean BP). This has even been noted in previously done studies such as a cohort comparison study by Aya AG, Mangin R, Vialles N, Ferrer JM, Robert C, Ripart J, et al.[16] In this prospective cohort study, incidence and severity of spinal anaesthesia associated hypotension in severely pre-eclamptic (n = 30) versus healthy (n = 30) parturients undergoing caesarean delivery were compared. After the administration of IV fluids, SA was performed with hyperbaric 0.5% bupivacaine, sufentanil, and morphine. Blood pressure (BP) was recorded before and at 2-min intervals for 30 min after SA. Clinically significant hypotension was defined as the need for ephedrine (systolic BP decrease to <100 mm Hg in healthy parturients or 30% decrease in mean BP in both groups). Despite receiving a smaller fluid volume (1653 ± 331 mL versus 1895 ± 150 mL; P = 0.005) and a larger bupivacaine dose (10.5 ± 0.9 mg versus 10.0 ± 0.7 mg; P = 0.019), the severely preeclamptic patients had a less frequent incidence of clinically significant hypotension (16.6% versus 53.3%; P = 0.006), which was less severe and required less ephedrine. "The risk of hypotension was almost six times less in severely pre-eclamptic patients (odds ratio, 0.17; 95% confidence interval, 0.05-0.58; P = 0.006) than that in healthy patients." Even in the present study, the need for ephedrine was lesser in epidural group, but even in spinal group there was less hypotension except for few cases where ephedrine was given (3mg for systolic blood pressure < 100mm hg) as compared to healthy parturients. And another finding was that even in the patients who had hypotension from both the groups, the foetal outcome was similar and the Apgar scores were normal. A retrospective study by Hood and Curry[11] compared 103 severely pre-eclamptic patients having spinal anaesthesia with 35 patients having epidural anaesthesia for caesarean delivery. There was only a 13% decrease in the mean lowest MAP from the baseline MAP in both epidural and spinal groups compared with a 25% decrease in both groups in the Wallace et al. study and with a 23% (epidural) and 31% (spinal) decrease in each group in our study. This difference is probably attributable to differences in study design among the various studies. Ephedrine was administered more often in the spinal group (40%) than in the epidural group (20%) in our study. This is in contradistinction to previous studies. Ephedrine use was similar in the Hood and Curry study[11] (23 and 26%) and Wallace et al.[9] study (22 and 30%) in the spinal and epidural groups, respectively. We treated hypotension as soon as the SAP decreased to 100 by administering 3 mg of ephedrine similar to that used in the study by Wallace et al.[9] In another study by Clark VA, Smith SG, Stewart AV. Int. J Obstet Anaesth. 2005;14:9–13., ephedrine requirements were reduced during spinal anaesthesia for caesarean section in pre-eclampsia. The mean ephedrine requirement of the normotensive group (27.9±11.6 mg) was significantly greater (P<0.01) than that of the pre-eclamptic group (16.4±15.0 mg). This suggests that the hypotension induced by spinal anaesthesia in women with severe but haemodynamically stabilised preeclampsia, is less than that of normotensive patients. "Another important point to be noted is that the hypotension was of short duration and easily treatable with ephedrine IV 3-6mg." Dyer RA, Piercy JL, Reed AR, Lombard CJ, Schoeman LK, James MF studied Hemodynamic changes associated with spinal anaesthesia for caesarean delivery in severe pre-eclampsia Anesthesiology. 2008;108:802–11.[17] Fifteen patients with severe preeclampsia consented to an observational study. The monitor employed used pulse wave form analysis to estimate nominal stroke volume. Calibration was by lithium dilution. CO and systemic vascular resistance were derived from the measured stroke volume, heart rate, and mean arterial pressure. In addition, the hemodynamic effects of phenylephrine, the response to delivery and oxytocin, and haemodynamics during recovery from SA were recorded. Hemodynamic values were averaged for defined time intervals before, during, and after SA. The results were that the Cardiac output remained stable from induction of SA until the time of request for analgesia. Mean arterial pressure and systemic vascular resistance decreased significantly from the time of adoption of the supine position until the end of surgery. After oxytocin administration, systemic vascular resistance decreased and heart rate and CO increased. Phenylephrine, 50 mcg, increased mean arterial pressure to above target values and did not significantly change CO. At the time of recovery from SA, there were no clinically relevant changes from baseline hemodynamic values. They concluded that Spinal anaesthesia in severe preeclampsia was associated with clinically insignificant changes in CO. Phenylephrine restored mean arterial pressure but did not increase maternal CO. Oxytocin caused transient marked hypotension, tachycardia, and increases in CO. "So by looking at all these studies including the present study, we can say that severe pre-eclamptic parturients experience lesser episodes of significant hypotension and also the hypotension can be easily treated by vasopressors like ephedrine". Another advantage of spinal anaesthesia being the ease of administration and faster onset of anaesthesia. It need not be repeated that spinal anaesthesia technique is easier than epidural technique requiring less expertise. As most of these cases are emergencies and the utero-placental circulation being in a compromised state, faster onset of the spinal blockade is desirable, thereby decreasing the time from induction to delivery which is the crucial period for the survival and well-being of the foetus. Neonatal outcomes assessed by Apgar scores were similar for both groups. "Because the duration time of SAP < 100 mm Hg was short, the utero-placental blood flow might not have been impaired in either group." However, with a wide range of 95% confidence interval differences in the incidence of newborns with 5-min Apgar score ≤ 7, a larger study with adequate power or a systematic review is needed to evaluate differences in neonatal outcomes. The incidence of maternal

complications was also similar in both the groups. Intensive care monitoring required only for the patients with hypotension or hypertension. Even these patients were easily treated with vasopressors and anti-hypertensives as well as with seizure prophylaxis with magnesium sulphate. There were no incidents of renal failure or pulmonary oedema or intra-op/ post-op seizures. In our institute we have been administering spinal anaesthesia for over 90% of the parturients with severe pre-eclampsia requiring caesarean section fulfilling the criteria for safe regional anaesthesia, and we have enough evidences from the present study, other retrospective and prospective studies, to follow the same.

CONCLUSION: In summary, although the incidence of hypotension and ephedrine requirement was slightly more frequent in the spinal group than in the epidural group, we found evidence that supports the use of spinal anaesthesia in severely pre-eclamptic patients.

- First, the difference in mean lowest MAP (mean difference, 12 mm Hg; 95% confidence interval, 4–17 mm Hg) did not appear to be clinically significant.
- Second, the hypotension was easily treated and there was only a brief period of significant hypotension in either group.
- Third, the neonatal outcomes assessed by the Apgar score were similar in both groups.
- No serious maternal complications in either group.

Even though epidural anaesthesia has its advantages with regard to maintenance of maternal haemodynamics and uteroplacental circulation, the ease of administration, the faster onset of anaesthesia, the clinically insignificant blood pressures changes which are easily treatable and the absent of any significant maternal and foetal complications make spinal anaesthesia a better choice of anaesthesia in parturients with severe pre-eclampsia.

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