



Role of Certified Registered Anesthetists (CRAs) in the Prevention and Management of Supine Hypotension during Cesarean Delivery under Spinal Anesthesia at the Tamale Teaching Hospital (TTH), Ghana

Martin Mumuni Danaah Malick ^{*1}, Evelyn Nyarko ², Peter Paul Bamaalabong ²

¹University for Development Students, School of Pharmacy and Pharmaceutical Sciences, Department of Pharmacy Practice.

²University for Development Students, School of Medicine, Department of Anesthesiology and Intensive Care.

*Corresponding Author: Martin Mumuni Danaah Malick; mdanaah@uds.edu.gh

Received 18 September 2021;

Accepted 28 October 2021;

Published 01 November 2021

Abstract

Background: Supine hypotensive syndrome is a pathophysiologic state in a parturient after 20 weeks' gestation when put in the supine position during cesarian section under spinal anesthesia. Spinal anesthesia produces rapid, effective, reliable and safe anesthesia making it the preferred technique for cesarian section. Maternal hypotension is a known common side effect of spinal anesthesia and is generally managed pharmacologically and/or non-pharmacologically. The aim of this study was to assess the management of supine hypotension during cesarean section under spinal anesthesia among CRAs at Tamale Teaching Hospital (TTH). **Methods:** A cross-sectional study with both quantitative and descriptive approaches were employed. Thirty-eight (38) CRAs were conveniently sampled and a structured self-administered questionnaire was used for data collection after pretesting for validity and reliability. Data was analyzed with Stata I/C. **Results:** Non-Pharmacological interventions: 19(50%) of CRAs placed parturient in the supine position n after spinal anesthesia with head up, 15 (39.5%) in Supine position alone, 4 (10.5%), used lateral position alone. Pharmacological interventions (Use of Intravenous fluids): Lactated Ringers solution 6(15.8%), Normal saline solution 24(63.2%), Crystalloid and colloid combination 8(21%). Vasopressor of choice: Ephedrine alone 36(94.8%), Phenylephrine alone 1 (2.6%), Multiple agents 1 (2.6%). Preferred intervention: non-Pharmacological 21(55.3%), Pharmacological 17(44.7%). Determinants of choice of intervention: Severity of hypotension 29(76.3%), availability of intervention 7(18.5%), diagnosis of the patient 1(2.6%), frequency of hypotension 1(2.6%). **Conclusions:** Most CRAs placed parturient in the supine position with head up as a non-pharmacological approach to managing supine hypotension after spinal anesthesia. Normal saline solution and ephedrine were widely used as pharmacological agents. Majority of the CRAs preferred using the non-pharmacological techniques as compared with the pharmacological approaches and their choice of intervention was significantly influenced by the severity of the intervention.

Keywords: Certified Registered Anesthetists, Supine hypotension, Parturient, Cesarean delivery, Spinal anesthesia

Introduction

Certified Registered Anesthetists (CRAs) are nursing professionals with specialized training in the delivery of anesthetic medications and management of any associated complications. Spinal anesthesia produces rapid, effective, reliable and safe anesthesia making it the preferred technique for cesarian section ^[1]. Maternal hypotension is a known common side effect of spinal anesthesia ^[2].

When a parturient is in a supine position, gravity pulls the uterus onto the spine and in effect compressing the inferior vena cava. Blood flowing from the extremities to the heart may be impaired resulting in maternal hypotension ^[3]. The retardation of blood movement from the lower parts of the body to the maternal heart and systemic circulation occurs from compression of the uterus against the inferior vena cava, and also the aorta ^[4]. The size, shape and weight of the gravid uterus may make a parturient susceptible

to the condition such that multiple gestation and those within the obese class of Body Mass Index (BMI), thus 30kg/m² and beyond will be at a greater risk [4]. Supine Hypotensive syndrome is diagnosed when there is a depreciation in blood pressure of 15-30mmHg (20%) or an appreciation of heart rate of 20bpm of patients' baseline parameters [5]. Eight percent (8%) of parturient in their last trimester can be affected [6]. Symptoms usually occur within 3-10 minutes after lying down [7]. Maternal symptoms such as nausea, vomiting and dyspnea frequently accompany severe hypotension, and adverse effects on the fetus, including depressed Appearance Pulse Grimace Activity Respiration (APGAR) Scores and umbilical acidosis, have been correlated with severity and duration of hypotension [8]. To prevent the occurrence of this fatal condition the Certified Registered Anesthetists (CRA) employ different techniques to curb the situation which include both pharmacological and non-pharmacological interventions [9]. The American Society of Anesthesiologists (ASA) proposed the use of both pharmacological and non-pharmacological interventions in managing supine hypotension during caesarean section under spinal anesthesia [10]. The non-pharmacological techniques may include left uterine displacement, left table tilt or the use of pelvic wedge. Left Uterine Displacement (LUD) has manifested prudent hemodynamic merits [11]. Left table tilt has proven a positive sustainability of hemodynamics [12]. These interventions efficiently decrease the episodes of hypotension and ephedrine requirement during caesarean section [13]. The pharmacological interventions also include the administration of intravenous fluids eg. Normal saline and drugs such as ephedrine, phenylephrine. Colloids were shown to be more reliable than crystalloids in preventing hypotension in a systematic review [14]. The preferred intervention for managing hypotension should involve volume resuscitation with crystalloids, colloid containing solution or blood [15]. Vasoconstrictors should be given immediately if the hypotension is severe, and to patients not responding to fluid therapy [16]. The aim of this study was to assess the management of supine hypotension during cesarean section under spinal anesthesia among CRAs at Tamale Teaching Hospital.

