Original Article

Incidence of Spinal Anesthesia Induced Severe Hypotension among the Pregnant Women Undergoing Cesarean Section at Muhima Hospital

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Abstract

Background

The spinal induced severe hypotension is frequently reported during cesarean section; the literature counts 70% of severe hypotension following spinal anesthesia for cesarean section. This complication is thought to be serious and even fatal, when not well managed; however, in Rwanda, we have a limited data about that spinal induced life-threatening complication.

Objectives

To determine the incidence and factors associated with spinal anesthesia induced severe hypotension during caesarian section at Muhima hospital.

Methodology

The study was cross-sectional, descriptive and analytical in design. The study population was the pregnant women scheduled for cesarean section, and a sample size of 108 was used. A self-developed questionnaire was used as data collection tool.

Results

Forty percent of participants' experienced spinal anesthesia induced severe hypotension; while preloading, left tilt position and infusion of ephedrine, were associated with lower incidence of severe hypotension.

Conclusion

The incidence of spinal induced severe hypotension is high, however, preloading; left lateral position and co-infusion of ephedrine were found to protect the participants from spinal induced severe hypotension. Therefore, these techniques should be promoted.

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Introduction

Spinal anesthesia (SA) is globally accepted as the best anesthesia technique for cesarean section.[1] However, the SA is accompanied with many complications.[2] The spinal induced severe hypotension is among the life threatening complications of spinal anesthesia.[3] SA induced severe hypotension is a state, in which the systolic blood pressure (SBP) decreases by more than 30% of the baseline.[4] This results from a spread of local anesthetics up to T4-T1 level; reducing the systemic vascular resistance (SVR) as a result of blockage of sympathetic preganglionic fibers.[5]

The SA induced severe hypotension can be accompanied by bradycardia; the parturient often complains of nausea, with or without vomiting followed by mild shortness of breath.[6]

The SA induced severe hypotension commonly occurs in obese and short pregnant women; furthermore, the spinal induced severe hypotension were reported in population with increased sensitivity to local anesthetics like geriatric patients and those with ascites.[7] The SA induced severe hypotension can lead to decrease of uterine blood flow and fetal circulation, and cause fetal hypoxia and acidosis; and it is associated with increased maternal and neonatal morbidity and mortality.[8] In his study, Ivan Sklebar in 2019, reported that, severe hypotension following SA for cesarean section was associated with 7% of maternal mortality.[9]

The SA induced severe hypotension is not a rare complication; a study done in Germany by Roth and colleagues,[10] reported that the incidence of SA induced severe hypotension was 7.4%;[10] while in south America, a study conducted in Brazil by Pereira and colleagues, in 2011, reported that, SA induced severe hypotension varied between 8% and 33%.[2]

In Asia, a study conducted in Thailand by Pitchya and the team, in 2008, reported the incidence of SA induced severe hypotension to be 40%.[11] In 2016, Rensburg and colleagues, reported that the SA induced severe hypotension led to 2% of maternal mortality.[12] In sub-Sahara Africa, a study done in Ethiopia, found the incidence of SA induced severe hypotension to be 25%, while supine position was associated with the high incidence of spinal SA induced severe hypotension.[13]

In another study conducted in South Africa by Olukayode Ademola Adeleke et al., in 2017, it was reported that the incidence of spinal induced severe hypotension during cesarean section was 39.1%.[6] Maternal characteristics like having the physical status of ASA III (i.e. with severe systemic disease), being obese or with a baseline SBP less than 120 mmHg were associated with high incidence of SA induced severe hypotension.[13]

Furthermore, being on antihypertensive therapy, emergency cesarean sections, high dose of Marcaine (greater than 10 mg), repeated SA technique, and high surgical blood loss (greater than 1000 ml) were reported to contribute to severe hypotension. [14]

On the other hand, factors that have been found to protect mothers from spinal induced severe hypotension include preloading of intravenous crystalloids (10-20 ml/kg) at 15-20 minutes before induction of SA.[15] Furthermore, the use of co-infusion of vasopressors (e.g. ephedrine) and left lateral position immediately after induction of SA were found to be core prophylactic methods to reduce the incidence of SA induced severe hypotension.[15]

In East Africa, a study conducted in Kenya, has found that the incidence of SA induced severe hypotension during cesarean section was 20%.[16] However, in Rwanda, there is a limited data about SA induced severe hypotension, therefore the present study assessed the incidence and factors associated SA induced severe hypotension during cesarean section at Muhima Hospital, Kigali, Rwanda.

