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# A comparative study between pre-emptive ephedrine and mephentermine administered intramuscularly to prevent hypotension following spinal anaesthesia in infraumbilical surgeries

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**Conflicts of Interest:** Nil

## Abstract

**Background:** Spinal anesthesia's the commonly used type of regional anaesthesia for infra-umbilical surgeries. The drawback of subarachnoid block are the complications associated with it such as hypotension, bradycardia, nausea and vomiting, post-dural puncture headache (PDPH), caudaequina syndrome, transient neurological syndrome. Hypotension is the common side effect encountered in our daily practice and still remains a hemodynamic challenge. Ephedrine, Phenylenephrine, Mephentermine are commonly used vasopressors to treat hypotension. This study has been designed to compare Ephedrine and Mephentermine administered preemptively through intra-muscular route to prevent hypotension following spinal anaesthesia.

**Aims & Objectives:** To determine and compare the effectiveness of Ephedrine & Mephentermine when used pre-emptively through intra-muscular route to prevent hypotension following spinal anaesthesia.

**Materials & Methods:** A comparative prospective randomized clinical study included 60 patients belonging to ASA I to ASA II aged between 18-60 years posted for elective infra-umbilical surgeries(lower abdominal and lower limb surgeries) requiring spinal anaesthesia from February 2021 to September 2022 at Kempegowda Institute of Medical Sciences. After routine pre-operative

evaluation, written informed consent was obtained and patients were randomized into two groups using computer generated randomization and received one of the following:

Group E – 30 patients received Inj. Ephedrine 30mg intramuscularly 10 minutes prior spinal anaesthesia (0.5%bupivacaine 3.5ml)

GroupM–30patients receivedInj.Mephentermine30mg intramuscularly 10 minutes prior spinal anaesthesia (0.5%bupivacaine 3.5ml).

The following were measured: heart rate, SBP, DBP, MAP, SpO2 before administering vasopressor and immediately after spinal anaesthesia when patient is put to supine position. Intraoperatively at regular time intervals.

**Statistics & Analysis:** Statistical Package for Social Sciences [SPSS] for Windows Version 22.0. Data collected in MS Excel software, Mann Whitney test, Chi Square test, Independent student T test for comparing data was used.

Results: Both the groups were compared demographically. The mean age in Group E was 31years, Group M- 30.2years. Males comprised of 53.3% and females 46.7% in Group E. Group M comprised of 66.7% males, 33.3% females. Mean height Group E 156.9cm, Group M- 158.07cm. - There was no statistical significance observed in anthropometric data. SBP, DBP, MAP were higher in Group M compared to Group E- statistically significant (MAP- $p<0.001$). Heart rate was higher in Group M than Group E but statistically significant after 1hour 25minutes post spinal anaesthesia. Both the groups were observed for complications such as nausea and vomiting, shivering, headache and were found to be statistically insignificant.

CONCLUSION: We conclude that pre-emptive Inj. MEPHENTERMINE 30mg when compared to Inj. EPHEDRINE 30mg is better and more effective in terms of preventing intraoperative hypotension following spinal anaesthesia for infra-umbilical surgeries and provides stable hemodynamic parameters when administered intramuscularly.

**Keywords:** Hypotension, Spinal Anaesthesia, Ephedrine, Mephentermine, Pre-Emptive.

**Introduction**

Spinal anaesthesia or Sub-arachnoid block is the commonly used type of regional anaesthesia for infra-umbilical surgeries. Hypotension (is defined as 20% below baseline or reduction in mean arterial blood pressure >30%)is the common side effect encountered in our daily practice with incidence of 16%-33%. It still remains a hemodynamic challenge and cause of concern to the anesthesiologists despite numerous attempts to restrict. Hypotension is treated with infusion of crystalloids/colloids (as pre-loading and co-loading), leg elevation with compression bandages, IV/IM Vasopressors. Recent guidelines have placed more emphasis on avoiding hypotension during neuraxial block. Ephedrine, Phenylenephrine, Mephentermine are commonly used vasopressors to treat hypotension. Ephedrine- is an indirect acting synthetic sympathomimetic- stimulating both alpha- and beta-adrenergic receptors. Pharmacologic effects are partly due to direct stimulation of adrenergic receptors and partly due to release of endogenous nor-epinephrine (indirect). Mephentermine is a synthetic Non-catecholamine sympathomimetic indirectly stimulating beta adrenergic receptors and to a lesser extent alpha receptors-by releasing nor-adrenaline. There are several studies comparing intravenous use of vasopressors to

treat hypotension following spinal anaesthesia in caesarean sections. This study has been designed to compare Ephedrine and Mephentermine administered pre-emptively through intramuscular route to prevent hypotension following spinal anaesthesia.