Materials and methods

A cross-sectional study with both quantitative and descriptive approaches were employed. Thirty-eight (38) CRAs out of the total of forty-eight (48) employed at the TTH were conveniently sampled and a structured self-administered questionnaire was used for data collection after pretesting for validity and reliability. The pretesting was done at the Tamale Central Hospital and the questionnaire was used to obtain information on the socio-demographic characteristics of the study participants, the use of non-pharmacological as well as pharmacological interventions, the most preferred choice of intervention and factors that influence the choices of intervention in managing supine hypotension in caesarean section under spinal anaesthesia among CRAs at TTH. Data was collated with Google form, coded and entered in the Microsoft excel (2016 version), and transferred to the Stata I/C version 16.0 for analysis. The Stata I/C was used to categorize, tabulate and recombine data in the form of frequency tables / graphs to address the purpose of the study in line with the research objectives. An authorization was granted by the department of Anesthesiology and intensive care in the medical school of UDS and the Department of Research of the Tamale Teaching Hospital with reference number TTH/R&D/SR/068 23/06/2021 before the commencement of the study. All study participants signed a written informed consent with their respective identities kept anonymous to ensure that no data could be traced to any study participant.

Exclusion and Inclusion criteria

All CRAs who were at post during the research period were included in the study. CRAs who were absent and those who declined to participate were all excluded from the study

Results

1. Gender distribution of study participants

32 (84.2%) Male, 6 (15.8%) female (Table 1/Fig. 1)

Table 1: Gender distribution of study participants

Gender	Frequency (n=38)	Percentage (%)
Male	32	84.2
Female	6	15.8

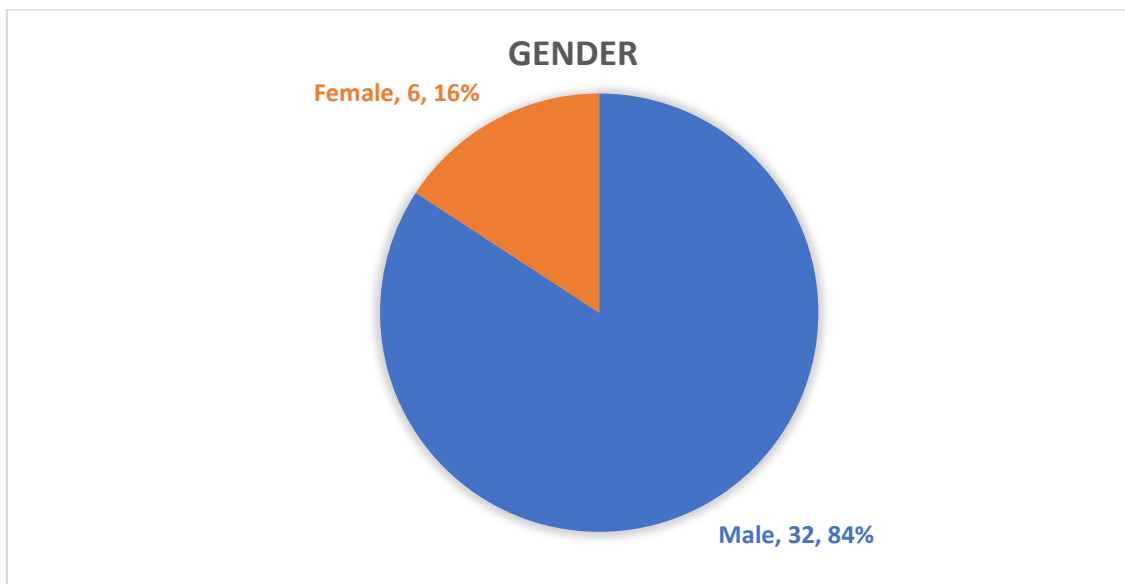


Fig. 1: Gender distribution of study participants

2. Non- Pharmacological intervention techniques to prevent/manage supine hypotension during cesarian section after spinal anesthesia

Supine position with head up 19(50.0%), Lateral position alone 4(10.5%), Supine position alone 15(39.5%). (Table 2/ Fig.2)

Table 2: Non- Pharmacological intervention techniques to prevent/manage supine hypotension during cesarian section after spinal anesthesia

Variables	Frequency (n=38)	Percentage (%)
Position's patients are placed immediately after spinal anesthesia		
Supine position with head up	19	50
Lateral position alone	4	10.5
Supine position alone	15	39.5

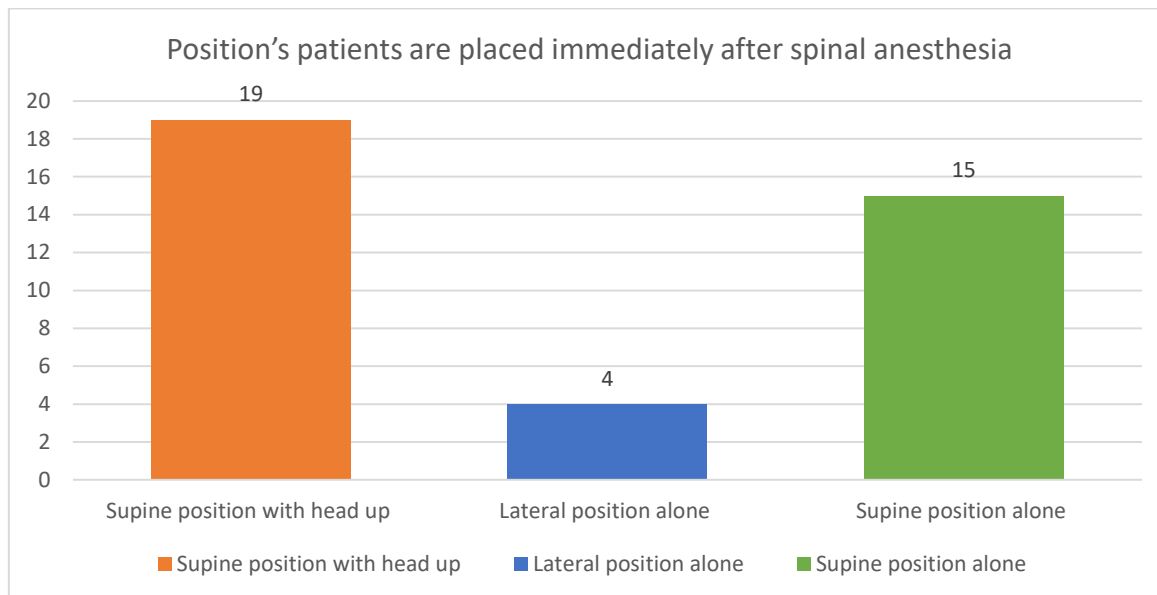


Fig. 2: Non- Pharmacological intervention techniques to prevent/manage supine hypotension during cesarian section after spinal anesthesia

