

## Review Article

# Evidence-Based Practice Guideline for Post-Spinal Hypotension Prevention in Cesarean Section in, Review of Article, 2023

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### Abstract

#### Background

The most common complication we see in obstetric surgery after spinal anaesthesia is hypotension. Postspinal hypotension prevention is critical during caesarean section for a successful maternal and foetal outcome. National guidelines prioritise treatment of post-spinal hypotension over prevention. Current guidelines emphasise non-pharmacological and pharmacological approaches to preventing post-spinal hypotension in caesarean sections for improved maternal and foetal outcomes.

#### Objective

To develop guideline on post spinal hypotension prevention in caesarean section to improve the practical protocols.

#### Methodology

The Cochrane review, PubMed, and Google Scholar databases were used to conduct a systematic and manual search of the literature. The key words for PubMed, Cochrane, and Google Scholar were used in the search. [Hypotension AND C-section OR C-section, hypotension AND Preload OR co-loading, spinal anesthesia AND colloid OR crystalloid, hypotension AND prophylaxis OR prevention,

sub-anesthetic dose AND post-spinal hypotension, spinal anesthesia AND atropine AND co-load AND leg-elevation AND spinal anesthesia-induced hypotension OR hypotension AND Cesarean section AND sequential compression device, 22 interventional studies, 3 meta-analyses.

#### Conclusion

When it comes to post-spinal hypotension in obstetrics, they strongly recommend crystalloid co-loading over preloading. Colloid preloading outperforms crystalloid co-loading. Non-pharmacological approaches, as well as a sub anesthetic dose of 0.5 mg/kg ketamine and a 0.5 mg atropine IV bolus, were effective agents in preventing post-spinal hypotension.

**Keywords:** Cesarean section; Co loading; Hypotension crystalloid; Post spinal hypotension preloading; Positioning; Prevention

### Abbreviations and Acronyms

C/S: Cesarean Section

CB: Elastic Crepe Bandage

CD: Cesarean Delivery

GOR: Grade of Recommendation

HR: Heart Rate

LOE: Level of Evidence

MABP: Mean Arterial Blood Pressure

NPI: Non-Pharmacologic Intervention

PCD: Pneumatic Compression Device

PSH: Post Spinal Hypotension

PSHP: Post Spinal Hypotension Prevention

RCT: Randomized Clinical Trial

SA: Spinal anesthesia

SCD: Sequential Compression Device

### Introduction

Cesarean section is one of the most commonly performed surgeries in women, and subarachnoid anesthesia is used more frequently than epidural and combined spinal-epidural techniques [1]. The most common problem of SA is nausea or vomiting, and it can expose the mother and baby to unconsciousness, pulmonary aspiration and hypoxia, acidosis, and neurological injury during caesarean section [2].

The most significant pathophysiological mechanism is the rapid onset of sympatholytic due to increased sensitivity of nerve fibers to local anesthetics during pregnancy, as well as at the preganglionic level and the sympathetic block, which is one to two segments higher than the somatic level [3,4].

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Post-SA hypotension after Cesarean section is associated with maternal morbidity and mortality, with reported incidences ranging from 7% to 74%. The incidence varies depending on how hypotension is defined [5]. Post-spinal hypotension is more common in pregnant women due to physiological changes that cause the enlarged uterus to compress the inferior vena cava and increase collateral venous plexus circulation in the epidural space. This change causes an increase in cerebrospinal fluid pressure in the lumbosacral area, which causes local anesthetics to be absorbed [6].

Generally, hypotension caused by spinal anesthesia during a cesarean section is associated with tachycardia, with bradycardia being a less common response. According to minimally invasive cardiac output monitoring, this represents a partially compensatory increase in cardiac output in response to a decrease in SVR [7].

The sensory level, anesthetic dose, and fetal birth weight greater than 3900 g were the most important risk factors that increased the incidence of hypotension in cesarean sections performed under spinal anesthesia [8]. Non-pharmacologic intervention (NPI) (such as leg wrapping, leg elevation, left side tilting, and inflatable splints or boots or thromboembolic deterrent stockings) or pharmacological methods such as vasopressors (Ephedrine, phenylephrine, and norepinephrine) and intravenous fluids can prevent post-spinal hypotension (PSH) [9].