**Materials and Methods**

This prospective, randomized clinical study was carried out at the Kempegowda Institute of Medical Sciences and Research Centre, Bangalore, Karnataka, India, between February 2021 and September 2022. The study was approved by the institutional ethics committee on 20 January 2021 and was carried out per the Declaration of Helsinki**.** All participants in the trial gave their written informed consent before participating in the study.

**Inclusion Criteria**

- Patient willing to give consent
- Age (18-60) years
- Either gender
- ASA I and ASA II
- Patients posted for elective infra-umbilical surgeries (lower abdominal and lower limb surgeries) requiring spinal anaesthesia.

**Exclusion Criteria**

- Hypertensive patients BP >140/100mmHg.
- Raised intracranial pressure
- Hypersensitivity to local anaesthetic agents
- Any contraindications for spinal anaesthesia

**SAMPLE SIZE:** The sample size was estimated using the below formula

$$N = \frac{\left(Z_{\alpha/2}\sqrt{2p(1-p)} + Z_{1-\beta}\sqrt{p_1(1-p_1)p_2(1-p_2)}\right)^2}{(p_1 - p_2)^2}$$

Where p1 and p2 are the proportion of event of interest (outcome) for group I and group II, and $p$ is $p = \frac{(p_1 + p_2)}{2}$,

$Z_{\alpha/2}$ is normal deviate at a level of significance and $Z_{1-\beta}$ is the normal deviate at 1-β% power with β% of type II error, normally type II error is considered 20% or less.

Total Sample Size: two groups of 30 each

60 patients satisfying the inclusion and the exclusion criteria were included in the study. Each patient was visited pre-operatively, the procedure was explained and a written informed consent was taken. All routine investigations required for preoperative evaluation and the proposed surgery were done. Patients were allowed for a period of absolute fasting of at least 8 hours premedicated with T. Pantoprazole 40mg at night 10PM and 6AM along with T. Alprazolam 0.5mg.

On arrival in the operating room, patients were randomized using a computer- generated randomization chart.

Group E – 30 patients received Inj. Ephedrine 30mg I.M

Group M – 30 patients received Inj. Mephentermine 30mg I.M

Baseline readings of Heart rate, Systolic blood pressure, Diastolic blood pressure, mean arterial pressure, peripheral oxygen saturation were recorded. Blood pressure was monitored using non-invasive blood pressure monitors.

Study drug was administered 10minutes prior to Spinal anaesthesia through intramuscular route given to non-dominant arm in the OT, along with securing IV access with 18G needle and was preloaded with Ringer lactate or Normal saline 15ml/kg

Under aseptic precautions, spinal anaesthesia was given in midline approach, with patient either in sitting or lateral position at L3-L4/L4-L5 intervertebral space using 25/26G Quincke Babcock's spinal needle. Drug 0.5% hyperbaric Bupivacaine 3.5ml was injected after free flow of CSF (cerebrospinal fluid) to all patients.

Sensory and motor blockade level was assessed using loss of pin prick & Modified Bromage scale.

The time of spinal anaesthesia was taken as zero minute and continuous cardio-respiratory monitoring was done. Heart rate, SBP, DBP, MAP, SpO2 were measured immediately after spinal anaesthesia when patient is put to supine position, then at 2minutes interval for first 15 minutes, then at 10minutes interval for next 40 minutes, and at 15minutes interval till the end of surgery.(Hypotension is defined as 20% below baseline or as a reduction in mean arterial blood pressure >30%.)If hypotension occurred, IV-Fluids & Inj. Ephedrine 6mg IV was administered, if bradycardia occurred then Inj. Atropine 0.6mg IV was administered. Simultaneously, if any other side effects of SAB occur such as nausea and vomiting, shivering, headache were noted and managed accordingly.

**Objective:** To determine and compare the effectiveness of Ephedrine and Mephentermine administered through intramuscular route when used pre-emptively to prevent hypotension following spinal anaesthesia.

**Statistical Analysis& Results**

All collected data were entered into computer using MS Excel software.Statistical package for social sciences [SPSS] for window version 22.0, released2013 Armonk,NY:IBM Corp, is used to perform statistical analyses.