Methodology

Study setting

This study was conducted at Muhima hospital, which is a maternal and child health care centre located in Nyarugenge district, Kigali city. Muhima hospital is a specialized hospital in pediatrics, and obstetrics and gynecology, but it also has other services like emergency and outpatient department. We chose this hospital because we expected to find there an adequate number of participants that would fulfill the inclusion criteria, as it is known for having a good number of cesarean sections.

Design

The study was cross-sectional, descriptive as well as analytical. The study was conducted from the 1st July to the 31st August 2020.

Study population

The study population of this study was made of all pregnant women scheduled for cesarean section at Muhima hospital during study period. Those eligible were elective cases; and the study excluded the emergency cesarean sections.

Sample size

The sample size was calculated by applying the adjusted Yamane's formula: n=N/(1+Ne^2). Where "n" is the sample size, "N" is the study population, according to the statistics from Muhima hospital, 150 pregnant women are scheduled for cesarean section every month. Therefore, the study population was equal to 150, while "ε" represented the adjust margin of error (ε=pe/t), e= the degree of accuracy expressed as a proportion (0.05), p is the number of standard deviations that would include all possible value in the range (2), t= t-value for selected alpha level or confidence interval at 95%, and is equal to 1.96; while ε is the adjusted margin of error ε=pe/t]; therefore, ε=2*0.05/1.96=0.051. By applying the formula;

n=150/(1+150*(0.051)^2)=108, so, the sample size was 108.[17]

Sampling

The convenience sampling method was used whereby all parturients who were most readily available during the research period were included. This approach was considered appropriate to this study given that it was not possible to have all the scheduled parturients at the same time to make a random sampling.

Data collection tool

The self-developed data collection tool was used, and it comprised three sections: Section A was made of socio-demographic characteristics of participants; section B consisted of twelve questions about medico-surgical data of the parturient; while section C gathered the data about induction of SA.

Validity and reliability of the data collection tool

About the content validity of the data collection tool, the items were found to be appropriate to assess the spinal SA induced severe hypotension and the associated factors. In addition, the pilot study was done to evaluate the reliability of the self-developed data collection.

Data collection on 10% of sample was done and Cranach's alpha of 0.83 was computed; therefore, the data collection tool was found to be valid and reliable to assess the SA induced severe hypotension and associated factors.

Data collection procedure

The researchers met the manager of the maternity unit to introduce themselves and explain the study purpose and asked the permission to meet the pregnant women waiting for caesarean section. The participants were approached and informed about the purpose and procedure of the study, given the opportunity for voluntary consent.

After the researcher had checked each participant's file and interviewed her, she was accompanied to the operating room to collect data on induction of SA.

Data analysis

Data were captured and analyzed using SPSS 22. Descriptive statistics (frequencies, percentages of socio-demographic and medical-surgical data) and cross-tabulation of socio-demographic and medical surgical data and severe hypotension) and inferential statistics (Binary Logistic regression to assess the relationship between independent and dependent variables) were computed.

Ethical considerations

The researchers secured ethical clearance from the College of Medicine and Health Sciences Institutional Review Board, and the permission to collect data was obtained from the Ethics Committee of Muhima Hospital. The researchers approached and informed the participants about the research purpose and objectives, procedures involved and their rights regarding the study. The participants were requested for voluntary participation, and were guaranteed of the right to withdraw from the study at any stage without facing negative consequences.

To ensure anonymity and confidentiality participants, the codes were used on questionnaires, which were eventually securely stored in a locked box. The soft copies of the data were confidentially protected by password and made accessible only to primary researchers.