3. Types of Intravenous fluids used for preloading or co-loading to prevent supine hypotension during cesarian section under spinal anesthesia

Lactated Ringers solution 6(15.8%), Normal saline solution 24 (63.2%), Crystalloids and Colloids combinations 8(21.0%). (Table 3/ Figure 3)

Table 3: Types of Intravenous fluids used for preloading or co-loading to prevent supine hypotension during cesarian section under spinal anesthesia

Variables	Frequency (n=38)	Percentage (%)
Lactated Ringers Solution	6	15.8
Normal Saline (0.9%) solution	24	63.2
Crystalloids and colloids combination	8	21.0

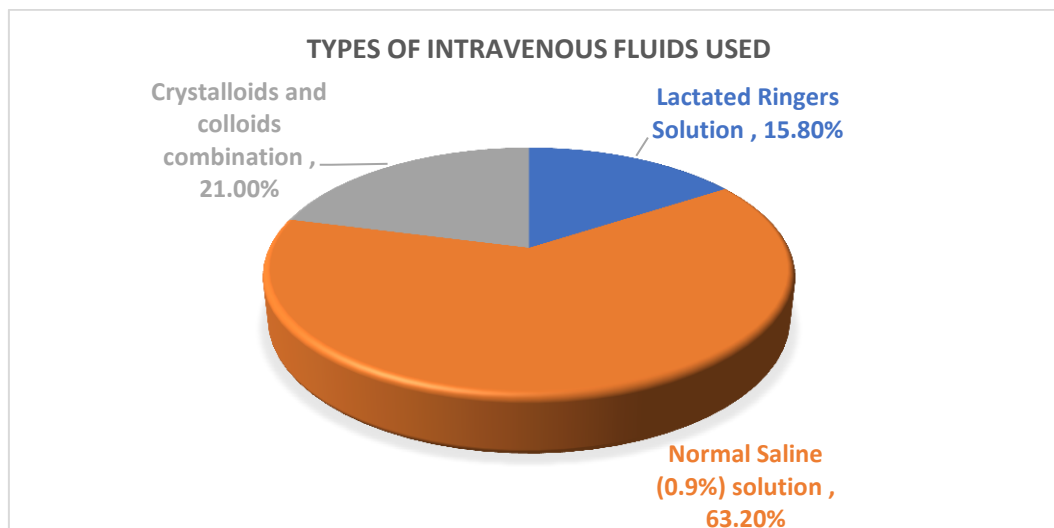


Fig. 3: Types of Intravenous fluids used for preloading or co-loading to prevent supine hypotension during cesarian section under spinal anesthesia

4. Types of vasopressor agents used in documented cases of supine hypotension during cesarian section under spinal anesthesia

Ephedrine alone 36(94.8%), Phenylephrine alone 1(2.6%), Use of multiple vasopressor agents 1(2.6%). (Table 4/ Fig.4).

Table 4: Types of vasopressor agents used in documented cases of supine hypotension during cesarian section under spinal anesthesia

Variables	Frequency (n=38)	Percentage (%)
Ephedrine Alone	36	94.8
Phenylephrine alone	1	2.6
Use of multiple agents	1	2.6

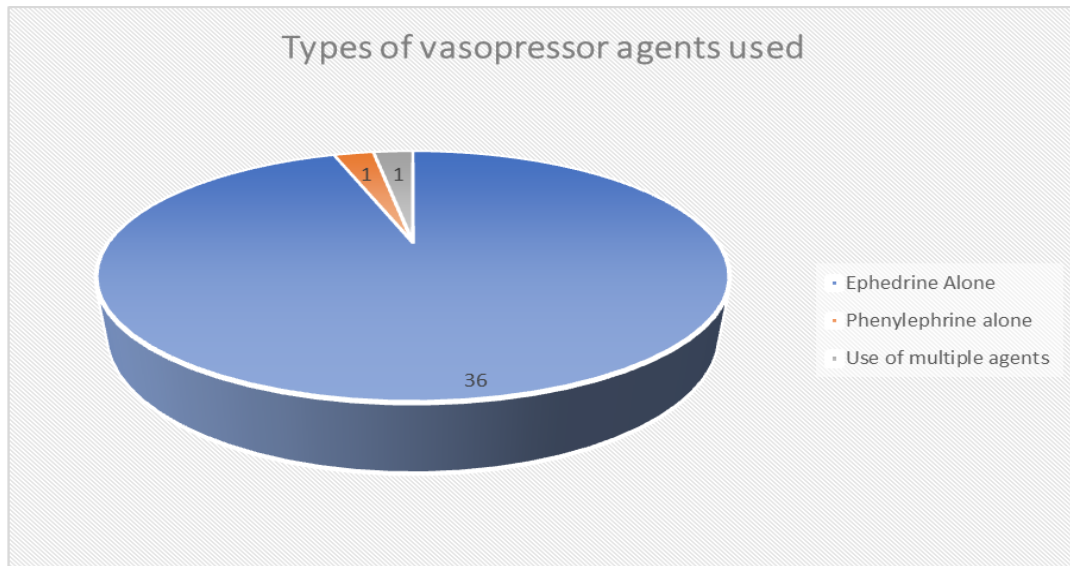


Fig.4: Types of vasopressor agents used in documented cases of supine hypotension during cesarian section under spinal anesthesia