**Descriptive Statistics:** Descriptive analysis of all explanatory and outcome parameters is done using frequency and proportions for categorical variables, whereas in mean and SD for continuous variable.

**Inferential Statistics:** Mann Whitney Test- used to compare mean age between 2 groups, Chi square test- compare gender distribution, complications between 2 groups.

Independent student't' test- to compare the mean height and weight, SBP, DBP, MAP, HR, SpO2 between 2 groups.

The level of significance was set at P<0.05

**Demographic Data**

**Age and gender distribution among 2 groups**

| Variable | Category | Group E | | Group M | | p-value |
|---|---|---|---|---|---|---|
| | | Mean | SD | Mean | SD | |
| Age | Mean | 31.00 | 6.10 | 30.27 | 8.64 | 0.31[a] |
| | Range | 21 - 50 | | 19 - 52 | | |
| | | n | % | n | % | |
| Gender | Males | 16 | 53.3% | 20 | 66.7% | 0.29[b] |
| | Females | 14 | 46.7% | 10 | 33.3% | |

**Note:** a. Mann Whitney Test & b. Chi Square Test

**Comparison of mean Height (in cm) & Weight (in kg) between 2 groups using Independent Student t Test**

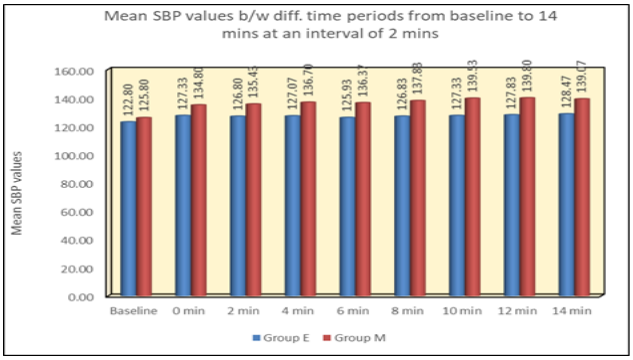
| Parameter | Groups | N | Mean | SD | Mean Diff | p-value |
|---|---|---|---|---|---|---|
| Height | Group E | 30 | 156.90 | 4.03 | -1.17 | 0.23 |
| | Group M | 30 | 158.07 | 4.40 | | |
| Weight | Group E | 30 | 64.37 | 7.28 | 2.04 | 0.22 |
| | Group M | 30 | 62.33 | 5.16 | | |

Mean age in Group E was 31years, Group M- 30.2years. Males comprised of 53.3% and females 46.7% in Group E. Group M comprised of 66.7% males, 33.3% females. Mean height Group E 156.9cm, Group M- 158.07cm. Difference in none of the above anthropometric variables of patients of the Group E and Group M was found to be significant.

**Systolic Blood Pressure:** SBP was recorded at 2 minutes interval for the first 15 minutes and it was observed that there was an increase in SBP from baseline recording of patients and also at subsequent time intervals in Mephentermine group compared Ephedrine group.

At zero minute (corresponds to spinal anaesthesia, which is 10 minutes after study drug administration)-

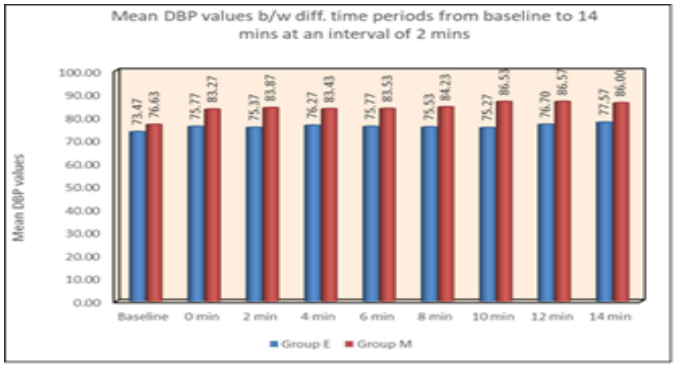
Mean SBP was significantly higher in Mephentermine group compared to Ephedrine group which was statistically significant (p- 0.02) and subsequently at all time intervals measured.




SBP was recorded at 10minutes interval for the next 40 minutes and was found that the mean SBP and SD in Mephentermine group higher when compared to Ephedrine group which was statistically significant (p<0.001). SBP was recorded at 15minutes interval till end of surgery and was found to be statistically significant in Mephentermine group when compared to Ephedrine group with p<0.001.