## Justification

It is common for a pregnant woman to be indicated for a cesarean section under spinal anesthesia, so proper and adequate prevention is essential. According to studies, up to 75% of all pregnant women experience spinal block-induced sympatholytics, resulting in vasodilation and, as a result, maternal hypotension, which may compromise uterine blood flow and foetal circulation, resulting in fetal hypoxia, bradycardia, and acidosis [10]. The standard obstetric prevention has frequently failed to meet the maternal and fetal needs, and dealing with PSH is a daily challenge for anesthetists of varying levels of experience. This demonstrates that anesthetists and post-spinal anesthesia prevention strategies do not work well together during procedure. There are a lot of scientific literatures, that support non-pharmacological and pharmacological interventions as necessary components to complete the gap of PSH in obstetrics as needed so, performing review and developing guideline on Post spinal hypotension prevention (PSHP) is very beneficial both for health professionals and giving care for obstetric patients and fetus. The goal of this review is to create PSHP guidelines that include both pharmacologic and non-pharmacologic interventions, thereby improving clinicians' practice in the prevention of PSH-related maternal and fetal outcomes.

One national published guideline specifically focused on PSH management in obstetric undergoing for cesarean section as far as my search. However, currently update evidence, which have the different idea specially the current evidence on the crystalloid co-loading vs preloading, colloid preloading vs crystalloid co-loading and additional the effect of ketamine and atropine in prevention of PSHP than the previous guidelines.

Previous guidelines on the prevention and management of post-spinal hypotension in obstetrics recommend that co-loading be as important as pre-loading to avoid unnecessary time waste. Non-pharmacological approaches should be prioritized over pharmacological methods. Furthermore, rapid crystalloid co-loading has comparable efficacy to colloids and should be preferred due to a lower risk

profile [11]. However, current evidence concludes and recommends that co-loading outperform preloading. Colloid preloading outperforms crystalloid co-loading, and a non-pharmacological approach was added to the previous guideline. Furthermore, a 0.5 mg/kg sub anesthetic dose of ketamine and a 0.5 mg IV bolus of atropine are effective agents for preventing post-spinal hypotension.

## Objectives

To develop guideline on post spinal hypotension prevention in caesarean section to improve the practical protocols.

### scope of the guideline

Target audience of this guideline involves groups of health professionals working in every operating room or obstetrics patient undergoing cesarean section, including anesthetists, Nurses, doctors and other health care professionals contributing to a multidisciplinary approach for post spinal hypotension prevention.