5. Measures used to avoid or minimize aortocaval compression in order to avoid or minimize the incidence of supine hypotension during cesarian section under spinal anesthesia

Pelvic wedge 6(15.8%), Manual displacement of gravid uterus with hands 4(10.5%), Left bed tilt 27(71.1%), others 1(2.6%). (Table 5/ Fig. 5)

Table 5: Measures used to avoid or minimize aortocaval compression in order to avoid or minimize the incidence of supine hypotension during cesarian section under spinal anesthesia

Variables	Frequency (n=38)	Percentage (%)
Pelvic wedge	6	15.8
Manual displacement with hands	4	10.5
Left bed tilt	27	71.1
Others	1	2.6

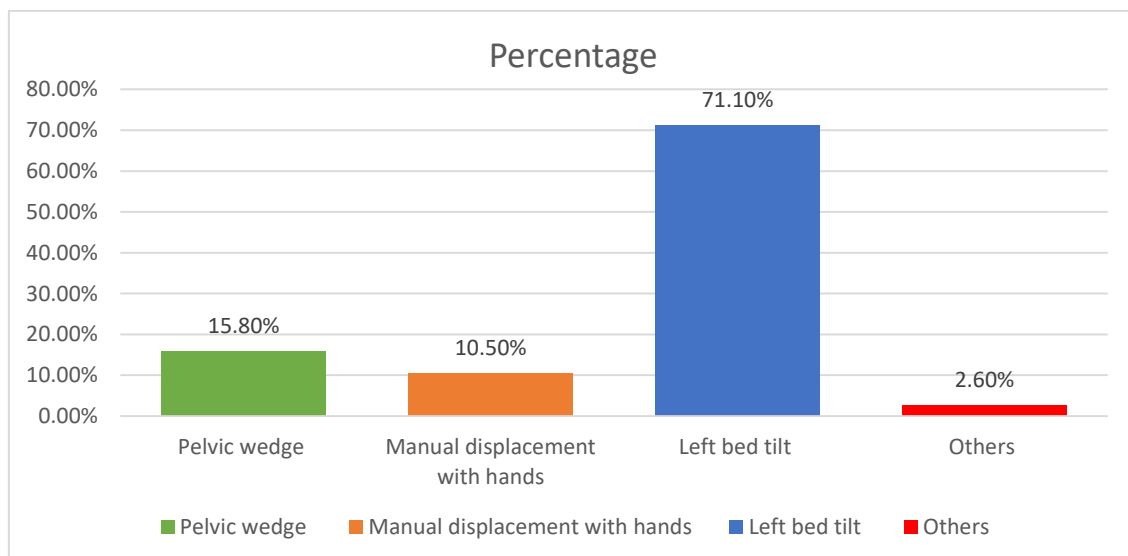


Fig. 5: Measures used to avoid or minimize aortocaval compression in order to avoid or minimize the incidence of supine hypotension during cesarian section under spinal anesthesia

6. Interventions used to improve venous return in order to avoid or minimize the incidence of supine hypotension during cesarian section under spinal anesthesia

Compressing stockings 1(2.6%), Raising foot end of the bed 36(94.8%), others 1(2.6%). (Table 6/ Fig. 6)

Table 6: Interventions used to improve venous return in order to avoid or minimize the incidence of supine hypotension during cesarian section under spinal anesthesia

Variables	Frequency (n=38)	Percentage (%)
Compression stockings	1	2.6
Raising foot end of the bed	36	94.8
Others	1	2.6

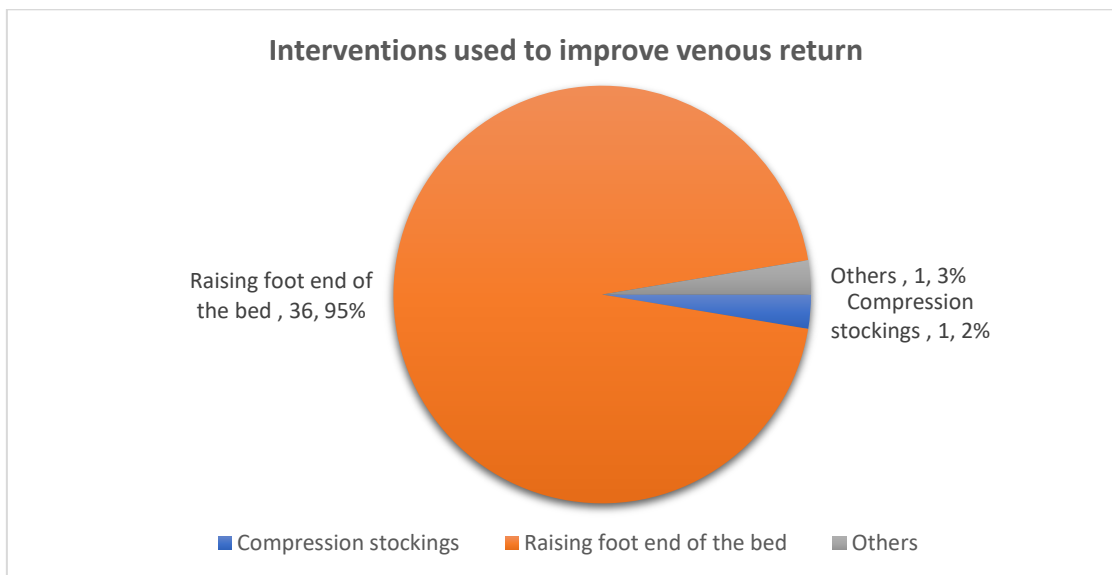


Fig. 6: Interventions used to improve venous return in order to avoid or minimize the incidence of supine hypotension during cesarian section under spinal anesthesia

7. Interventions used in controlling supine hypotension intraoperatively during cesarian section under spinal anesthesia

Bed tilt 4(10.5%), use of Intravenous Fluids (IVF) Only 4(10.5%), use of vasopressor only 3(7.9%), use of pelvic wedge 2(5.3%), use of IVF with vasopressors 23 (60.5%), others 1(2.6%). (Table 7/ Fig. 7).