**Diastolic Blood Pressure**: DBP was recorded at 2 minutes interval for the first 15 minutes and it was observed that there was increase in DBP from baseline recording of patients and also at subsequent time intervals in Mephentermine group compared to Ephedrine group.

At zero minute- mean DBP was significantly higher in Mephentermine group compared to Ephedrine group which was statistically significant (p<0.001) and subsequently at all time intervals measured including at 10 minutes interval for the next 40 minutes and at 15 minutes interval till end of surgery.




## Mean Arterial Blood Pressure

**Comparison of mean MAP values b/w diff. time periods from baseline to 14 mins at an interval of 2 mins using Independent Student t Test**

| Time | Groups | N | Mean | SD | Mean Diff | p-value |
|---|---|---|---|---|---|---|
| Baseline | Group E | 30 | 90.67 | 8.47 | -2.33 | 0.25 |
| | Group M | 30 | 93.00 | 7.13 | | |
| 0 min | Group E | 30 | 93.47 | 8.83 | -6.80 | 0.004* |
| | Group M | 30 | 100.27 | 8.53 | | |
| 2 min | Group E | 30 | 93.00 | 8.57 | -7.93 | 0.001* |
| | Group M | 30 | 100.93 | 9.21 | | |
| 4 min | Group E | 30 | 93.60 | 7.71 | -7.33 | 0.001* |
| | Group M | 30 | 100.93 | 9.23 | | |
| 6 min | Group E | 30 | 92.87 | 7.39 | -8.13 | <0.001* |
| | Group M | 30 | 101.00 | 9.25 | | |
| 8 min | Group E | 30 | 92.80 | 7.73 | -9.23 | <0.001* |
| | Group M | 30 | 102.03 | 9.71 | | |
| 10 min | Group E | 30 | 92.63 | 8.61 | -11.57 | <0.001* |
| | Group M | 30 | 104.20 | 10.45 | | |
| 12 min | Group E | 30 | 93.50 | 8.41 | -11.47 | <0.001* |
| | Group M | 30 | 104.97 | 12.18 | | |
| 14 min | Group E | 30 | 95.03 | 6.48 | -8.50 | <0.001* |
| | Group M | 30 | 103.53 | 12.01 | | |

* - Statistically Significant

| Comparison of mean MAP values b/w diff. time periods from 10 to 40 mins at an interval of 10 mins using Independent Student t Test | | | | | | |
|---|---|---|---|---|---|---|
| Time | Groups | N | Mean | SD | Mean Diff | p-value |
| 10 min | Group E | 30 | 94.63 | 6.61 | -9.54 | <0.001* |
| | Group M | 30 | 104.17 | 9.64 | | |
| 20 min | Group E | 30 | 94.13 | 6.10 | -9.64 | <0.001* |
| | Group M | 30 | 103.77 | 9.48 | | |
| 30 min | Group E | 30 | 94.27 | 6.25 | -10.56 | <0.001* |
| | Group M | 30 | 104.83 | 8.62 | | |
| 40 min | Group E | 30 | 95.43 | 6.16 | -8.40 | <0.001* |
| | Group M | 30 | 103.83 | 8.12 | | |

* - Statistically Significant

| Comparison of mean MAP values b/w diff. time periods from 15 to 75 mins at an interval of 15 mins using Independent Student t Test | | | | | | |
|---|---|---|---|---|---|---|
| Time | Groups | N | Mean | SD | Mean Diff | p-value |
| 15 min | Group E | 30 | 94.70 | 6.18 | -7.87 | <0.001* |
| | Group M | 30 | 102.57 | 7.20 | | |
| 30 min | Group E | 30 | 95.50 | 5.22 | -6.73 | <0.001* |
| | Group M | 30 | 102.23 | 6.08 | | |
| 45 min | Group E | 30 | 94.97 | 5.79 | -7.17 | <0.001* |
| | Group M | 28 | 102.14 | 6.43 | | |
| 60 min | Group E | 27 | 94.15 | 8.08 | -7.85 | <0.001* |
| | Group M | 28 | 102.00 | 5.46 | | |
| 75 min | Group E | 17 | 94.41 | 5.83 | -8.26 | <0.001* |
| | Group M | 27 | 102.67 | 5.78 | | |

* - Statistically Significant

The mean MAP for Mephentermine group was found to be higher than Ephedrine group, and was found to be statistically significant at all time intervals starting from zero minute till end of surgery.