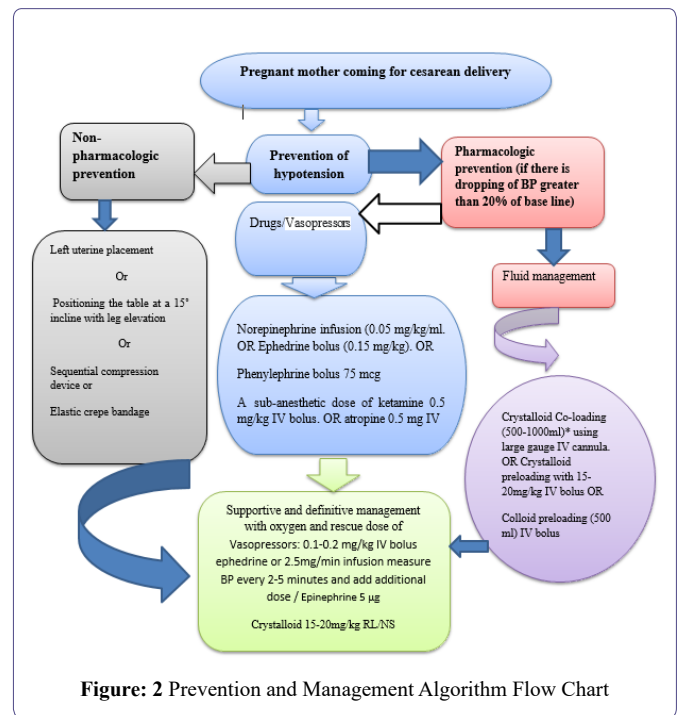
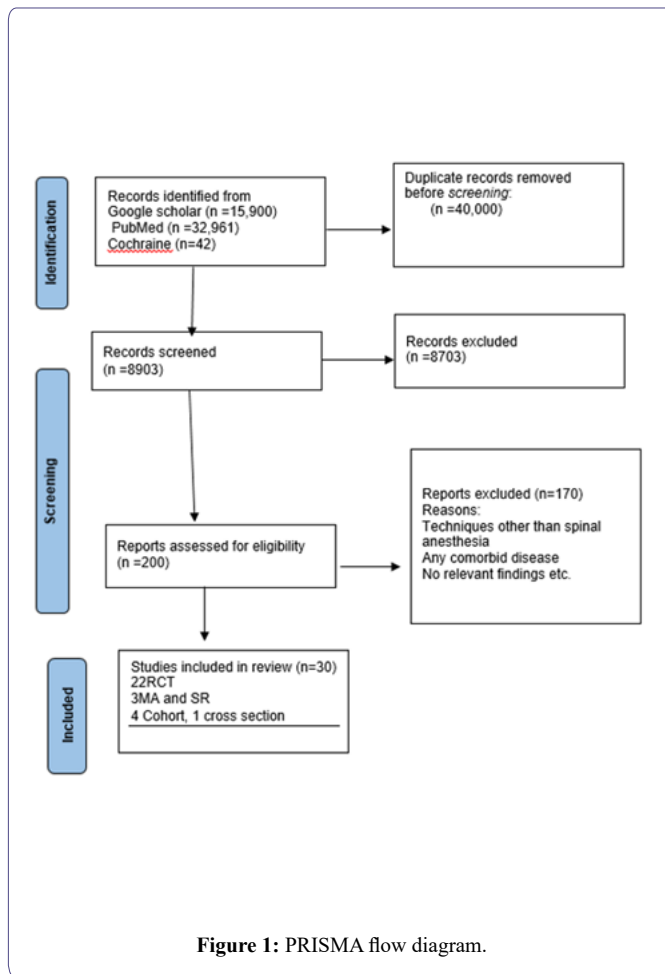
Parturient undergoing spinal anesthesia for cesarean section was the target populations of this guideline. This guideline will address PSHP for obstetrics patients undergoing cesarean section through both pharmacological and non-pharmacological interventions supported by current best evidences.

## Methods and Materials

The review reported according to Reporting Items for practice Guidelines in Health care (RIGHT) protocol. A systematic and hand search of literature was done from Cochrane review, PubMed, and Google Scholar. The search performed using key words for PubMed, [Hypotension AND Cesarean section OR C-section, hypotension AND Preload OR co-loading, spinal anesthesia AND colloid OR crystalloid, hypotension AND prophylaxis OR prevention, sub-anesthetic dose AND post-spinal hypotension, spinal anesthesia AND atropine OR co-load, leg-elevation AND spinal anesthesia-induced hypotension, Cesarean section OR hypotension, maternal care bundle OR sequential compression device).

This review included interventional studies, meta-analysis and systematic review studies, cohort studies, and cross-sectional studies, as well as full articles published between 2017 and 2022 and written in English. The search engine results were filtered by interventions, outcomes, population data, and methodological quality. Full-term pregnant women (ASA II) were the inclusion criteria for studies on parturients undergoing cesarean sections under spinal anesthesia in obstetric populations, and they were published in English. This is the goal of this policy.

Exclusion criteria studies on parturient with obesity, diabetes, cardiac disease, hypertensive disorders of pregnancy, CKD, per partum bleeding, age less than 18 years (Figures 1 & 2), those converted to GA for failed SA, and coagulation disorder are included in this guideline. Following extraction and filtering with a patient population and exclusion criteria, 22 RCTs, 3 SRs and meta-analyses, 4 cohort studies, and 1 cross-sectional study were evaluated for quality and a conclusion was reached based on their level of evidence and recommendation grades adapted from the Oxford Center for Evidence-Based Medicine (Tables 1 & 2).



