



Cohort Study

Effect of anesthesia choice on hemodynamic stability and fetomaternal outcome of the preeclamptic patient undergoing cesarean section



Derartu Neme^{a,*}, Zemedu Aweke^a, Bedru Jemal^a, Hailemariam Mulgeta^a, Teshome Regasa^a, Geracho Garolla^a, Ababayehu Zemedkun^a, Ashagrie Sintayhu^b

^a Dilla University, Ethiopia

^b Wolaita Sodo University, Ethiopia

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ABSTRACT

Background: The main aim of this study is to compare hemodynamic stability and fetomaternal outcome between general and spinal anesthesia in pre-eclampsia patients undergoing C/S.

Methods: A prospective cohort study was used with a calculated sample size of 266. Comparison of numerical variables between study groups was done using unpaired student t-test and Mann Whitney U test for symmetric and asymmetric data respectively. A P-value <0.05 considered significant.

Result: There is a comparable distribution of socio-demographic, obstetric variables, and baseline hemodynamic variables between groups. The change in a hemodynamic variable from baseline and during the first 24 h was also comparable between groups. The numbers of ICU admission were comparable between groups (8.03% vs. 10.41%, $p = 0.549$) in spinal and general anesthesia groups respectively. With regards to hospital stay patients in general anesthesia groups had longer hospital stay 5.92 days compared to 4.67 days in the spinal anesthesia group, with a statistically significant difference, ($p = 0.024$). The Spinal anesthesia group showed lower maternal mortality 2.6% compared to 14.8% in the general anesthesia group during the first 48th hour ($p = 0.027$). At the first 48 h only 7.14% of neonates in the spinal anesthesia group, and 16.6% o in the general anesthesia group had reported dead ($p = 0.315$).

Conclusion: Spinal anesthesia (SA) was alternative to general anesthesia regarding hemodynamic stability. Regarding maternal outcome, SA overall shows a better maternal outcome during the first 48 h. The numbers of ICU admission were comparable between groups. The SA group showed lower maternal mortality at the 48th hr.

1. Back ground

Preeclampsia is a multisystem disorder characterized by new onset of hypertension systolic blood pressure ≥ 140 mmHg and/or diastolic blood pressure ≥ 90 mmHg and proteinuria >300 mg/24 h arising after 20 weeks of gestation in a previously normotensive woman [1]. Severe preeclampsia is the development of hypertension characterized by systolic blood pressure exceeding 160 mm Hg and/or diastolic blood pressure exceeding 110 mmHg, together with proteinuria >5 gm/24hr after 20 weeks of gestation [2].

Preeclampsia globally affects up to 7.6% of pregnancies, including up to 21% of twin pregnancies [3]. The risk factors for pre eclampsia include nulliparous which is about 7.6%, ethnic groups, three times common in black compared to Caucasians, twin gestations, chronic hypertension, multi-fetal gestation, high maternal age (>35 years), and

obesity were among the common risk for the development of pre-eclampsia [4]. Maternal weight and the risk of pre-eclampsia are progressive and the morbidity is about 4.3% with a body mass index (BMI) < 19.8 and 13.3 with BMI >35 kg/m² [5].

Pathophysiology of preeclampsia is associated with the fetoplacental unit, in which abnormal placentation and placental function are major predisposing factors for preeclampsia. The effects of preeclampsia consist of uteroplacental hypoxia, an imbalance in angiogenic and antiangiogenic proteins, oxidative stress, maternal endothelial dysfunction, and elevated systemic inflammation. Severe vasoconstriction causes endothelial cell injury, thromboxane A2 levels increase and coagulation cascade activates [6–9].

Anesthetic management of pre-eclampsia patients remains a challenge. Both of the anesthetic options are General anesthesia (GA) and spinal anesthesia (SA). Although general anesthesia can be used in pre-

* Corresponding author.

E-mail address: nemedere.emma@gmail.com (D. Neme).