Results

Socio-demographic and medical-surgical data of participants

Table 1. Socio-demographic and medical-surgical data (n=108)

Variable		Number	Percent
Age of participants (in years)	< 20	5	4.6
	21-35	80	73.4
	36 <	24	22.0
Marital status	Married	67	61.5
	Cohabitant	54	31.2
	Single	8	7.3
Education level	None	4	3.7
	Primary	19	17.4
	Secondary	64	58.7
	University	22	20.2
Religion Status	Christian	102	93.6
	Muslim	4	3.7
	Other	3	2.8
Employment Status	Unemployed	22	20.2
	Self employed	65	59.6
	Private or public	22	20.2
Parities	Primiparous	27	24.8
	Multiparous	82	75.2
Previous surgery		71	65.1
Co-morbidity		28	25.7
BMI	< 26	16	14.7
	27-35	77	70.6
	36 <	16	14.7

Table 1 presents the socio-demographic and medical-surgical data of participants; it was shown that 73% of participants were married, and most of the participants, 80 (73.4%), belonged to the age group 21-35 years. About medical-surgical history, 71 (65.1%) had experienced previous cesarean section, 82 (75.2%) were multiparous; majority, 81 (74.3%) of participants did not have any coexisting disease. As for the BMI, those within the range of 27-35 BMI predominated at 77 (70.3%), while 14% included those of BMI 36 and above.

Induction of spinal anesthesia

Table 2 presents the data about the induction of SA. The majority of the participants had G18 as IV line, 66 (59.5%) got preloaded with IV crystalloids, while 65(59.5%) received prophylactic co-infusion of ephedrine. All the participants received heavy Marcaine as a local anesthetic for SA.

About the level of lumbar puncture, 67 (61.5%) were injected at L3-L4, while 42 (38.8%) were at L4-L5. Seventy-five percent of participants were positioned immediately in left lateral, while 27 (24.8%) were left in the supine position.

Regarding the level of block, 22 (20.2%) had dermatome of thoracic (T4), 55 (50.5%) had the dermatome of T6, while 32 (29.4%) had dermatome of below T6. About complications of SA, 44 (40.4%) experienced severe hypotension, while 43 (39.4%) of the participants had the complaints of nausea and vomiting.

Table 2. Induction of spinal anesthesia (n=108)

Variables		Frequency	Percent
Preloading of IV fluids		65	59.5
Co-infusion of ephedrine		65	59.5
Heavy Marcaine		109	100
Lumbar puncture	L3-4	67	61.4
	L4-5	42	38.8
Rate of injection	Slow	106	97.3
	Rapid	3	2.8
Immediate position	Left lateral	82	75.2
	Supine	27	24.8
Dermatome	T4	22	20.2
	T6	55	50.5
	Below T6	32	29.4
Severe Hypotension		44	40.4
Vomiting		43	39.4

Association of induction of spinal anesthesia and severe hypotension.

The present study has revealed a significant association of preload of IV fluids, co-infusion of ephedrine, left lateral position and SA induced severe hypotension (P<0.05), while other variables like the rate of injection and level of block did had not influenced the SA induced severe hypotension.

Table 3. Cross tabulation of induction of spinal anesthesia and severe hypotension

Variable	Severe hypotension		Chi^2	P value
	Frequency	Percent		
Preload of IV fluids				
Yes	15	13.76	19.997	.000*
No	29	26.6		
Co-infusion of ephedrine				
Yes	1	0.91	44.48	.000*
No	43	39.44		
Dermatome				
T4 and above	22	20.18	1.234	.54
T6	15	13.76		
Below T6	7	6.422		
Rate of injection of Local anesthetic				
Slow	2	1.83	.886	.346
Rapid	42	38.53		
Position after induction of spinal anesthesia				
Left lateral position	18	16.52	10.313	.001*
Supine position	26	23.85		

*Statistically significant (p<0.05).

Factors associated with severe hypotension

The present study revealed the association of preload of IV fluids and SA induced severe hypotension; the parturients who got preloaded with IV fluids were protected from SA induced severe hypotension (OR=0.846, CI= -0.68—1.876) in comparison with the ones who did not.
Furthermore, the women who got co-infusion of ephedrine were protected from SA induced severe hypotension (OR= - 4.088, CI=-19.35-19.85) comparing to the ones who did not. The parturients who were positioned in left lateral were also protected from severe hypotension (OR= - 1.46, CI=-1.27-1.3) in comparison with the ones who remained in supine position after induction of spinal anesthesia.