Table 7: Interventions used in controlling supine hypotension intraoperatively during cesarian section under spinal anesthesia

Variables	Frequency (n=38)	Percentage (%)
Bed tilt	4	10.5
Use of Intravenous Fluids (IVF) Only	4	10.5
Use of vasopressors only	3	7.9
Use of Pelvic wedge	2	5.3
Use of IVF plus vasopressors	23	60.5
Others	2	5.3

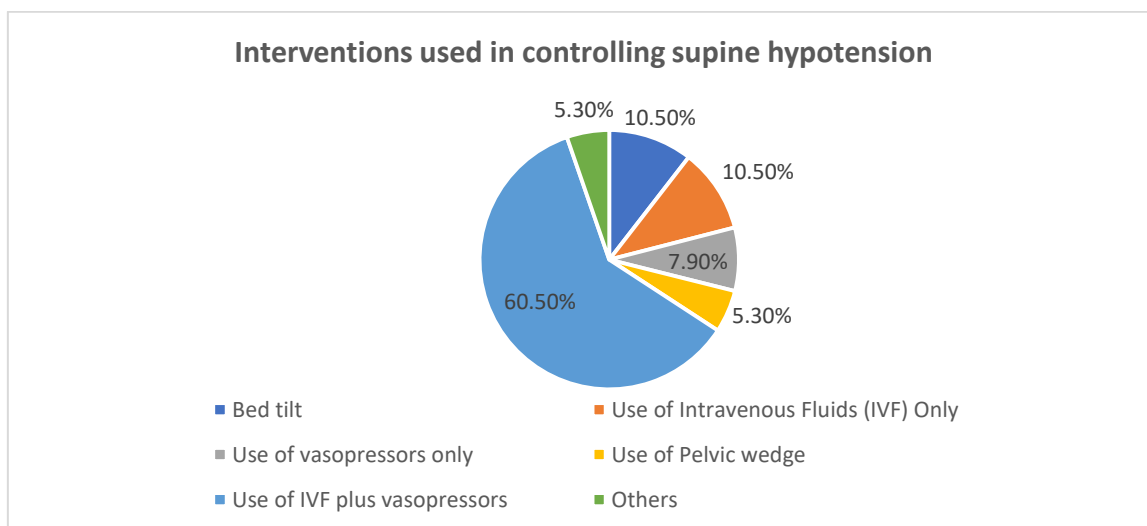


Fig. 7: Interventions used in controlling supine hypotension intraoperatively during cesarian section under spinal anesthesia

8. Preference in managing supine hypotension during cesarian section under spinal anesthesia

Non- Pharmacological interventions 21(55.3%), Pharmacological interventions 17(44.7%). (Table 8/ Fig. 8).

Table 8: Preference in managing supine hypotension during cesarian section under spinal anesthesia

Variables	Frequency (n=38)	Percentage (%)
Non-Pharmacological interventions	21	55.3
Pharmacological interventions	17	44.7

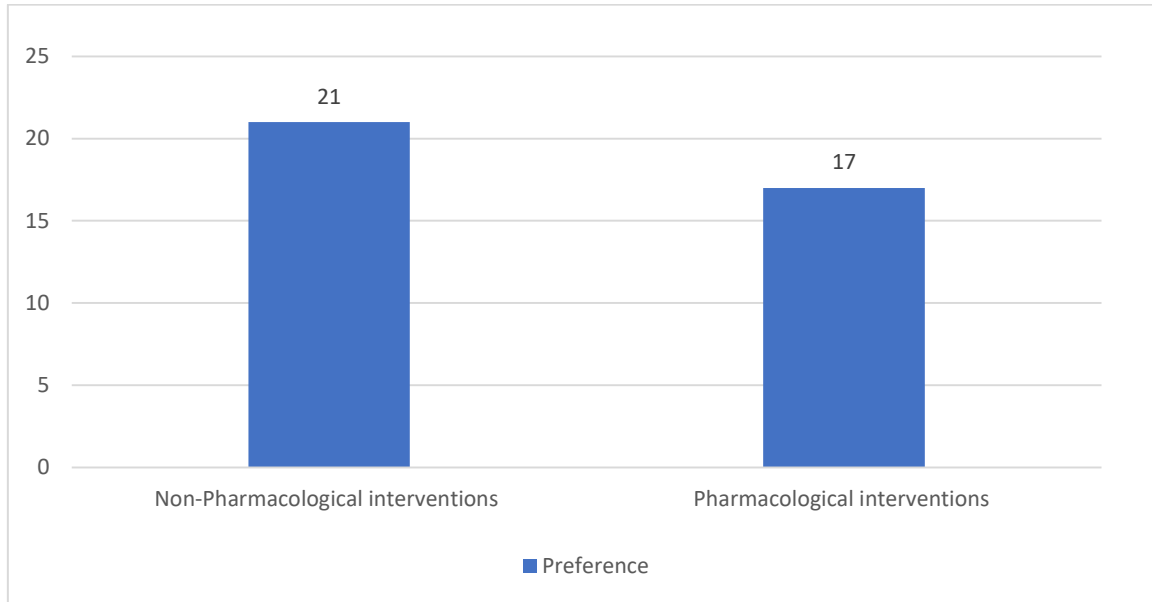


Fig.8: Preference in managing supine hypotension during cesarian section under spinal anesthesia

