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Cross-sectional Study

Comparison of an ephedrine infusion with lidocaine %5 for prevention of hypotension during spinal anesthesia in cesarean section

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ABSTRACT

Background: Spinal anesthesia is the method of choice for cesarean section and in most cases causes hypotension.
Objective: The aim of this study was to treat hypotension by ephedrine in order to prevent maternal and fetal complications, and also to determine the effective amount of ephedrine for reducing arterial hypertension in order to prevent its complications, including cardiac arrhythmias.
Method: This cross-sectional descriptive study was conducted on 131 patients. Mean arterial blood pressure (MAP) of the candidates for cesarean section in the supine position was measured and recorded as mean baseline blood pressure. 75 mg of lidocaine (5%) was used as spinal anesthesia, following which the average blood pressure was measured every 1 min. In the event of a decrease in the mean arterial blood pressure of at least 20% of the mean baseline blood pressure, ephedrine 0.1/mg/kg was injected intravenously and after 1 min of MAP was measured.
Result: The prevalence of hypotension was 89.30%. 25.60% of patients with hypotension had 30–34.99% reduction in MAP compared to baseline MAP. 12% patients had 40% drop in their MAP. 4 min following spinal anesthesia, the incidence of hypotension reduced by 20%. The average dose of ephedrine required to reduce the incidence of hypotension was 20.5 mg.
Conclusion: Reduction in MAP following spinal anesthesia using lidocaine is common. Ephedrine at the dose of 20 mg is effective to reduce the incidence of perioperative hypotension.

1. Introduction

Spinal anesthesia is the preferred method of caesarean section. Spinal anesthesia enables mother to be conscious that reduce the incidence of pulmonary depression and its adverse effects on infant [1]. The quality of spinal anesthesia required is less to reach adequate relaxation of abdominal muscle however, it is associated with physiological consequences and unintended complications [2]. The major disadvantages of this method are difficulty controlling the level of anesthesia, bradycardia, headache, nausea, vomiting, apnea, hypoxia, decreased consciousness, and decreased arterial blood pressure [3]. Cesarean section with spinal anesthesia is commonly known to cause hypotension with the incidence of 30–100% [4]. Hypotension often occurs due to decreased vascular resistance of sympathetic block and dilation of veins and arteries [5]. Sympathetic block rate depends on block level, and generally includes 2–6 dermatomes above anesthesia level [6]. Venous dilatation causes blood retention in the veins, thereby reducing venous return, and receptor stimulation reduction. Chronotropic stretching in the right atrium and large veins causes bradycardia, resulting in decreased cardiac output and hypotension [7]. Decreased venous return is associated with decreased attrition and insufficient dilatation of the right atrium, leading to bradycardia through the Bain Bridge reflex. In these patients, bradycardia occurs in the case of sympathetic block at the level of T1-4 (cardioaccelerator fibers) [8]. On the other hand, with block T1-4, compensatory tachycardia generally does not occur in response to hypotension [9]. Hypotension with systolic blood pressure less than 90 mmHg decreases uterine and placental perfusion, asphyxia, fetal acidosis and neonatal depression [10]. Hypotension also causes nausea, vomiting, decreased blood supply to the brain and consequently decreased level of consciousness, and decreased blood supply to the

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medulla oblongata [11]. In severe hypotension due to reduced pulmonary circulation, oxygen transport from the alveoli is reduced, leading to maternal and fetal hypoxia [12]. Therefore, prevention and treatment of arterial hypotension is essential in cesarean section surgery. Preventive measures might include: administration of intravenous and intravenous crystalloid fluids, lower extremity compression stockings, lower extremity elevation, degrees Trendelenburg status, and vasopressor drugs including ephedrine [13]. In addition to preventive measures, oxygen therapy, left-lateral tilt, and vasopressor drugs such as metaraminol, phenylephrine and ephedrine are used to treat hypotension due to spinal anesthesia. Ephedrine is the selective vasopressor corresponding to its weak alpha-adrenergic and strong beta-adrenergic effects, thus increasing cardiac output and heart rate, increasing cardiac output and blood pressure. For two decades, the researcher considers 10 mg of ephedrine to be effective in the treatment of hypotension caused by spinal anesthesia. Therefore, this study, based on the long-term researcher experience and the above description, uses ephedrine to treat hypotension after spinal anesthesia, to determine the minimum amount of intravenous ephedrine needed to compensate for hypotension in order to prevent unintended effects of ephedrine.