S/No	Author / year	Population	Sample size / design	Finding of the evidence	LOE	
1	Meron Abrar et al, 2021	Obstetrics	96, Cohort study	Crystalloid fluid co-loading to the operating mothers during the cesarean section was a better option for the prevention of spinal anesthesia-induced hypotension.	2b	B
2	Dr Ankita Chandel et al, 2020	Obstetrics	50, RCT	Co-loading provides a better alternative than preloading for prevention of maternal hypotension secondary to spinal anesthesia given for caesarean section.	1b	A
3	Diriba Teshome et al, 2022	Obstetrics	96, Prospective cohort	Hypotension occurred 77.1% of the time in the preload group and 35.4 percent of the time in the co-load group, according to this study. As a result, crystalloid co-loading was superior to preloading in preventing spinal anesthesia-induced hypotension in mothers who had a cesarean section.	2b	B

Level of evidence	Grading criteria	Grade of recommendation
1a	Systematic reviews of RCTs including meta-analysis	A
1b	Individual RCT with narrow confidence interval	A
1c	All or none randomized controlled trials	B
2a	Systematic review of cohort study	B
2b	Individual cohort including low quality RCT	B
2c	Outcome research study	C
3a	Systematic review of case control studies	C
3b	Individual case control study	C
4	Case series, poor quality cohort and case control studies	C
5	Expert opinion without explicit critical appraisal, or based on physiology, bench research or "first principles"	D

**Table 1: Levels of Evidences and Grades of Recommendations.**

**Note:**\*Adapted from Centre for Evidence-Based Medicine (<https://creativecommons.org/licenses/by/4.0/>)

4	Budi Yulianto Sarim et al,2022	Obstetrics	51, RCT	Crystalloid fluid co-loading was significantly better in reducing hypotension incidence, after spinal anesthesia in cesarean section compared with the Preloading and control groups.	1b	A
5	Neha Bhardwaj et al,2020	Obstetrics	50, RCT	Co-loading of crystalloid fluid is a better method than preloading of crystalloids for prevention of maternal hypotension after SAB given for LSCS. So, we should not waste extra time for preloading of fluid before surgery, which can delay the surgery, for prevention of hypotension after spinal anesthesia.	1b	A
6	MIAH MAK et al,2020	Obstetrics	90,RCT	Severity of hypotension and increased ephedrine requirement were evident in patients who received crystalloid pre-loading (group II), which means crystalloid co-loading (group I) was more capable to prevent spinal anesthesia induced hypotension.	1b	A
7	Riley et al 2019; 47(1): 35-40	Obstetrics	160, Retrospective cohort	Vasopressor use was lower in colloid preloading than in crystalloid co-loading. However, differences in all outcome measures were minimal and likely clinically insignificant, suggesting that both fluid-loading techniques are appropriate to use for the prevention of spinal hypotension in women undergoing CD	2b	B

8	Raad Ghazi Re-shan,2018	Obstetrics	60, RCT	There is significant difference between the effect of preloading and co-loading on blood pressure after spinal Anesthesia. It had been found that those patients who were administered pre-loading dose more likely to develop hypotension than those administered co-loading one.	1b	B
9	Hai-Fang Ni et al ,2017	Obstetrics	824, A Meta-Analysis	For parturients receiving crystalloid loading in spinal anesthesia for cesarean delivery, coload strategy is superior to preload for the prevention of maternal hypotension.	1a	A
10	Ahmed Hasanin et al,2017	Obstetrics	150,RCT	LE performed immediately after spinal block reduced the incidence of PSH in parturient undergoing CS	1b	A
11	Ebrahim Elgzar et al.2019	Obstetrics	120.RCT	Lower leg compression technique can effectively reduce PSH and neonatal acidosis	1c	B
12	Sumita Swain et al.2019	Obstetrics	60, RCT	Elevation of lower limb just after spinal anesthesia is an effective method to prevent hypotension during spinal anesthesia, for elective caesarean section without any unwanted side effect like hypotension, tachycardia, or any other maternal side effects.	1b	A
13	Sofia Assen et al.2020	Obstetrics	52, RCT	This study shows that performing leg elevation after spinal anesthesia for elective cesarean section significantly reduces the incidence of post spinal hypotension and severity of hypotension.	1b	A