9. Determinants of choice of intervention for the management of supine hypotension during cesarian section under spinal anesthesia

Severity of the hypotension 29(76.3%), Availability of the intervention 7(18.5%), Diagnosis of the patient 1(2.6%), frequency of the hypotension 1(2.6%). (Table 9/ Fig. 9)

Table 9: Determinants of choice of intervention for the management of supine hypotension during cesarian section under spinal anesthesia

Variables	Frequency (n=38)	Percentage (%)
Severity of the hypotension	29	76.3
Availability of the intervention	7	18.5
Diagnosis of the patient	1	2.6
Frequency of the hypotension	1	2.6

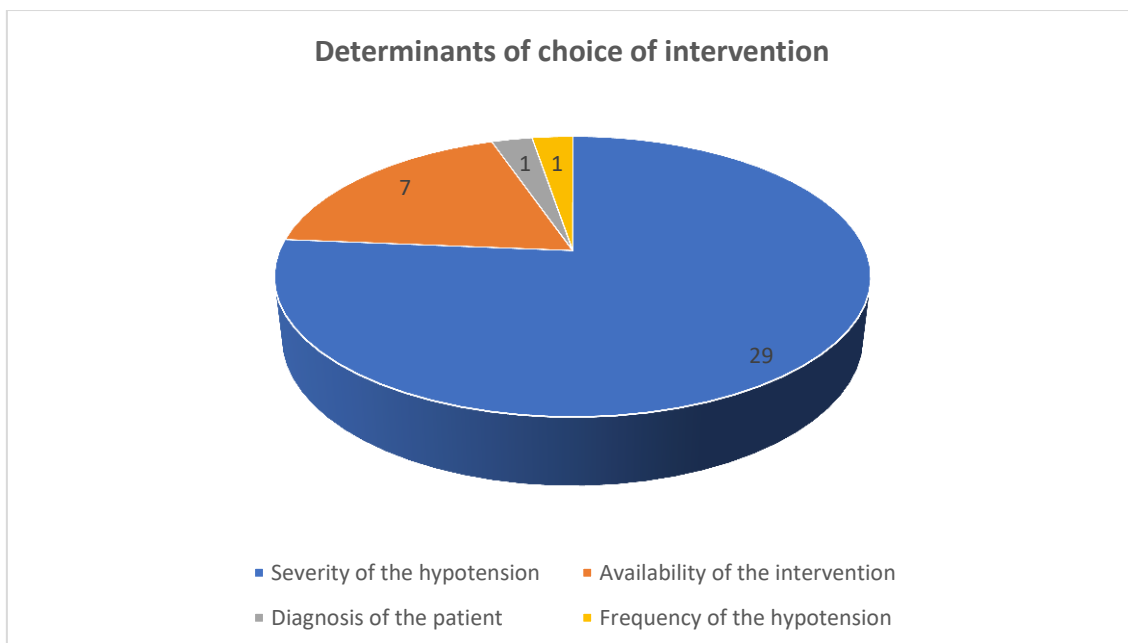


Fig. 9: Determinants of choice of intervention for the management of supine hypotension during cesarian section under spinal anesthesia

Discussion

Our gender distribution findings (**Table 1**) are very curious and interesting to note because they are somehow contrary to the human societal norms which have for decades now considered Nursing in general as a predominantly female profession.

Immediately after spinal anesthesia, majority of the CRAs at the TTH placed the parturient in the supine position with head up while a quarter of them keep patients in the supine position alone with the aim of minimizing the incidence of supine hypotension during cesarian section under spinal anesthesia (**Table 2**). These results are in agreement with the findings by Kim et al, 2013 who reported that patients who were given spinal anesthesia in the sitting position and were laid supine afterwards developed minimal hypotension ^[17].

The preferred use of normal saline solution by the CRAs at the TTH to preload or coload patients in order to prevent or treatment supine hypotension during cesarian section under spinal anesthesia (**Table 3**), is not too surprising because crystalloids such as normal saline solution have been used for many decades by clinicians to augment cardiac output with subsequent increase in arterial blood pressure. This finding is in concordance with results from a study conducted by Chooi et al. 2017, which revealed that normal saline solutions are the most frequently and widely used crystalloids in the management or prevention of supine hypotension during cesarian section under spinal anesthesia ^[18]. However, these same findings (**Table 3**) are contrary to those obtained by Morgan et al, 2001, which seems to suggest that colloids rather are better than crystalloids in preventing or managing supine hypotension during cesarian section under spinal anesthesia ^[14].

Most CRAs at the TTH predominantly use ephedrine as the vasopressor agent of choice in the management of supine hypotension during cesarian section under spinal anesthesia (**Table 4**). These results are similar to those revealed in a study by Burns et al, 2001, who reported a very high percentage (95.2%) of respondents using ephedrine alone in managing supine hypotension during cesarian section under spinal anesthesia ^[19]. On the other hand, results from a study by Ankcorn et al, 2001, indicated that if a patient who develops supine hypotension during cesarian section under spinal anesthesia does not adequately respond to intravenous fluids therapy, vasopressor therapy should be instituted immediately ^[16]. Paradoxically, Webster et al, 2013 revealed in their study that phenylephrine was the vasopressor agent of choice for the management of supine hypotension during cesarian section under spinal anesthesia ^[20]. Despite the above noted similarities of our findings (**Table 4**) with other relevant studies ^[16,19], our results do not conform with the recommendations of the ASA 2016 Guidelines on obstetric anesthesia which recommends the use of phenylephrine as the preferred vasopressor agent in the management of supine hypotension during cesarian section under spinal anesthesia ^[10]. Our study findings further suggest that Ephedrine and Phenylephrine are the two most frequently used vasopressor agents by CRAs at the TTH in the management of supine hypotension during cesarian section under spinal anesthesia (**Table 4**). These findings agree with results from Allen et al, 2000, which also disclosed that Ephedrine and phenylephrine are the two most widely used vasopressor agents of choice in the management of supine hypotension during cesarian section under spinal anesthesia ^[21].