**Heart Rate**

Heart rate was recorded at various time intervals. The mean heart rate of patients in Mephentermine group was found to be higher than mean heart rate of patients in Ephedrine group. However, it was found to be statistically insignificant up to 70 minutes following SAB.

At 1hr25min following SAB, HR was higher in Mephentermine group when compared to Ephedrine group which was statistically significant (p-0.03)

At 1hr40min following SAB, HR was highest in Mephentermine group compared to Ephedrine group which was statistically significant (p-0.001).

$SPO_2$: The mean SpO2 between Ephedrine group and Mephentermine group was found to be statistically insignificant at all time intervals.

**Complications**

| Comparison of Complications between 2 groups using Chi Square Test | | | | | | |
|---|---|---|---|---|---|---|
| Variable | Category | Group E | | Group M | | p-value |
| | | n | % | n | % | |
| Nausea & Vomiting | No | 30 | 100.0% | 30 | 100.0% | .. |
| | Yes | 0 | 0.0% | 0 | 0.0% | |
| Shivering | No | 26 | 86.7% | 29 | 96.7% | 0.16 |
| | Yes | 4 | 13.3% | 1 | 3.3% | |
| Headache | No | 27 | 90.0% | 24 | 80.0% | 0.28 |
| | Yes | 3 | 10.0% | 6 | 20.0% | |

Comparing the above complications in both Mephentermine group and Ephedrine group, it was found to be statistically insignificant.

**Rescue Drug Administration**

| Distribution of Rescue Drug Administration between 2 groups using Chi square Test | | | | | | |
|---|---|---|---|---|---|---|
| Variable | Category | Group E | | Group M | | p-value |
| | | n | % | n | % | |
| Rescue Drug | Yes | 1 | 3.3% | 0 | 0.0% | 0.31 |
| | No | 29 | 96.7% | 30 | 100.0% | |

Only one patient was given a rescue drug of Ephedrine 6mg IV at 10 min following SAB. This apart, none of the other patients in either Ephedrine group or Mephentermine group had received the rescue drug.

**Discussion**

Neuraxial anaesthesia is one of the most common regional anaesthesia techniques practiced and is the preferred choice for infra-umbilical surgeries. Hypotension following sub-arachnoid block is one the common complications encountered after administering spinal anaesthesia. Hypotension following sympathetic blockade needs to be treated aggressively so that it can reduce patient discomfort, nausea and vomiting, dizziness and further complications due to hypotension

including risk of cardiac arrest and needs to be prevented in patients receiving spinal anaesthesia, since hypotension can be a major limiting factor for a more widespread use of sub-arachnoid block. First line in the prevention of hypotension following spinal anaesthesia is pre-loading with crystalloids/colloids. Other methods are being leg elevation with compression bandages and stockings. Pharmacologically, vasopressors remain mainstay for prevention and treatment for hypotension following SAB. The commonly used drugs in this group are Phenylephrine, Ephedrine, Mephentermine. They can be administered through intravenous and intramuscular routes and comparing the efficacy of these three vasopressors have been majorly studied in patients undergoing caesarean sections through intravenous route. Ephedrine and Mephentermine are commonly used vasopressors in Asian countries due to its cost effectiveness. Vasopressor through intramuscular route was in practice but the literature regarding comparing the effectiveness of two vasopressors through intramuscular route is less studied in patients undergoing infra-umbilical surgeries. In our study entitled "A comparative study between pre-emptive ephedrine and mephentermine administered intramuscularly to prevent hypotension following spinal anaesthesia in infraumbilical surgeries", we are comparing the effectiveness of Ephedrine and Mephentermine when administered through intramuscular route pre-emptively in patients undergoing infra-umbilical surgeries.

The pharmacokinetic studies have suggested that the peak effect of vasopressors is (5-15) minutes after intramuscular administration. However, the absorption through intramuscular route cannot be predicted.

Hence, in our study we have administered the study vasopressor 10 minutes prior to spinal anaesthesia. Considering the above knowledge, our study was designed as prospective randomized study.

In our study, patients posted for elective infra-umbilical surgeries belonging to ASA I and ASA II of either gender in age group (18-60) years without hypertension were included after matching inclusion and exclusion criteria.