14	Prajith et al.2020	Obstetrics	90,RCT	Leg-wrapping with Elastic crepe bandage (CB) is cost-effective, non-invasive, non-pharmacological, and effective tool to reduce the incidence of hypotension after spinal anesthesia in a parturient.	1b	A
15	Feyza Bolcal Çalışır et al.2019	Obstetrics	200, RCT	The methods of positioning the operating table at a 15° incline and leg elevation, applied on their own or together, to pregnant women receiving spinal anesthesia, insignificantly reduced the frequency and depth of SA-induced maternal hypotension. It could provide materno-fetal benefits with respect to less use of vasopressors.	1b	A
16	Abdelrhman Alshawadfy et al.2021	Obstetrics	100, RCT	The application of left uterine placement is an important and effective parameter in a maternal care bundle for decreasing the incidence of post spinal anesthesia hypotension in parturients undergoing elective cesarean section.	1b	A
17	Mostafa Alghozat et al.2020	Obstetrics	76, RCT	SCD could reduce extensive changes in diastolic blood pressure as an important hemodynamic parameter and the incidence of nausea and vomiting. Thus, SCD can be used in spinal anesthesia care practices for elective C/S.	1b	A

18	Agarwal et al,2022	Obstetrics	80, RCT	The sequential compression device is useful for prevention of hypotension in pregnant females undergoing elective caesarean section under spinal anesthesia.	1b	A
19	Dina Salah et al,2019	Obstetrics	80, RCT	It is concluded that ketamine in a sub-anesthetic dose is an effective agent that can be used in preventing post spinal hypotension in parturients undergoing CS delivery.	1b	A
20	Salman Maqbool et al,2022	Obstetrics	144, RCT	Prophylactic bolus of atropine against to blunt unopposed vagal activity provided stable hemodynamic (pulse and systolic blood pressure) values in caesarean section at time of spinal block.	1b	A
21	Shang et al. Medicine (2021) 100:7	Obstetrics	587, 33RCT, for Meta-analysis	Colloid preloading is superior to crystalloid preloading in reducing the incidence of hypotension induced by spinal anesthesia and vasopressor requirement in the healthy parturients undergoing elective cesarean delivery.	1a	A
22	Susu Zhang et al,2019	Obstetrics	97, RCT	Infusion of 4mg/minute norepinephrine presented fewer cases of tachycardia, less fluctuation and a lower HR compared to baseline values, as well as a less stressed fetal status compared to ephedrine infusion at 4mg/minute. In addition, norepinephrine infusion presented a lower standardized SBP compared to ephedrine.	1b	A

23	Jaitawat et al, 2019	Obstetrics	120, RCT	Prophylactic bolus dose of phenylephrine 75 mcg was found to be effective for the management of spinal-induced hypotension and should be preferred over 100 mcg which causes significant bradycardia and reactive hypertension.	1b	A
24	Cui-cui Jiao et al, 2020	Obstetrics	80, RCT	Prophylactic methoxamine infusion for preventing spinal-induced hypotension in obstetric patients were 2.178 (95% CI 1.564 to 2.680) µg/kg/min and 4.821 (95% CI 3.951 to 7.017) µg/kg/min, respectively. Moreover, it is seemed that the higher dose of methoxamine administered as fixed rate, the more maternal hemodynamic stability and the better neonatal out-comes might be got.	1b	A
25	Preet M. Singh et al, 2020	Obstetrics	4126. 52RCT, Meta-analysis	The analysis suggests the possibility that norepinephrine and metaraminol are less likely than phenylephrine to be associated with adverse fetal acid-base status during Caesarean delivery.	1b	A
26	Man-Ping Yang et al, 2021	Obstetrics	190, RCT	In patients undergoing elective cesarean section with spinal anesthesia, norepinephrine infusion compared to ephedrine, bolus resulted in less hypotension and tachycardia, and exhibited potential neonatal benefit.	1b	A