A significant number of CRAs at the TTH prefer tilting the bed laterally to the left to displace the gravid uterus from the great vessels in order to avoid aortocaval compression and subsequently

minimize the incidence of supine hypotension during cesarian section under spinal anesthesia (**Table 5**). This result strongly agrees with Hasanin et al, 2018; who demonstrated that left table tilt has proven to provide a positive sustainability of hemodynamics ^[12]. Crawford et al, 1972 also found in their study that 15 degrees wedge placement under right hip was an effective technique in minimizing supine hypotension during cesarian section under spinal anesthesia ^[22], which is similar to our findings shown in (**Table 5**). Manual displacement of the uterus with the hands to minimize aortocaval compression though not commonly used by CRAs at the TTH (**Table 5**), was found by Sandhya et al, 2016 to be among the common non pharmacological strategies for the management of supine hypotension during cesarian section under spinal anesthesia ^[23].

Almost all of the CRAs at the TTH raise the foot end of the bed in order to improve venous return with subsequent reduction in the incidence of supine hypotension during cesarian section under spinal anesthesia (**Table 6**). This finding is in agreement with the results from Ankcorn *et al.* 2000; who discovered that raising the foot end of the bed is a very effective way of minimizing the incidence of supine hypotension during cesarian section under spinal anesthesia ^[16]. As reported by Chooi et al, 2017, all these measures are to help increase venous return to heart thereby maintaining blood pressure at the time of the cesarian section ^[18]. The use of compression stockings was not found to be a common practice by CRAs at the TTH as a means of improving venous return during cesarian section under spinal anesthesia (**Table 6**) unlike reported by Chooi *et al.*, 2017 in their study ^[18]. All of the above-described intervention techniques are aimed at reducing or minimizing the occurrence of supine hypotension but not eliminating it totally as reported by Paech *et al.*, 2008 ^[23].

Intraoperatively, more than half of the CRAs at the TTH use a combination of intravenous fluids therapy with vasopressors for the management of supine hypotension during cesarian section under spinal anesthesia (**Table 7**). Hartman *et al.*, 2008; also reported a similar finding in their study ^[24].

Our study has convincingly revealed that, the majority of the CRAs at the TTH prefer the use of non-Pharmacological interventions for the prevention and management of supine hypotension during cesarian section under spinal anesthesia (**Table 8**). On the contrary, burns *et al.*, 2001; noted in their study that most of the respondents preferred using Pharmacological interventions instead of non-Pharmacological interventions in the prevention and management of supine hypotension during cesarian section under spinal anesthesia ^[19].

The key determinants of the choice of intervention among the CRAs at the TTH for the prevention or management of supine hypotension under spinal are the severity of the hypotension and the availability of the intervention (**Table 9**). However, Sklebar *et al.*, 2019; in their study reported that the experience of the anesthetist was the only factor significantly associated with the choice of interventions for the management of supine hypotension during cesarian section under spinal anesthesia ^[25].

Study Limitations

The major limitation of our study is the fact that we did not have any opportunity to witness the CRAs implementing any of the clinically known and documented pharmacological or non-pharmacological interventions to either prevent or treat supine hypotension during cesarian section under spinal anesthesia. Moreover, the study design did not allow us to monitor real life patients in order to ascertain the safety and efficacy outcomes of

the different intervention modalities used by the CRAs at TTH to prevent and or treat supine hypotension during cesarian section under spinal anesthesia. Finally, the researchers could not ascertain with clarity whether the documented cases of supine hypotension during cesarian section under spinal anesthesia were solely managed by the CRAs or it was collaborative effort with other members of the obstetric team such as the midwife or consultant gynecologist

Conclusions

Majority of the CRAs at the TTH are males. Most of the CRAs at the TTH placed the parturient in a supine position with head up as a means of preventing or treating supine hypotension during cesarian section under spinal anesthesia. Ephedrine alone was the vasopressor agent widely used as a pharmacological intervention modality to treat supine hypotension during cesarian section under spinal anesthesia. Normal saline solution alone was the preferred IVF used by the CRAs at the TTH for preloading or co-loading parturient to prevent supine hypotension during cesarian section under spinal anesthesia. Left bed tilt was the technique mostly used by the CRAs at the TTH to avoid or minimize aortocaval compression with subsequent reduction in the incidence of supine hypotension during cesarian section under spinal anesthesia. Raising foot end of the bed was used predominantly by the CRAs at the TTH to improve venous return in order to avoid or minimize the incidence of supine hypotension during cesarian section under spinal anesthesia. Most of the CRAs at the TTH employed a combination of IVF with vasopressor agents to control supine hypotension intraoperatively during cesarian section under spinal anesthesia. Although the Majority of the CRAs at the TTH preferred using the non-pharmacological techniques as compared with the pharmacological approaches in preventing or managing supine hypotension during cesarian section under spinal anesthesia, it will be clinically imprudent for the researchers to assume or conclude the non-pharmacological interventions are safer and more effective than the pharmacological interventions. The choice of intervention was intrinsically influenced by the severity of the intervention as well as the availability of the interventions

Recommendations

Management of the TTH should task all relevant stakeholders within the institution with the responsibility of designing and implementing protocols or algorithms for the management of supine hypotension during cesarian section under spinal anesthesia that are based on recommendations from internationally recognized and reputable professional organizations such as the American Society of Anesthesiology (ASA)

The department of obstetrics and gynecology together with the department of anesthesiology and critical care of the TTH should collaborate with the training unit of the human resources department to provide in house periodic training in the area of non-pharmacological intervention techniques for the management or prevention of supine hypotension during cesarian section under spinal anesthesia for all CRAs.