The study groups were divided into two groups- Group M and Group E, where they received the study drugs Inj. Mephentermine 30mg I.M and Inj. Ephedrine 30mg I.M respectively. The study vasopressor was administered 10 minutes prior to spinal anaesthesia- where the local anaesthetic used was 0.5% hyperbaric bupivacaine 3.5ml in all study patients. The following parameters were recorded. Baseline SBP, DBP, MAP, HR, SPO2 and subsequently recorded at 2minutes interval for the first 15 minutes, 10 minutes interval for the next 40 minutes and 15 minutes interval till the end of surgery.

**Demographic Data**

The research on vasopressors has been going on since decades. However, the study of administering vasopressor pre-emptively in either gender is less. In our study, patients belonging in the age group (19-52) years in both groups included with mean age in Group E-31years, Group M-30years. In Group E 53.3% were males, 46.7% females; in Group M- 66.7% males, 33.3% were females. The difference in the age and gender were statistically insignificant. The mean height in Group E-156.90cms, Group M-158.07cms. it is inclusive of either gender. The mean weight in Group E-64.37kg, Group M-62.33kg. The difference in both height and weight was found to be statistically insignificant. In the study conducted by **Kaur et al**, entitled 'comparative study of three vasopressors for maintenance of blood pressure during spinal anaesthesia in lower abdominal surgeries'

on 90 patients of either gender in the aged 20-50 years with ASA status I and II. The mean age, mean height, mean weight, percentage of males and females in Mephentermine, Phenylephrine and Ephedrine groups were observed and it was found that there was no statistically significant difference found in the above anthropometric variables among the three groups- which is similar to our study result.

In the study conducted by **Satia et al,** entitled 'comparison of Phenylephrine, Ephedrine and Mephentermine for control of hypotension following spinal anaesthesia for infra-umbilical surgeries', included 90 patients belonging to ASA I and ASA II of which 44% were males, 55% were females and was found to be statistically insignificant.

In the study conducted by **AS Yadav et al,** entitled 'comparative evaluation of pre-operative IM Ephedrine and Mephentermine for reduction of spinal anaesthesia induced hypotension during LSCS', included 90 term pregnant patients in the age group 20-35 years. The mean age, mean height, mean weight in Mephentermine and Ephedrine groups were observed and was found to be statistically insignificant. The above studies are similar to our study data.

**Time Interval of Study Vasopressor Administration**

In our study, we have administered the study vasopressor 10 minutes prior to Spinal anaesthesia. This is in accordance with the time taken for peak onset of action of vasopressors when administered through intramuscular route is 5-15 minutes.

In the study conducted by **Nagaraj Sharanabasappa et al,** studied the efficacy of Ephedrine30mg IM in reducing the incidence of hypotension when given 10 minutes prior SAB. They proved that this group had better haemodynamic stability during intra-operative period without side effects. The time interval in our study co-relates with our study.

In the study by **AS Yadav et al**, compared the efficacy of Ephedrine 30mg IM and Mephentermine 30mg IM administered 5 minutes prior SAB concluded that Ephedrine 30mg better than Mephentermine 30mg. In the study conducted by Satia et al, compared three vasopressors for controlling hypotension following spinal anaesthesia by administering Ephedrine 10mg, Mephentermine 10mg, Phenylephrine 100mcg as intravenous bolus when hypotension was detected.

In the study conducted by **Kaur et al**, comparing three vasopressors for maintenance of blood pressure in lower abdominal surgeries demonstrated administration of Phenylephrine 100mcg, Ephedrine 6mg, and Mephentermine 6mg as intravenous bolus when hypotension was detected following SAB.

**Systolic Blood Pressure:** (SBP) in our study at baseline recordings among both groups, difference in haemodynamic variables of the above two groups were found to be similar.

In Group M- Mean SBP was found to be higher at all time intervals starting from spinal anaesthesia administration (zero minute) till the end of surgery when compared to Group E which was statistically significant at 8 minutes ($p<0.001$).

**Diastolic Blood Pressure (DBP):** It was observed to be increased when compared with baseline recordings in both the Group E and Group M. Further, the mean DBP of patients belonging to GroupM was more than Group E. The difference between the groups was statistically significant (p- <0.001) from the time of administration of spinal anaesthesia (zero minute) till the end of surgery at all time intervals recorded.

**Mean Arterial Pressure:** (MAP) The mean MAP at basal recordings was statistically insignificant. The subsequent mean MAP was statistically significant (p – 0.004) in the patients receiving Mephentermine30mg IM compared to patients receiving Ephedrine 30mg IM at the time of spinal anaesthesia (zero minute) i.e., 10minutes after administering study vasopressor.