27	Shuqin Ma et al, 2021	Obstetrics	99, RCT	Prophylactic norepinephrine infusion effectively lowers the incidence of post-spinal anesthesia hypotension and results in overall stability of SBP control, with measurements remaining closer to baseline levels.	1b	A
28	Weijia Du et al, 2022	Obstetrics	62, RCT	When administered as a prophylactic fixed-rate infusion, phenylephrine and norepinephrine are both capable of maintaining maternal blood pressure following spinal anaesthesia in twin pregnancies. There were no differences in the maternal hemodynamics or foetal outcomes between women receiving norepinephrine and phenylephrine.	1b	A
29	S.M. Pouryag-hobi et al, 2022	Obstetrics	131, Cross-sectional	5% of lidocaine with ephedrine can reduce the incidence of hypotension among patients undergoing cesarean section.	3b	C
30	Osmani SG, et al, 2022	Obstetrics	120, observational study	Both study drugs – phenylephrine and noradrenaline, when used as prophylactic bolus in patients undergoing cesarean deliveries under spinal anesthesia, are effective in reducing the incidence of bradycardia, hypotensive episodes, and nausea, vomiting.	2b	B

**Table 2:** The studies included in the review for the guideline.

## Discussion

### Prevalence of post spinal hypotension

In the developed world, spinal anesthesia is the most commonly used technique for elective cesarean section, accounting for approximately 78% of procedures; in Ethiopia, without prophylactic measures, the incidence is very high (80%-100%) [12].

## Prevention

### Non Pharmacologic

Non-pharmacologic methods could be used to prevent post-spinal hypotension. There are various studies that go into detail about non-pharmacological approaches and their vasopressor requirements. Among these, a randomized controlled trial (RCT) was conducted on full-term pregnant women in different years with different authors scheduled for CS, to which the participant was randomly assigned. After a fluid preload of 10 mL per kg of crystalloid, spinal blocks were performed in the sitting position. After administering an intrathecal local anesthetic and positioning the patient supine, leg elevation was performed and maintained until the skin incision was begun. Intraoperative hemodynamic parameters (arterial blood pressure and heart rate), intra-operative ephedrine consumption, PSH incidence, and nausea and vomiting incidence were all recorded. Finally, they conclude that performing leg elevation following spinal anesthesia for a cesarean section significantly reduces the risk of complications [13-15].

The study included 120 parturient (60 lower leg compression technique and 60 control), 76 women (36 sequential compression device and control), and 90 term obstetrics divided into G1 (control), Elastic Crepe Bandage (CB)-G2, and Pneumatic Compression Device (PC-D)-G3. Furthermore, 80 patients (40 with a sequential compression device and 40 as controls) were studied in different areas with different sociodemographic data and reproductive histories, as well as electronic monitoring of maternal hemodynamic parameters and neonatal hemodynamic assessment sheets and authors. The groups were compared in terms of maternal hemodynamic changes after spinal anesthesia, nausea, vomiting, and neonatal Apgar scores at 1 and 5 minutes. Almost all of the Conclusions were related: CB leg wrapping is inexpensive and noninvasive, and a sequential compression device was developed [16-19].

A randomized clinical trial was carried out on 200 pregnant women who had caesarean sections. Pregnant women were divided into two groups: Group 1 (15-degree left lateral incline) and Group 2 (15-degree left lateral incline and leg elevation) (Group 2). Another RCT was conducted with a sample size of 100 pregnant women divided into two equal groups. After SA, the MAP, HR, neonatal APGAR scores, and umbilical cord blood gas analysis, the need for total vasopressor and atropine was recorded until the infant was delivered, every five minutes after delivery until the 30th postpartum minute, and at the end of the surgery. During caesarean sections, positioning the table at a 15-degree incline and maintaining leg elevation may provide maternofetal benefits. By lowering the frequency of post-spinal hypotension in pregnant women and reducing the risk of foetal death. The application of left uterine placement is an important and effective parameter in a maternal care bundle for decreasing [20,21].

