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A Comparative Study of Phenylepherine and Norepinephrine Infusion in Prevention of Postspinal Hypotension During Spinal Anesthesia in Non-Obstetric Procedures

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Abstract

Background: Although it is generally established that phenylepherine is the preferred vasopressor for maintaining blood pressure stability during spinal anesthesia, its use has been connected to a reflex decrease in heart rate and an associated decrease in cardiac output. As a result, research into substitute chemicals like norepinephrine has been sparked. When opposed to phenylephrine, norepinephrine may be more effective in controlling blood pressure because it has less of an impact on heart rate and cardiac output while still acting as a strong-adrenergic receptor agonist.

Aim of Study: This study is to detect lowest MAP during the first 10 minutes after spinal anesthesia and compare the efficacy of prophylactic intravenous infusions of phenylepherine and norepinephrine in controlling hemodynamics in patients undergoing lower abdominal incision minor and intermediate surgical interventions (below T10) with spinal anesthesia.

Patients and Methods: In our randomized, double-blinded study, 38 healthy patients undergoing lower abdominal incision surgical interventions under spinal anesthesia were randomized to maintain intraoperative hemodynamics with infusion of norepinephrine 4 μg/ml or phenylephrine 100 μg/ml. This study compared between both groups to detect lowest mean arterial pressure during the first 10 minutes after spinal anesthesia. Heart rate, cardiac output, stroke volume and index of cardiac output number using electrical cardiometry were also compared.

Results: Norepinephrine may be more successful in lowering blood pressure compared to phenylephrine because it has less of an effect on heart rate and cardiac output while still acting as a potent-adrenergic receptor agonist.

Conclusion: The present study showed that prophylactic norepinephrine infusion as an alternative vasopressor to phenylephrine infusion prevented post spinal hypotension in non-obestetric patients and maintained intraoperative hemodynamics.

Key Words: *Phenylephrine – Norepinephrine – Non obstetric procedures.*

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Introduction

FOR lower abdomen and lower limb procedures, spinal anesthesia (SA) is a frequent approach. Physiologically, spinal-induced hypotension brought on by sympathetic blocking is a serious disorder. It happens as a result of peripheral vasodilatation, which lowers venous return to the heart and produces hypotension and decreased cardiac output **[1,2]**. If untreated, spinal-induced hypotension might result in cardiovascular failure.

It is difficult to prevent arterial hypotension following SA, and frequent bolus delivery of crystalloid fluids often results in volume overload and congestive heart failure symptoms as soon as SA's effects wear off **[3,4]**.

Vasopressors, such as ephedrine "direct and indirect alpha", have been advised in place of this in a number of papers, although doing so may raise heart rate and myocardial oxygen consumption, which can have negative cardiovascular consequences in senior people **[5,6]**. With no immediate impact on heart rate, the "Pure Direct Alpha-1 Receptor Agonist" phenylepherine displays beneficial benefits during SA, particularly in cardiac patients and after caesarean delivery **[7,8]**. According to a recent study, norepinephrine is more effective than phenylephrine at maintaining blood pressure in pregnant women. Additional research is still needed to demonstrate its security in this situation and its effectiveness in patients who are not pregnant **[9,10]**.

Prophylactic continuous infusion with rescue bolus dosage is more successful for hemodynamic stability than depending on rescue dosing alone, with the benefit of reducing clinician effort **[11]**.

Electrical cardiometry, a constantly applicable method of measuring cardiac output (CO), stroke volume (SV), and other hemodynamic parameters, has recently been established for improved monitoring. Its use is expanding as a result of its non-invasiveness, accuracy in CO readings, and capacity to function as a continuous bedside monitor.

Aim of Study: This study is to detect lowest MAP during the first 10 minutes after spinal anesthesia and compare the efficacy of prophylactic intravenous infusions of phenylepherine and norepinephrine in controlling hemodynamics in patients undergoing lower abdominal incision minor and intermediate surgical interventions (below T10) with spinal anesthesia.