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eclampsia women, it is associated with greater maternal morbidity and mortality. The added risks associated with GA include airway difficulties due to edema aggravated by tracheal intubation and the presser response to laryngoscopy and intubation [10].

Preeclampsia affects 5–8% of all pregnancies worldwide. It affects 5%–7% of pregnancies and is a significant cause of maternal and neonatal morbidity and mortality [12]. It was implicated in 54 of 569 maternal deaths in the United States in 2006 [14]. In Ethiopia, pre-eclampsia contributed to the complication of approximately 1% of all deliveries and 5% of all pregnancies. Moreover, 16% of direct maternal mortality and 10% of all maternal mortality were due to pre-eclampsia/eclampsia. Severe pre-eclampsia is related with complications to pulmonary edema, acute renal failure, convulsion, DIC, headache, postpartum hemorrhage, HELLP syndrome, visual disturbance, lower respiratory tract infection, and congestive cardiac failure [15,16].

Severe preeclampsia poses a dilemma for anesthetists, and there is some controversy about the best anesthetic technique for cesarean delivery because of the risks related to airway edema, difficulty with the airway or failed intubation, hypertensive response to direct laryngoscopy, and aspiration pneumonitis. Drug interactions may also be a problem, particularly between magnesium sulfate, neuromuscular blocking agents, calcium channel blockers, and inhalational anesthetics. Regional anesthesia on the other hand may be associated with severe hypotension, high motor neuronal blockade, and the possibility of a convulsion occurring during the procedure [17–21].

2. Method and materials

2.1. Study design and patients

An exposure-based prospective multi-center comparative cohort study was conducted from March 2020 to December 2021. Ethical clearance was obtained from Dilla university institutional review board. Verbal and written informed consent was obtained from each participant. The study was prospectively registered on a research registry with a unique identification number of researchregistry7668 which is found on <https://www.researchregistry.com/browse-the-registry/#/home/registration/details/621259bed3f34300214785d5/>. The work was reported in line with STROCSS criteria www.strocsguideline.com [22].

All parturient with preeclampsia of Systolic blood pressure greater than or equal to 160 mmHg or diastolic blood pressure greater than or equal to 110 mmHg on two occasions at least 15 min apart while the patient was resting on the bed with age 18–45 were included in the study.

Pregnant women with cardiac disease and history of psychiatric illness, Pregnant women who received spinal anesthesia and converted to general anesthesia, Women who have sensitivity to local anesthetics, Women who have Eclampsia, abruption placenta or placenta previa and Women who have coagulopathy, thrombocytopenia with platelet count less than 80,000/cm³ were excluded from the study.

Two hundred sixty-six parturient were selected after assessment for eligibility criteria and consent was taken they were categorized into two groups.

2.2. Sample size determination, sampling technique

The required sample size was calculated by using Epi-info version 7.0 using intraoperative hypotension under spinal and general anesthesia. The proportion of intraoperative hypotension was taken from a previous study done in Pakistan [23]. The incidence of intraoperative hypotension in the GA group was 16.6% and spinal group 33.3%, confidence interval = 95%, and power of 80%.

Two hundred sixty-six preeclamptic patients were selected randomly using systemic random sampling technique by considering the Annual severe preeclamptic cesarean section report of Gedeo and Sidama zone,

which was 860 patients admitted in the last one year. By using proportional allocation to size (PAS) samples were drawn from each hospital.

Data were collected from the clinical charts of mothers who underwent cesarean section. The questionnaire contains information about patients' socio-demographic data, which can be retrieved from patients' charts. Patient diagnosis, starvation status, ASA status, weight, and other relevant information were taken from the anesthesia preoperative record chart. Five trained BSc anesthetists were involved in the data collection. Initial investigations like complete blood count, absolute platelet count, liver function tests, serum creatinine, and urine dipstick for grading of proteinuria were performed after admission.