In our study groups, there was no incidence of hypotension observed in Group M when compared to Group E except in one patient in where the rescue vasopressor Inj. Ephedrine 6mg IV was administered only once at 10 minutes interval in first 15 minutes which was statistically insignificant. Among the studies comparing vasopressors administered intramuscularly, MAP was the main observation recorded than SBP, DBP. In our study, the mean SBP, DBP, MAP was significantly high in Mephentermine group when compared to Ephedrine group.

In 2020, **Nagaraj Sharanabasappa et al,** in their study entitled 'efficacy of IM Ephedrine30mg in reducing hypotension after SAB', concluded that hypotension was less in group who received Ephedrine 30mgIM 10minutes prior SAB with pre-loading 15ml/kg comparing with control group. The administration of Ephedrine 30mg IM 10 minutes prior concurs with our study observations. Also, the MAP was found to be highly significant at 8minutes after SAB, and 18minutes from time of administering vasopressor intramuscularly thereby concurring with our study results with respect to systolic blood pressure.

In 2016, **AS Yadav et al** in their study entitled 'comparative evaluation of pre-operative IM Ephedrine and Mephentermine for reduction of spinal anaesthesia induced hypotension during LSCS', concluded that after injecting study vasopressor Mephentermine30mg and Ephedrine 30mg intramuscularly 5minutes prior to SAB there was increase in SBP and was significant at 5minutes. DBP was also found to be increased compared with control group, but was statistically insignificant. The incidence of hypotension was 23% in Mephentermine group, 26% in Ephedrine group when compared to 60% in control group. The findings are similar to our study.

In 2018 **Kaur et al,** in their study comparing three vasopressors when administered intravenously found that at baseline haemodynamic variables of mephentermine, Phenylephrine, ephedrine were statistically insignificant. Proportion of patients with only single hypotensive event was found to be higher in Ephedrine group (100%), Mephentermine group (97.67%) as compared to Phenylephrine group (66.67%). Difference in the number of hypotensive events among the groups was found to be statistically significant (p-0.001).

The mean MAP in the above three groups was found to be higher in Phenyleprine group when compared to Mephentermine and Ephedrine group following first intravenous administration which was statistically significant ($p<0.001$). Both Phenyleprine and Mephentermine groups required second interventional dose administered intravenously but the mean MAP in Phenyleprine group was higher compared to Mephentermine group which was statistically significant ($p<0.001$). However, patients in ephedrine group did not require the second interventional dose following first IV administration. The above study results were not similar with our study findings.

In 2020**, Satia et al**, compared three vasopressors for controlling hypotension following spinal anaesthesia found that MAP in Mephentermine group increased to

90mmHg and 13% of patients developed hypertension following Mephentermine 10mg IV administration. In Ephedrine group, hypotension persisted 30% of patients after Ephedrine 10mg IV administration. The MAP in Ephedrine group was 65 mmHg after 2 minutes of IV bolus administration. Hence, requiring second bolus dose. However, in Phenyleprine group the MAP increased from 55mmHg to 80mmHg within a minute after bolus administration of Phenylephrine 100mcg IV. The findings of the above study are not comparable with our study.

**Heart Rate (HR):** In our study, heart rate was recorded at regular time intervals. It was observed that there was increase in HR in group receiving Mephentermine and Ephedrine compared with basal recordings. The mean HR of patients in Mephentermine group was higher than patients in Ephedrine group. However, it was not statistically significant in the 1st hour following SAB, but was found to be statistically significant in the 2nd hour following SAB (p-0.03). Bradycardia was not observed in any patient in our study.

**Nagaraj Sharanabasappa et al,** conducted study on patients undergoing elective infra-umbilical surgeries (lower abdominal and lower limb surgeries) under SAB showed that the group which received Ephedrine 30mg IM 10minutes prior SAB showed increase in heart rate when compared to basal heart rate and control group which showed to decrease more. Thus, co-relating with our study findings.

**AS Yadav et al,** conducted study on parturients which showed increase in heart rate in both groups Mephentermine 30mg IM and Ephedrine 30mg IM administered 5minutes prior SAB. However, it was not statistically significant. This study result is not comparable with our study.

In the study by **Satia et al**, comparing three vasopressors when administered through intravenous route following spinal anaesthesia induced hypotension found that there was increase in heart rate in 26% of patients who received Ephedrine 10mg IV, 10% in Mephentermine 10mg IV. However, the patients who received Phenyleprine100mcg IV showed bradycardia in 26% of patients which was corrected by Inj. Atropine 0.6mg IV.