Table 4. Binary Logistic of patient's preparations and severe hypotension

Variables	Odds Ratio	P Value	95% CI
Preload	0.846	0.107	-0.68 - 1.876
Infusion of ephedrine	- 4.088	0.000*	-19.35 - 19.85
Left tilt position	- 1.46	0.002*	- 1.27 – 1.35
Supine position	1	0.001*	0.75 – 1.9

Discussions

Incidence of SA induced severe hypotension

In the present study, 40.4% of the participants experienced SA induced severe hypotension; this is consistent with the findings of a study done in Brazil where it was reported that 33% of the participants developed SA induced severe hypotension during the caesarean section.[9]
The small difference may be explained by different research methologies, where, in our study, we used the sample size of 108, while in Brazil, the researchers used 253 as sample size, in addition, the study settings were different, and as Brezil is a middle income country, with developed health systems including anesthesia care, while in developing country, the health system is not well developed to prevent the anesthesia complication.

Furthermore, in another study conducted in Germany in 2017, it was found that SA induced severe hypotension occurred among 28.3% of parturients attending the hospital for elective cesarean section.[18] This is quite different from our findings; the difference may be attributed to the study setting, as Germany has the well developed health care system.

Oliveros, 2009, in his study, has reported that severe hypotension caused by spinal block account for 33% of participants.[19] Other study reported the spinal induced severe hypotension in 15% of obstetric patients undergoing caesarean delivery, this incidence of spinal induced severe hypotension is quiet low, comparing to our findings. The reason is that in their study, comparison was made of the technique of sitting for five minutes and lying down immediately after induction of spinal anesthesia, the first group required less ephedrine and IV fluids and thus less incidence of severe hypotension; other reason of this difference may be attributed to the variation in the study setting and the sample size, 90 participants they used.[20]

However, the high incidence was also reported in England, where Crawford fund that 35.18% of pregnant women experience severe hypotension after induction of spinal anesthesia for caesarean section. [21] In South Africa, Bishop and colleagues found that the overall incidence of obstetric spinal induced severe hypotension was 30.4% [22], this is consistent with our research findings, the small difference may be attributed to the study setting.

Factors associated with spinal induced severe hypotension

Our study found that, the parturients who had been given preload of IV crystalloids were protected from spinal induced severe hypotension compared to those who had not.

These results correlate with what Carvalho et al. reported; preloading the parturient with 10-20 ml/kg of intravenous fluids at least 15-20 minutes before induction of SA, protects the parturients from spinal induced severe hypotension.[23] In a study done in USA, the co-loading of IV crystalloids contributed to a reduction of incidence of SA induced severe hypotension to 1.9% compared to 28.3% in control group, this highlights the importance of IV fluids in prevention of spinal induced severe hypotension.[24]

Furthermore, the present study highlighted vasopressors as cornerstone in prevention of spinal induced severe hypotension. The parturients who received co-infusion of ephedrine just before induction of SA, were protected from severe hypotension. Our results are consistent with the findings of other authors,[25] who suggested that, ephedrine infusion during injection of spinal anesthesia contributed to reduction of severe hypotension to 13.3% compared to 40% that occurred in the control group, while the neonatal outcomes were similar in the two groups.[26]

In Egypt, a study conducted by Nevan M. El-Mekawy, 2012, reported that total IV fluids requirement was lower in parturient who received ephedrine infusion during spinal anesthesia, while the incidence of severe hypotension was reported in 10% compared to 36% in group of only intravenous crystalloids, although there was no statistically significant difference in the fetal status, measured by APGAR score. [27]

Moreover, the supine position during spinal anesthesia for cesarean section has been recognized to contribute to SA induced severe hypotension.[3] This was also found to be the case in the present study; the left lateral position immediately after induction of SA protected mother from severe hypotension, compared to supine position. This is consistent with the results of a study done in USA, where the left lateral position after SA protected the mother from SA induced severe hypotension; however, this should be supplemented by other means like IV fluids to prevent that life-threatening SA induced complication.[27]

The left lateral tilt to 15% within 15 minutes of induction of SA reduced significantly the SA induced severe hypotension among pregnant women undergoing SA for cesarean section. [28] It was concluded that the use of crystalloid 15ml/kg and co-infusion of ephedrine 2.5mg/minute; and immediate left lateral position are the best prophylaxis to SA induced severe hypotension during cesarean section.[29]

Conclusions

This study assessed the incidence of SA induced severe hypotension and the associated factors among pregnant women undergoing cesarean section at Muhima Hospital. The findings of this study show that the incidence of spinal induced severe hypotension was 40.4%. Preloading of intravenous fluids, co-loading of ephedrine and left lateral position just after induction of spinal anesthesia protected the parturient from spinal induced severe hypotension.