Patients' clinical variables were obtained after standard patient monitoring is applied (WHO standard). Patients' peripheral oxygen saturation, heart rate, blood pressure, the electrical activity of the heart was recorded based on the data collection tool. For Spinal Anesthesia (SA), hydration with 500 ml of normal saline was accomplished on the arrival of the patient to the operating theatre. Hyperbaric bupivacaine (0.5%), 10–12 mg was given intrathecally. Patient's blood pressure and heart rate was recorded at 10', 30', 1hr, 2hr, 3hr, 6hr, 12hr and 24hr.

2.3. Data analysis and interpretation

Data were checked, coded, and entered to Epi-info version 7.0 and transported to SPSS version 22 for analysis. Descriptive statistics were used to summarize tables and figures and numeric data was described in terms of mean \pm SD for symmetric and median (Interquartile range) for asymmetric numeric data. To reduce selection bias and potential baseline difference between the spinal anesthesia and general anesthesia groups, prior propensity score matching was performed to match patients from the two groups in a 1:1 ratio. The propensity score was calculated by regression analysis using covariates.

Comparison of numerical variables between groups was done using unpaired student t-test and Mann Whitney U test for symmetric and asymmetric data respectively. Frequency and percentage were used to describe categorical variables and statistical difference between groups was tested using Chi-square and Fisher exact test where appropriate. Kaplan–Meier survival analysis was conducted and treatment groups were compared using the log-rank test. Expecting a priori differences between patients treated with spinal anesthesia and those treated with general anesthesia, we adjusted for confounding by using multivariable analysis, to produce a risk-adjusted treatment effect.

3. Result

3.1. Socio-demographic characteristics of study participants

There is a comparable distribution of sociodemographic and

Table 1
Socio-demographic and preoperative characteristics of study participants.

	General anesthesia group	Spinal anesthesia group	p-value
Age in years	27.13 \pm 3.76	28.36 \pm 5.88	0.360
Weight in kg	65.21 \pm 5.82	68.04 \pm 9.20	0.182
Height in meters	1.63 \pm 0.048	1.64 \pm 0.064	0.843
Surgery types Elective	11.2%	22.4%	0.347
Emergency	88.8%	77.6%	
Gestational age in weeks	37.3 \pm 0.92	37.9 \pm 1.86	0.763
Para	1.69 \pm 0.78	1.61 \pm 0.94	0.826
Gravid	2.73 \pm 1.42	2.69 \pm 1.81	0.617
NPO time in hours	3.86 \pm 1.89	3.44 \pm 2.52	0.571
Medication Yes	62.6%	55.1%	0.217
No	37.4%	44.9%	
ANC follow up Yes	73.9%	89.2%	0.081
No	26.1	10.8%	

obstetric variables between groups. Table 1 below shows the obstetric and socio-demographic characteristics of study participants.

3.2. Hemodynamic changes during 24 h between groups

3.2.1. Change in hear rate from baseline in preeclamptic patients between spinal and general anesthesia group

There are no statistically significant differences between groups regarding the baseline heart rate. The heart rate at 10th, 30th and 60th minutes were lower in the spinal anesthesia group compared to general anesthesia group, with statistical significant differences. The difference during 2nd, 3rd, 6th, 12th and 24th hour was not statistically significant. Fig. 1 below shows the change in heart rate during the first 24 h.

3.3. Change in blood pressure from baseline in preeclamptic patients between spinal and general anesthesia group

There are no statistically significant differences between groups regarding baseline diastolic and systolic blood pressure. The change in systolic blood pressure over the first 24 h between general and spinal anesthesia group had shown lower systolic blood in spinal anesthesia group. The difference was statistically significant at 30th and 60th minute. The change in diastolic blood pressure over the first 24 h between general and spinal anesthesia group had shown lower diastolic blood pressure in spinal anesthesia group, with statistically significant differences at 30th and 60th minute. Fig. 2 below shows the change in blood pressure during the first 24 h (see Fig. 3).