In the study by **Kaur et al**, there was increase in heart rate in Phenylephrine group when compared to Mephentermine and Ephedrine groups at the time of 1st interventional dose. This was found to be statistically insignificant.

Following 1st interventional dose of Phenylephrine 100mcg, Ephedrine 6mg, and Mephentermine 6mg as intravenous bolus, the heart rate in Phenylephrine group decreased when compared to Mephentermine and Ephedrine groups which was found to be statistically significant ($p<0.001$). And after second interventional dose the HR decreased more in Phenylephrine group when compared to Mephentermine and Ephedrine groups. The difference was statistically significant ($p<0.001$).

In the above studies, considering the results of Ephedrine and Mephentermine groups were found to be similar to our study.

The percentage saturation of oxygen (SpO2) in our study was observed from the time of spinal anaesthesia at various time intervals till the end of surgery and was found to be statistically insignificant. Similar results were found in the study conducted by Nagaraj S et al.

**Use of rescue vasopressor:** In our study, there was no incidence of hypotension in Mephentermine group. But one patient in Ephedrine group required rescue vasopressor Inj. Ephedrine 6mg IV at 10th minute

following SAB. This need for vasopressor could be due slow onset of action when administered through intramuscular route.

**Nagaraj S et al,** conducted study on patients undergoing lower abdominal and lower limb surgeries, where the rescue drug Mephentermine 6mg IV was used. 11.11% of patients who received Ephedrine 30mg IM required rescue vasopressor compared with 61.11% in control group which concurs with our study result.

**AS Yadav et al**, conducted study on parturients demonstrated the need for rescue vasopressor (Ephedrine 6mg IV) in 23.33% of Mephentermine group (30mg IM) and 26.66% of Ephedrine group (30mg IM). The control group required Ephedrine 9mg IV. Hence it can be inferred that the use of rescue vasopressor is marginally lower in patients receiving Mephentermine 30mg IM compared with receiving Ephedrine 30mg IM. This study result is not comparable with our observations.

**Complications**

In our study none of the patients had any incidence of nausea and vomiting in both Mephentermine and Ephedrine groups. Shivering and headache were other complications observed. In the Ephedrine group 13.3% of patients had shivering, and 3.3% of patients in Mephentermine group.Both Ephedrine and Mephentermine are known to cause headache. In our study Group Mephentermine demonstrated (20%) higher incidence of headache than in Ephedrine group (10%). However, the difference between the groups were found to be statistically insignificant.

In the study by **Nagaraj S et al**, conducted study on patients undergoing lower abdominal and lower limb surgeries, concluded that there was no incidence of nausea and vomiting observed in patients receiving Ephedrine 30mg IM- which concurs with our study findings.

The study comparing vasopressors have been previously conducted on parturients and they have showed that nausea and vomiting were observed in the studies conducted by **S Varathan et al, Yadav et al,** and Ananth S et al. The result of above studies does not concur with our study. In study conducted by Yadav et al, shivering was observed in 6.6% of patients in Mephentermine group and 10% in Ephedrine group- which concurs with our study observations.

**Conclusion**

It was concluded from our study that both the drugs Mephentermine and Ephedrine were effective in preventing hypotension following spinal anaesthesia when administered preemptively through intramuscular route.Both the vasopressors are similar in its actions. Mephentermine seemed to be more effective and a better choice compared to Ephedrine as it provided haemodynamic stability during intra-operative period with less use of rescue vasopressor. However, headache was the side effect observed in both the groups which was statistically insignificant. We conclude that pre-emptive administration of vasopressors is effective in preventing hypotension following spinal anaesthesia in patients undergoing infra-umbilical surgeries and pre-emptive administration of Mephentermine through intramuscular route 10 minutes prior to spinal anaesthesia is a better vasopressor when compared to pre-emptive administration of Ephedrine through intramuscular route 10 minutes prior to spinal anaesthesia with well-maintained stable haemodynamic conditions intraoperatively.

Our study vasopressors are well established drugs for treatment of hypotension following sympathetic

blockade. There is reduction in the usage of rescue vasopressor when Mephentermine and Ephedrine are administered pre-emptively through intramuscular route. Due to its cost effectiveness, future studies of the above vasopressors, can be studied in patients belonging to other ASA grading, their efficacy in other co-morbid conditions so that the vasopressors can be used in more wider population.

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