Based on the findings of the present study, the recommendations are presented as follows: the administration of the hospital should take measures to prevent the spinal induced severe hypotension by setting up the protocol of intravenous fluids preloading and left lateral position after induction of spinal anesthesia. Further research is needed to explore the importance of vasopressors (e.g. ephedrine) infusion in prevention of SA induced severe hypotension. Moreover, more researches are needed in the field of obstetric anesthesia to find the best interventions to prevent and treat the SA induced severe hypotension, as well as other SA induced severe complications.

Problems and limitations

In this study, we met some problems including the delay to obtain permission to conduct our research due to the covid-19 pandemic. In addition, as this study was cross sectional in design, there was no establishment of cause-effect relationship of different factors and incidence of SA induced severe hypotension.

Authors 'contributions

TM supervised the research work and edited the article, HS, DS and BL designed the research proposal, collected and analyzed the data, and wrote the article.

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References

1. Javed S, Hamid S, Amin F, Mahmood KT. Spinal anesthesia induced complications in caesarean section - A review. *J Pharm Sci Res*. 2011;3:1530–8.
2. Pereira IDF, Grando MM, Vianna PTG, Braz JRC, Castiglia YMM, Vane LA, et al. Retrospective Analysis of Risk Factors and Predictors of Intraoperative Complications in Neuraxial Blocks at Faculdade de Medicina de Botucatu-UNESP. *Brazilian J Anesthesiol.* 2011;61:568–81.
3. Apan A, Özgün CA. We are IntechOpen , the world ' s leading publisher of Open Access books Built by scientists , for scientists TOP 1 %. *Intech*. 2016;i:13.
4. Ali S, Athar M, Ahmed SM. Basics of CPB. *Indian J Anaesth*. 2019;49:257–62.
5. Hanss R, Bein B, Weseloh H, Bauer M, Cavus E, Steinfath M, et al. Heart rate variability predicts severe hypotension after spinal anesthesia. *Anesthesiology*. 2006;104:537–45.
6. Hermanowski J, Modi A. High Regional Block (including Total Spinal Anaesthesia). Document Ref: MAT 0054 *West Suffolk, NHS Trust*. 2017;1–8.
7. Patil V, Upadhye J. Anesthetic complications in cesarean section. *Int J Res Med Sci.* 2018; 6(10):3215-3219
8. Šklebar I, Bujas T, Habek D. Spinal anaesthesia-induced hypotension in obstetrics: Prevention and therapy. *Acta Clin Croat.* 2019;58:90–5
9. Zwane SF, Bishop DG, Rodseth RN. Hypotension during spinal anaesthesia for Caesarean section in a resourcelimited setting: Towards a consensus definition. *South African J Anaesth Analg. Taylor & Francis*; 2019;25:1–5.
10. Roth R, Klohr S, Hofmann T, Rossaint R, Heesen M. Definitions of hypotension after spinal anaesthesia for caesarean section: literature search and application to parturients¨. *Acta Anaesthesiol Scand.* 2010; 54(8):909-21
11. Atousa F, Haleh G, Zeinabsadat F, Samaneh Z. Maternal and anaesthesia - related risk factors and incidence of spinal anaesthesia - induced hypotension in elective caesarean section : A multinomial logistic regression. *Indian J Anaesth* .2018 ;62(1):36-46.
12. Rensburg G van, Dyk D van, Bishop D, Swanevelder J, Farina Z, Reed A, et al. The management of high spinal anaesthesia in obstetrics: suggested clinical guideline in the South African context. *South Afr J Anaesth Analg.* 2016;22:S1–5.
13. Chekol WB, Melesse DY, Mersha AT. Incidence and factors associated with hypotension in emergency patients that underwent cesarean section with spinal anaesthesia: Prospective observational study. *Int J Surg Open [Internet]. Elsevier Ltd*; 2021;35:100378. Available from: https://doi.org/10.1016/j.ijso.2021.100378
14. Brenck F, Hartmann B, Katzer C, Obaid R, Bru D, Benson M, et al. Hypotension After Spinal Anesthesia for Cesarean Section : Identification of Risk Factors Using An Anesthesia Information Management System. *J Clin Monit Comput.*2009; 23;85–92.
15. Bajwa SJ, Jindal R, Kulshrestha A. Co-loading or pre-loading for prevention of hypotension after spinal anaesthesia! a therapeutic dilemma. *Anesth Essays Res*. 2013;7:155.