3.4. Maternal outcome between groups during the first 24 h

Regarding maternal ICU admission, 3 mothers in the spinal anesthesia group and 5 patients in the general anesthesia group had admitted to ICU within the first 24 h. The difference is not statistically significant with p value 0.549. With regards to hospital stay patients in general

anesthesia groups had longer hospital stay 5.92 days compared to 4.67 days in the spinal anesthesia group, with statistically significant difference, (p = 0.024). The differences in maternal outcome at 24 h were also shown in Table 2 below.

3.5. Neonatal outcome between groups during the first 48 h

Regarding the neonatal outcome at the first 48 h only 7.14% neonates in the spinal anesthesia group, and 16.6% patients in the general anesthesia group had reported dead. The difference is statistically significant p = 0.315. The difference in Apgar score during the first 10 min didn't show statistically significant difference. Table 3 below shows the neonatal outcome between study groups.

4. Discussion

The result of the current study demonstrated no statistically significant difference between the baseline hemodynamic and other preoperative variables. Regarding the peri-operative hemodynamic status, the current study reveals a lower heart rate at 10th, 30th, and 1st hours in spinal anesthesia groups compared to general anesthesia with statistically significant differences. The Similar result was observed in the study comparing spinal versus general anesthesia for severely preeclamptic patients demonstrating spinal anesthesia providing better hemodynamic profile with respect to both blood pressure control and heart rate [24]. The same result was also reported by Bashar MA et al., where spinal anesthesia was reported safe and effective in controlling hemodynamic status [25].

The result of the current study also showed spinal anesthesia reduced systolic and diastolic blood pressure in the first hours follow up compared to those in the general anesthesia group. A similar result was reported in the study done on severe preeclamptic patients where spinal anesthesia was shown to reduce the rise in diastolic and systolic blood pressure [26]. In contrast to this, a study by Dyer et al. general