2. Methods

In this cross-sectional descriptive study, the study population included all pregnant women aged 18–35 years who were candidates for cesarean section with spinal anesthesia and developed moderate arterial hypertension after spinal anesthesia.

Inclusion criteria were term pregnant women with normal blood pressure and ASA status I and II, no labor pain and no clinically significant anxiety. Exclusion criteria were history of chronic hypertension, preeclampsia, eclampsia, antihypertensive medication, diabetes mellitus, labor pain, clinically significant anxiety and general spinal anesthesia contraindications (aspirin use and anticoagulants during the seven days before surgery), spinal needle insertion or infection, lumbar disc herniation, history of lumbar surgery, spinal deformity, chronic headaches and migraines, and history of lidocaine allergy.

Patients were no administered any medication at the time of arrival or before the surgery. Upon entering the operation room, 18-gauge IV catheter was interested and 500 mL of Ringer solution was infused. All vital signs were continuously monitored. Spinal/epidural anesthesia was performed by exercised anesthesiologist using 25-gauge epidural Tuohy needle at the L 3–4 or L 4–5 intervertebral space with patients in left lateral or sitting position. Hyperbaric lidocaine 5% (75 mg) was given as spinal anesthesia. Hemodynamic parameters were measured every 1 min after spinal anesthesia. After anesthesia, arterial pressure was maintained using IV 10 mg/ml ephedrine (ephedrine group), perioperatively. The success of anesthesia was measured using pinprick and the surgery was imitated. Following the drop of MAP below 90% of baseline, ephedrine was administered.

2.1. Sample size and calculation method

The minimum sample size was 123 samples based on the ephedrine mean (±85% ±85) and an accuracy of 0.15 (d = 0.15) with 95% confidence interval (a = 5%).

2.2. Data collection tools

Mean Arterial Pressure (MAP) was measured using automated device and was recorded in mmHg in the checklist. The mean arterial hypotension, as well as the amount of ephedrine used, and its effects were also frequently recorded in the checklist. The data collected in the questionnaire were entered into SPSS software and described by descriptive statistics using tables and graphs and by calculating number, frequency and mean within 95% confidence interval. Comparisons were made using t-tests, chi-square and one-way analysis of variance or their parametric equations.

This study was approved by the Research Ethics Board of Alborz University of Medical Sciences.

The methods were reported in accordance with STROCC 2021 guideline [14].

Unique identifying number is: researchregistry7339.

3. Results

A total of 131 patients undergoing cesarean section were enrolled. Results showed that mean baseline mean arterial blood pressure (MAP) was 96.13 mmHg before spinal anesthesia (Table 1). The incidence of reduction in MAP was 89.30% (Table 2).

25.60% of people were presented with 30–34.99% reduction in MAP compared to baseline levels whereas 12% patients had 40% reduction in MAP relative to baseline levels (Table 3).

Considering that the time to complete the sensory block in spinal anesthesia with lidocaine 5% is about 1 min, during this period 1.53% of patients experienced 20–24.99% decrease and 25–29.99% decrease in baseline MAP. While 3.80% of patients had 30%–34.99% decrease in baseline MAP. In 17.68% of patients there was a decrease in baseline MAP of 40–44.99.