### Pharmacologic

#### Fluid Management

Two comparative cohort study designs were used, with a sample size of 96 mothers (48 of whom were preloaded with 20 ml/kg of fluid 20 minutes before spinal block and 48 of whom were co-loaded with 1000 ml of ringer lactate) participating in the study over two years. According to this study within the respective years, hypotension occurred 77.1% of the time in the preload group and 35.4 percent of the time in the co-load group [22,23].

The study was conducted in various areas, with various authors and sample sizes. Full-term parturient were randomized in each study, with the preloading group receiving 15-20 ml/kg of ringer lactate 15-20 minutes before spinal anesthesia administration, and the co-loading group receiving 1000 ml of ringer lactate. Blood pressure and heart rate were measured at 1-minute intervals beginning 1 minute after intrathecal injection and continuing until the first 10 minutes, every 5-minute interval until the next 20 minutes and every 10-minute interval thereafter until the surgery was completed. Co-loading of crystalloid fluids is more effective than preloading of crystalloid fluids in reducing the incidence of hypotension after spinal anesthesia in cesarean patients, according to all studies with similar results. It is also more effective at reducing the need for vasopressors and the occurrence of nausea and vomiting after spinal anesthesia [23-28].

A meta-analysis of randomized controlled trials comparing crystalloid co-loading with preload and colloid preloading with crystalloid preloading in women undergoing spinal anesthesia for cesarean delivery was performed. Co-loading is superior to preloading for the prevention of maternal hypotension in parturient receiving crystalloid loading in spinal anesthesia for cesarean delivery, and colloid preloading is superior to crystalloid preloading for reducing the incidence of hypotension induced by spinal anesthesia and the vasopressor requirement in healthy parturient undergoing elective cesarean delivery, respectively [29,30].

#### Drug / Vasopressors

Parturient were randomly assigned to either a norepinephrine infusion (0.05 mg/kg/min) just before spinal anesthesia lasting 30 minutes or an ephedrine bolus (0.15 mg/kg) just before spinal anesthesia lasting 30 minutes in a double-blind, randomized controlled clinical trial. A rescue bolus of 5 mg of norepinephrine for the norepinephrine group and 5 mg of ephedrine for the ephedrine group was administered when hypotension happened. In another study, norepinephrine (4 mg/minute) or ephedrine (4 mg/minute) were given immediately after spinal anesthesia with an on-off titration to keep systolic blood pressure (SBP) between 80% and 120% of baseline. In both, study the incidence of hypotension within 30 min of spinal anesthesia administration, the outcomes of both maternal and neonatal outcomes 30 min after spinal block, and neonatal cerebral oxygenation 10 min after birth. Norepinephrine infusion, compared to ephedrine, resulted in less hypotension and tachycardia and exhibited potential neonatal benefits. [31,32].

A prophylactic dose of 0.05 or 0.075 g/kg/min norepinephrine was used in the dose-finding trial. And the effect of 75-mcg vs. 100-mcg phenylephrine doses on the incidence of spinal-induced hypotension prevention by different authors in different years, as well as the adverse effect of drugs with different doses during cesarean section by different authors in different years. A bolus dose of phenylephrine 75 mcg and a dose of 0.05 or 0.075 g/kg/min were found to be effective for the prevention and management of spinal-induced hypotension, respectively [33,34].

In another study, researchers compared the levels of phenylephrine and norepinephrine in healthy twin term pregnancies undergoing CD under spinal anesthesia. Following spinal anesthesia, either norepinephrine (6 g/mL) or phenylephrine (75 g/mL) was infused at a rate of 60 mL/h to maintain systolic blood pressure (SBP) near baseline until delivery. Anesthesia monitors were used to collect HR, SBP, systemic vascular resistance (SVR), and CO. Also compared were

umbilical cord blood gases and adverse events. Both phenylephrine and norepinephrine are capable of maintaining maternal blood pressure following spinal anesthesia in twin pregnancies when administered as a prophylactic fixed-rate infusion [35].