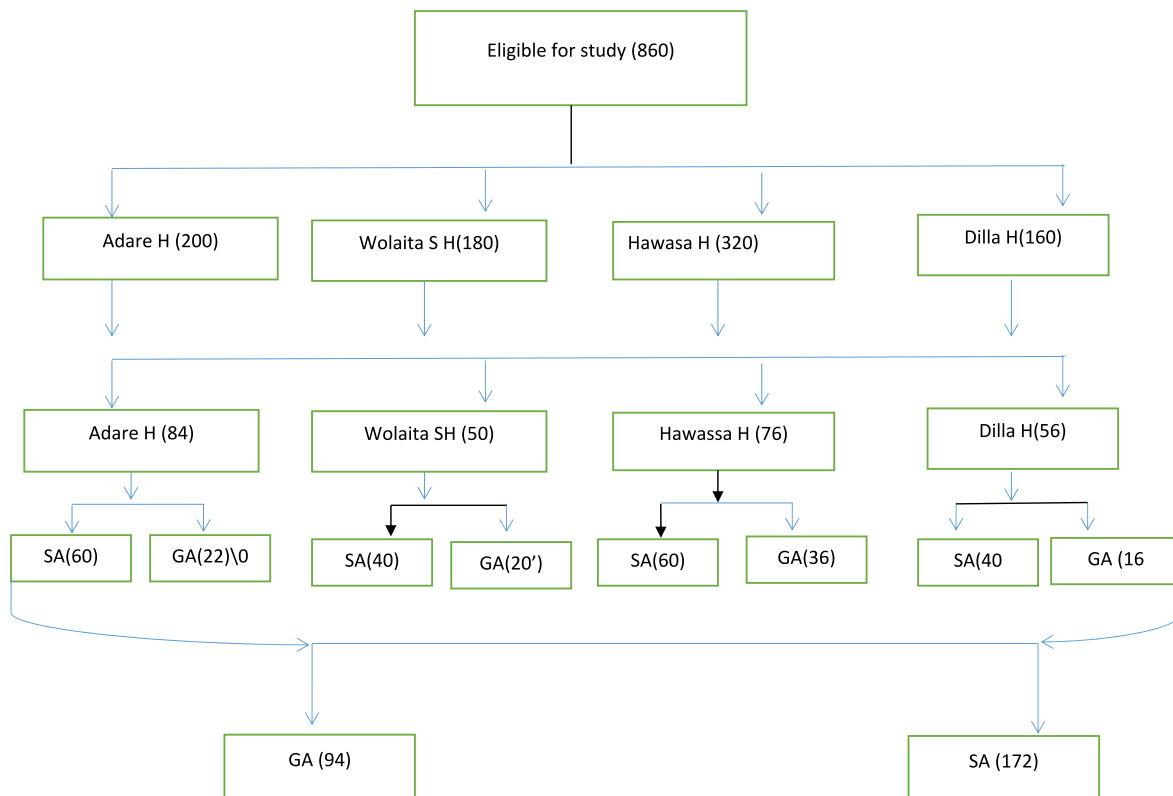


Fig. 1. Strobe flow diagram.

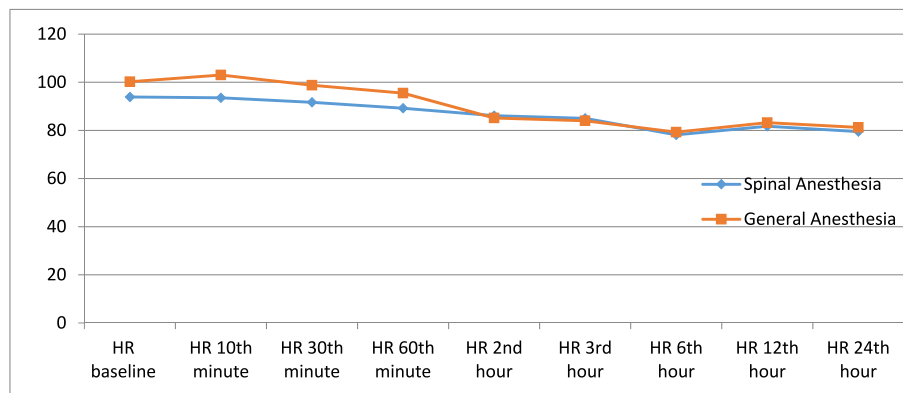


Fig. 2. Hear rate changes between spinal and general anesthesia groups during the first 24 h.

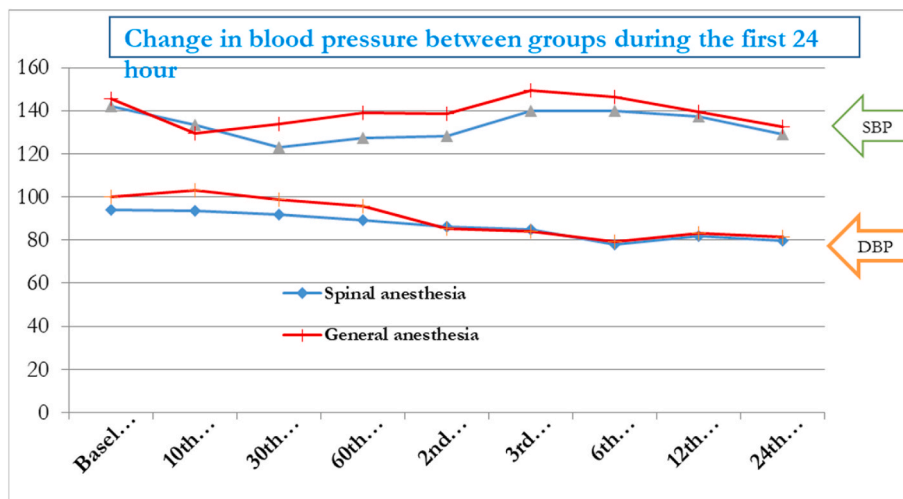


Fig. 3. Blood pressure changes between spinal and general anesthesia groups during the first 24 h.