Management at the TTH should task the directorate of Pharmacy of the institution with the responsibility of ensuring that crystalloids such normal saline solution and vasopressor agents including ephedrine and phenylephrine are always available during the delivery of obstetric anesthesia for either elective or emergency cesarian sections.

The department of anesthesiology and intensive care should consider establishing a collaborative research initiative with the department of obstetrics and gynecology to compare the safety and efficacy of the non-pharmacological and pharmacological interventions in the prevention and management of supine hypotension during cesarian section under spinal anesthesia

Conflict of interest

All the researchers have no conflict-of-interest situations to declare

Sources of Funding

This research did not receive any specific grant from any funding agencies in the public, commercial or not-for profit sectors

Authors Contributions

EN conceived the research idea and collected all the relevant data. MMDM conducted the literature review and wrote the manuscript. PPB performed the data analysis and helped with the manuscript writing. All authors thoroughly reviewed the manuscript and approved its content for publication

Acknowledgement

The authors of this research wish to officially acknowledge and appreciate the valuable inputs received from Mr. Isaac Mensah during the data analysis and management process

Data availability statement

All the quantitative and qualitative data used in writing the article are included in this manuscript

References

- [1] Deborah J. Wilson et al. Spinal anesthesia for cesarian section. *J Soc. Obstet Gynaecol Can* 2008; 20(8): 754 – 761
- [2] Stones, PA et al. Complications of spinal anesthesia following extradural block for cesarian section. *Br J Anaesth* 2009; 6(2): 335 – 337
- [3] De-Giorgio et al. Supine hypotensive syndrome as the probable cause of both maternal and fetal death: A case of fatal supine hypotensive syndrome. *Journal of forensic Sciences* 2012; 57(6): 1646-1649
- [4] Krywko et al. Aortocaval compression syndrome. In *StatPearls*. StatPearls Publishing 2021.
- [5] Humphries et al. Hemodynamic Changes in women with symptoms of supine hypotensive syndrome. *Acta Obsterica e Gynecologica Scandinavica* 2020; 99(5): 631-636
- [6] Riley et al. Left Uterine tilt for cesarian delivery significantly improves Maternal Hemodynamics and should not be considered outdated Dogma. *Anesthesiology* 2018; 128(4): 858-859
- [7] Kinsella et al. Supine hypotensive Syndrome. *American College of Obstetricians and Gynecologists* 1994; 83(5): 774-788
- [8] Klohr et al. Definitions of hypotension after spinal anesthesia for cesarian section: Literature search and

- application to parturient. *Acta Anesthesiologica Scandinavica* 2010; 54(8):909-921
- [9] Kinsella et al. international consensus statement on the management of hypotension with vasopressors during cesarian section under spinal anesthesia. *Anesthesia* 2018; 73(1): 71-92
- [10] Malick et al. Practice Guidelines for obstetric Anesthesia: An updated report by the American Society of Anesthesiologists Task Force on Obstetric Anesthesia and the Society of Obstetric Anesthesia and Perinatology.
- [11] Chungsamarnyart et al. Hemodynamic profiles with and without left uterine displacement: A randomized study in term pregnancies receiving subarachnoid blockade for cesarian delivery. *Journal of clinical anesthesia* 2020; 64(10): 96-103
- [12] Hasanin et al. Hemodynamic effects of lateral tilt before and after spinal anesthesia during cesarian delivery: An observational Study. *BMC Anesthesiology* 2018; 18(1): 8-10
- [13] Kundra et al. Manual displacement of the uterus during cesarian section: Manual displacement of the uterus during LSCS 2007; 62(5): 460-465
- [14] Morgan et al. The effects of an increase of central blood volume before spinal anesthesia for cesarian delivery: A qualitative systematic review. *Anesthesia and analgesia* 2001; 92(4): 997-1005
- [15] Pickett et al. *Decision making in Medicine*. Elsevier 2010; Third. pp. 78-89
- [16] Ankcorn et al. *Spinal Anesthesia: A Practical Guide* 2000.
- [17] Kim et al. Effect of position changes after spinal anesthesia with low dose bupivacaine in elderly patients: Sensory block characteristics and hemodynamic changes. *Korean Journal of Anesthesiology* 2013; 64(3): 234-239
- [18] Chooi et al. Techniques for preventing hypotension during spinal anesthesia for cesarian section. *The Cochrane Database of Systematic Reviews* 2017.
- [19] Burns et al. Prevention and Management of hypotension during spinal anesthesia for elective cesarian section: A Survey of Practice. *Association of Anesthetists* 2001; 56(8): 777-798
- [20] Webster et al. *Obstetric anesthetists Association Survey 109. Phenylephrine in obstetric anesthesia- a survey of UK practice* 2013.
- [21] Allen et al. A survey of the management of spinal induced hypotension for scheduled cesarian delivery. *International Journal of Obstetric anesthesia* 2009; 18(4): 356-361
- [22] Crawford et al. Time and lateral tilt at cesarian section. *British Journal of Anesthesia* 1972; 44(5): 477-484
- [23] Paech et al. Should we take a different angle in managing pregnant women at delivery? Attempting to avoid the supine hypotensive syndrome. *Anesthesia and intensive Care* 2008; 36(6): 775-777
- [24] Hartman et al. The incidence and risk factors for hypotension after spinal anesthesia induction: An analysis with automated data collection. *Anesthesia and Analgesia* 2002; 94(6): 1521-1529.
- [25] Sklebar et al. Spinal anesthesia induced hypotension in obstetrics: Prevention and therapy. *Acta Clinica Croata* 2019; 58(1): 90-95



Open Access This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this license, visit <https://creativecommons.org/licenses/by/4.0/>.

© The Author(s) 2021