The study focuses on prophylactic methoxamine infusion rates of 1 g/kg/min, 2 g/kg/min, 3 g/kg/min, or 4 g/kg/min. No hypotension exists (maternal SBP is 80% of baseline, or 90 mmHg). To prevent spinal-induced hypotension, obstetric patients were given a prophylactic methoxamine infusion at a fixed rate based on body weight, and it was concluded that the higher the dose of methoxamine administered at a fixed rate, the more maternal hemodynamic stability and better neonatal outcomes could be obtained [36].

Patients who received a prophylactic bolus dose of phenylephrine (100 g) and noradrenaline (8 g) immediately after SA, followed by the same bolus dose to maintain SBP at 90% of baseline, were studied for hemodynamic changes and foetal outcomes; This study looked at maternal hemodynamic variables, the Apgar score, and maternal complications. As a result, while providing greater hemodynamic stability, noradrenaline is as effective as prophylactic phenylephrine in preventing spinal hypotension [37].

An ephedrine infusion was compared to lidocaine 75 mg/5% for spinal anaesthesia; after lidocaine administration, the average blood pressure was measured every 1 minute. When the mean arterial blood pressure dropped by at least 20% of the mean baseline blood pressure 0.1 mg/kg ephedrine was injected intravenously. MAP depletion was common following lidocaine spinal anaesthesia. At a dose of 20 mg, ephedrine is effective in reducing the incidence of perioperative hypotension [38]. GOR-C, LOE-3b A vasopressor drug meta-analysis was performed to assess umbilical arterial base excess, foetal umbilical arterial pH, PCO<sub>2</sub>, and the occurrence of maternal outcomes. According to the findings, norepinephrine and metaraminol are less likely than phenylephrine to be associated with poor foetal acid-base status during pregnancy [38,39].

The researchers looked at how a sub-anesthetic ketamine dose (0.5 mg/kg IV bolus) affected post-spinal hypotension. HR and MAP were measured at baseline prior to the intrathecal injection, then every 5, 10, 15, and 20 minutes after the injection, and then every 15 minutes until the procedure was completed. Every 5 minutes until the surgery was completed, the total dose of ephedrine required and the Ramsay sedation score were recorded. Subanesthetic ketamine has been shown to be effective in preventing post-spinal hypotension in CS delivery parturients [40].

Finally, HR and blood pressure were measured in the first 15 minutes after the block was placed in the study on the efficacy of atropine to blunt unopposed vagal activity in the prevention of hypotension. A prophylactic bolus of atropine against unopposed vagal activity provided stable hemodynamic values during caesarean spinal delivery [41].

## Conclusion

Avoiding hypotension during a spinal anesthesia cesarean section is critical for a successful maternal and fetal outcome. To prevent post-spinal hypotension, pharmacological methods, or drug prophylaxis, are commonly used. It is recommended to use a non-pharmacological approach that includes a sequential compression device (SCD) and left uterine placement.

## Recommendations

1. Use non-pharmacological approaches as needed: **Strong recommendation.**
2. Make use of crystalloid co-loading 1000ml R/L or N/S, no need of delaying the surgery and spinal anesthesia for fluid preloading: **Strong recommendation.**
3. Use colloid preloading 500ml, because it is superior in decrease the incidence of hypotension, vasopressor requirement, and nausea/vomiting and adverse neonatal outcomes compared with crystalloid preloading: **Strong recommendation.**
4. Utilize a sub-anesthetic dose of ketamine 0.5mg/kg IV bolus, since it has effective agent in preventing post-spinal hypotension: **Strong recommendation**
5. Apply prophylactic bolus atropine 0.5mg IV bolus, because it provided stable hemodynamic values in cesarean spinal delivery: **Strong recommendation.**

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