Fig. 1 shows the number of cases of at least 20% decrease in baseline MAP at different times. The number of cases decreased by 4 min after spinal anesthesia, with 43 patients (32.82%) at the end of 4 min having at least 20% decrease in baseline MAP. 28 min after spinal anesthesia 20% decrease in MAP was recorded in 6 cases (4.58%).

The total dose of injectable ephedrine in each patient was 20.50 mg and 7.64 mg per time (Table −1). The minimum ephedrine injections were 5 mg and maximum were 12 mg. However, the minimum total ephedrine injections per patient were 5 mg and maximum were 161 mg (Table −1). Arterial hypotension in 26.70% of cases was treated with less than 10 mg of ephedrine, whereas in 18.30% patients at least 30 mg was required. In 1.5% patient, mean arterial hypertension was treated with a total of at least 60 mg (Table 4).

Most patients (27.50%) received only one dose of ephedrine and 26% of them received ephedrine twice, while 10.10% patients required at least five ephedrine injections (Table 5).

4. Discussion

Spinal anesthesia is the method of choice for cesarean section however is commonly associated with hypertension. Ephedrine is the vasopressor drug of choice, however its effects can be similar to phenylephrine in the treatment of hypotension after spinal anesthesia in cesarean section [15]. Our study evaluated the use of ephedrine with 5% lidocaine for the prevention of hypotension among cesarean section patients at our center. A number of studies have indicated that intravenous ephedrine is effective for the prevention of hypotension [16]. The results of this study showed that the incidence of hpyotension after cesarean section with lidocaine was 89.30%. Wanna Somboonviboon et al. reported that reduction in MAP declines occurred more than 30%

Table 1
Frequency of mean arterial hypertension and ephedrine.

Index	At least	Maximum	Middle	Average	Standard deviation
Arterial hypertension before spinal anesthesia (mmHg)	78	110	98	96/13	7/30
The amount of ephedrine injected at a time (mg)	5	12	7/50	7/64	1/28
Total Ephedrine injections per patient (mg)	5	161	17	20/50	17/90

Table 2
Prevalence of mean arterial hypertension.

group	Number	Percentage	The cumulative percentage
No decrease in mean arterial blood pressure	14	10/70	10/70
Lowered arterial mean blood pressure	117	89/30	100

Table 3
Frequency of the highest mean arterial hypertension.

Percentage drop MAP	Frequency	Abundance	The cumulative percentage
20-24/99	19/70	23	19/70
25-29/99	22/20	26	41/90
30-34/99	25/60	30	67/50
35-39/99	20/50	24	88
>40	12	14	100

relative to baseline MAP in majority of the patients baseline MAP [17], whereas in the study by Farnoush et al., the prevalence of severe hypotension was 42% [18], indicating that prevention of hypotension is important for better perioperative and postoperative outcomes. Iclal Ozdemir and colleagues treated hypotension by intravenous injection of 0.5 mg/kg ephedrine [19]. Mitra Jabalameli et al. reported that ephedrine and ringer lactate injections reduces the prevalence of hypotension to 40% [20]. In a study by Eroglo F. et al., oral ephedrine declined the incidence of hypotension to half [21]. In the present study, reduction in MAP was seen until 4 min of the induction of spinal anesthesia, following which the incidence of hypotension reduced. It is likely to be related to complete sympathetic gradual blockage and subsequent rapid bleeding from surgery. In most studies, the recommended intravenous ephedrine dose was about 30 mg, whereas in the present study the average dose was 20.50 mg per surgery. Miller's principles of anesthesia suggest that ephedrine for post-spinal anesthesia hypotension should be 5–10 mg in cesarean surgery and an average of 7.5 mg, which is parallel to our findings [22,23].

Our study presents limited data (not including other parameters such as side effects) and does not included control or comparative groups. Furthermore, the data presented here is descriptive only.

5. Conclusion

Our analysis showed that 5% of lidocaine with ephedrine can reduce the incidence of hypotension among patients undergoing cesarean section. However further studies including more analysis and with 5% lidocaine and 0.5% bupivacaine are recommended.