16. Kahoro MD. Incidence of And Risk Factors for Hypotension During Spinal Anesthesia for Cesarean Section at Kenyatta national hospital. *Erepository UoN*. 2009;
17. Adam AM. Sample Size Determination in Survey Research. *J Sci Res Reports*. 2020;26:90–7.
18. Hanss R, Bein B, Ledowski T, Lehmkuhl M, Ohnesorge H, Scherkl W, et al. Heart Rate Variability Predicts Severe Hypotension after Spinal Anesthesia for Elective Cesarean Delivery. *Anesthesiology*. 2005;102(6):1086-93. doi: 10.1097/00000542-200506000-00005.
19. Oliveros CI. Managing hypotension induced by spinal anesthesia for caesarean section. *Colombian Journal of Anestesiology* .2009;37:135–40.
20. El-Hakeem EEA, Kaki AM, Almazrooa AA, Al-Mansouri NM, Alhashemi JA. Effects of sitting up for five minutes versus immediately lying down after spinal anesthesia for Cesarean delivery on fluid and ephedrine requirement; A randomized trial. *Can J Anesth*. 2011;58:1083–9.
21. Kar GS, Jenkins JG. High spinal anaesthesia: Two cases encountered in a survey of 81 322 obstetric epidurals. *Int J Obstet Anesth*. 2001;10:189–91.
22. Bishop DG, Cairns C, Grobbelaar M, et al. Obstetric spinal hypotension : Preoperative risk factors and the development of a preliminary risk score – the PRAM score. *S Afr Med J* .2017;107:1127–31.
23. Carvalho B, Dyer RA, Mercier FJ, Palanisamy A., et al, International consensus statement on the management of hypotension with vasopressors during caesarean section under spinal anaesthesia. *Anaesthesia* 2018, 73, 71–92
24. Eddhif M, Frikha N, Mebazaa MS, Ammar MS Ben. Prevention of hypotension during spinal anesthesia for cesarean section. *Prat en Anesth Reanim*. 2008;12:237–42.
25. Singh PM, Singh NP, Reschke M, Kee WDN, Palanisamy A, Monks DT. Vasopressor drugs for the prevention and treatment of hypotension during neuraxial anaesthesia for Caesarean delivery : a Bayesian network meta-analysis of fetal and maternal outcomes. *Br J Anaesth. Elsevier Ltd;* 2020;124:e95–107.
26. Desalu I, Kushimo OT. Is ephedrine infusion more effective at preventing hypotension than traditional prehydration during spinal anaesthesia for caesarean section in African parturients? *Int J Obstet Anesth.* 2005;14:294–9.
27. El-Mekawy NM. Comparative study between ephedrine infusion vs. CO/ post loading of fluids for prevention of hypotension in emergency cesarean section under spinal anesthesia. *Egypt J Anaesth [Internet]. Elsevier B.V.*; 2012;28:193–8. Available from: http://dx.doi.org/10.1016/j.egja.2012.02.009
28. Sahin L, Cesur M, Sahin M, Kilic E, Sen E. Maintenance of the parturient in the left lateral position after spinal anesthesia with plain levobupivacaine for cesarean section reduces hypotension: A randomized study. *Clin Exp Obstet Gynecol.* 2017;44:77–80.
29. Yilkal D. Review Article on Prevention and Management of Hypotension in Obstetrics after Spinal Anesthesia Developing country.*semanticscholar* .2019;8:8–11.