Table 2
Maternal outcome and length of hospital stay between groups.

		Spinal anesthesia	General anesthesia	P-value
Maternal outcome	Critical	23.9%	18.8%	0.725
	Stable	76.1%	81.2%	
Length of hospital stay		4.67	5.92	0.024
ICU admission (n)		3 (2.6%)	5 (10.41%)	0.549
Death at 48hr		3 (2.6%)	7 (14.8%)	0.027

Table 3
Neonatal outcome between groups.

		Spinal anesthesia	General anesthesia	P-value
Neonatal APGAR score	Apgar 1st minute	7.33 ± 1.32	7.76 ± 0.46	0.081
	APGAR 5th minute	8.33 ± 1.35	8.71 ± 0.46	0.244
	APGAR 10th minute	9.23 ± 1.45	9.57 ± 1.22	0.342
Neonatal mortality at 48 h	Yes	7.14%	16.6%	0.0023
	No	92.86%	83.4%	

anesthesia had a better hemodynamic profile with respect to reduced heart rate and blood pressure compared to the spinal anesthesia group [27].

The result of the current study showed spinal anesthesia had a lower 1st minute Apgar score of 7.33 ± 1.32 compared to 7.76 ± 0.46 in the general anesthesia group. The difference between groups regarding neonatal Apgar score at 1st, 5th, and 10th minutes were not different statistically. In the contrary study by Oreef MA et al. showed spinal anesthesia was associated with increased Apgar score in the first and 5th minutes [27]. Similarly, a combined spinal-epidural anesthesia compared with general anesthesia also showed an increased Apgar score at the early time compared to general anesthesia [28]. Another study also showed spinal anesthesia demonstrated an improved Apgar score compared to general anesthesia [29].

The difference might be the fact that immediate post-spinal anesthesia in the current study was not controlled pharmacologically, where this was prophylactically treated in those studies. Regarding maternal outcomes, spinal anesthesia groups had higher ICU admission within 24 h but the difference was not statistically significant. Thus, there were no statistically significant differences regarding maternal outcomes at 24 h. Unlike this finding study by Ashrafu Islam et al. demonstrated spinal anesthesia was associated with better maternal outcomes [30].

With regards to a hospital stay, patients in general anesthesia groups had longer hospital stay 5.92 days compared to 4.67 days in the spinal anesthesia group, with a statistically significant difference. The Similar result was observed in the study where spinal anesthesia was associated with a shorter hospital stay [31].

4.1. Limitations of the study

The limitations of this study are the neonatal outcome were only assessed using the Apgar score and a factor like neonatal blood PH and other co-morbidity were not assessed. Additionally, the specific causes of maternal mortality were not analyzed. This observational study didn't also assess the lower amount of platelet for which spinal anesthesia was given.

5. Conclusion

Spinal anesthesia was alternative to general anesthesia with respect to hemodynamic stability. Regarding maternal outcome, spinal anesthesia overall shows a better maternal outcome at during the first 48 h. The numbers of ICU admission were comparable between groups. The Spinal anesthesia group showed lower maternal mortality at the 48th hour. Though, there is no difference between groups regarding the first 10 min Apgar score, the neonatal mortality was higher in the general anesthesia group. The duration of hospital stay was longer in the general anesthesia group with a statistically significant difference.

Provenance and peer review

Not commissioned, externally peer-reviewed.

Ethical approval

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Author contribution

Derartu Neme, Zemedu Aweke, Bedru Jemal, contribute to study conception, design, data collection, and performed statistical analysis. Hailemariam Mulgeta, Teshome Regasa and Ababayehu Zemedkun contributed for interpretation of the result, writing up and prepared manuscript. All the authors read the manuscript and approved the final submission.

Please state any conflicts of interest

There is no conflict of interest to declare.

Registration of research studies

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Guarantor

Derartu Neme: nemedere.emma@gmail.com.

Zemedu Aweke: zemeduaweke@yahoo.com.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.amsu.2022.103654>.

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