Availability of data and material

Data sharing not applicable to this article as no datasets were generated or analyzed during the current study.

Consent to participate

From the under 16 years old was given by a parent or legal guardian.

Consent for publication

Not applicable.

Table 4
Ephedrine injections in mean arterial hypertension.

Group	Ephedrine Injection (mg)	Frequency	Abundance	The cumulative percentage
0	0	14	10/70	10/70
1	<10	35	26/70	37/40
2	10- 19/99	34	26/00	63/40
3	20- 29/99	24	18/30	81/70
4	30- 39/99	16	12/20	93/90
5	40- 49/99	4	3/10	96/90
6	50- 59/99	2	1/50	98/50
7	= or >60	2	1/50	100

Table 5
Frequency of ephedrine injections.

Frequency of injection of ephedrine	Frequency of patients	Frequency	Cumulative abundance percentage
0	14	10/70	10/70
1	36	27/50	38/20
2	34	26/00	64/10
3	19	14/50	78/60
4	15	11/50	90/10
5	8	6/10	96/20
6	1	0/80	96/90
7	1	0/08	97/70
8	0	0	97/70
9	1	0/80	98/50
10	0	0	95/50
11	1	0/80	99/20
23	1	0/80	100

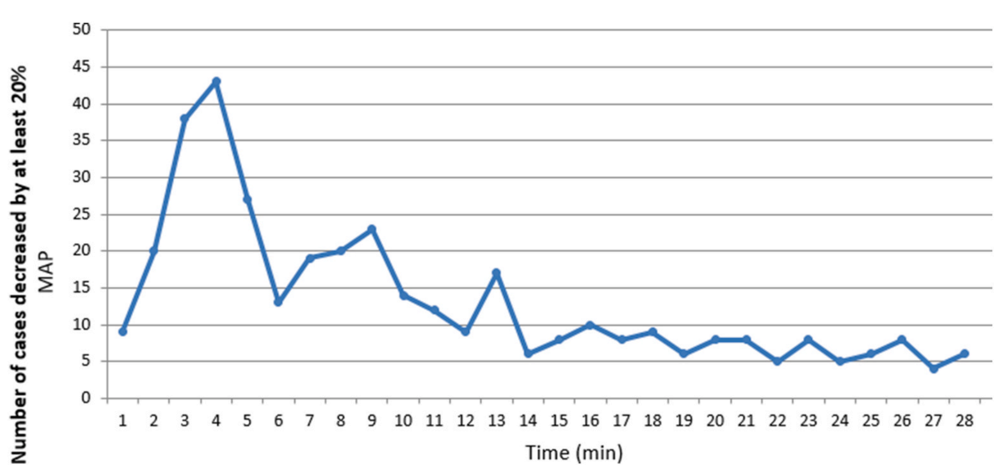

Fig. 1. Hypertension at different times.

Ethical approval

All procedures performed in this study involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

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No funding was secured for this study.

Author contribution

Dr. Seyyed mohsen pouryaghobi Dr. Banafsheh Mashak: conceptualized and designed the study, drafted the initial manuscript, and reviewed and revised the manuscript. Dr. Kourosh Kabir and Dr. Leila Hajimaghsoudi: Designed the data collection instruments, collected data, carried out the initial analyses, and reviewed and revised the manuscript. Dr. Mojtaba Ahmadinejad: Coordinated and supervised data collection, and critically reviewed the manuscript for important intellectual content.

Registration of research studies

Name of the registry: ResearchRegistry
Unique Identifying number or registration ID: 7339
Hyperlink to the registration (must be publicly accessible): https://www.researchregistry.com/browse-the-registry#home/registrationdetails/61869572249fe9001f474617/

Guarantor

Seyyed mohsen pouryaghobi.

Consent

Not applicable.

Provenance and peer review

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Declaration of competing interest

The authors deny any conflict of interest in any terms or by any means during the study.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.amsu.2021.103136.

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