Patients and Methods

After the approval of the Institutional Research Ethics Committee, 38 patients were recruited in this study, during 2018 from the Faculty of Medicine University Hospitals of Cairo University.

Randomization, concealment, and double blindness:

Two trial groups, each with 19 patients (Group P: Phenylephrine 100g/mL infused at 0.7g/kg/min and Group N: Norepinephrine 4g/mL infused at 0.05g/kg/min), were randomly assigned using an online randomization tool (http://www.randomizer.org). Use of sequentially numbered, sealed, opaque envelopes was used to hide the random allocation numbers. All of the researchers conducting this study were unaware of the study group allocation. The research medications were created by a different doctor who was not a member of the trial in 50-mL syringes that were identical to one another and contained 0.9% sodium chloride.

Inclusion criteria:

Patients who were undergoing lower abdominal incision surgical interventions (below T10) under spinal anesthesia aged 18 to 65 years old, and ASA <3. Patients who had fulfilled the above criteria were recruited and An informed written consent was obtained.

Exclusion criteria:

Patients' refusal, Contraindications for spinal anesthesia, pregnancy, Hypertension and cardiac dysfunction.

Before any intervention, baseline readings of heart rate (HR), arterial oxygen saturation, systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial blood pressure (MAP), cardiac output (CO), stroke volume (SV), and index of cardiac output number (ICON) were taken from patients being monitored in the operating room. The non-invasive measurement of stroke volume (SV), cardiac output (CO), and other hemodynamic parameters in adults, children, and newborns is done using electrical cardiometry (ICON; Cardiotronic, Inc.). Four skin sensors must be placed on the neck and left side of the thorax in order to continuously detect changes in electrical conductivity inside the thorax.

After recording the baseline readings two peripheral venous catheters (18 G) were placed under local anesthesia (one for fluids and one for inotropes). Patients received 500ml of crystalloid before subarachnoid injection of local anesthetic. At the L3-4 or L4-5 vertebral interspace, a conventional spinal anaesthetic of hyperbaric bupivacaine 15-20mg and fentanyl 20g was delivered while the patient was seated. Patients were positioned in the supine posture following intrathecal injection. Before making a surgical incision and right away after the study medication infusion began, sensory level was pinprick checked bilaterally to guarantee a T 10-dermatomal level.

HR, SBP, DBP, MAP were recorded every 3 minutes in the first 10 minutes after intrathecal injection then every 15 minutes till the end of the operations while CO, SV and ICON were recorded every 5 minutes till the end of the operations.

Sample size:

Our primary outcome is the lowest MAP during the first 10 minutes after spinal anesthesia. In a previous study (9), the lowest MAP in patients receiving PE was 80±7mmHg. We calculated a sample size that would detect a difference of 10% between both groups (i.e. 8mmHg). A minimum number of 34 patients (17 per group) will be needed to have a study power of 90% and alpha error of 0.05. The number will be increased to 38 patients (19 per group) to compensate for possible drop-outs.

Statistical analysis:

Using the statistical programme SPSS version 25, data were coded and input. For quantitative variables, the mean, standard deviation, median, minimum, and maximum were used; for categorical variables, frequencies (the number of occurrences) and relative frequencies (percentages) were used. Unpaired t tests were employed to compare groups for quantitative variables with normally distributed distributions, whereas non-parametric Mann-Whitney tests were used for those with non-normally distributed distributions. An analysis using the Chi square (χ^2) test was done to compare

categorical data. When the anticipated frequency was less than 5, the exact test was employed instead. Statistical significance was defined as a *p*-value less than 0.05.

Results

This is a double blinded randomized controlled study designed to compare between norepinephrine and phenyl-epherine to detect lowest MAP during the first 10 minutes after spinal anesthesia and compare the efficacy of prophylactic intravenous infusions of both drugs in controlling hemodynamics in patients undergoing lower abdominal surgical interventions under spinal anesthesia.

Thirty-eight (38) patients scheduled for minor and intermediate surgical interventions requiring lower abdominal incision (below T10) were recruited for this study under spinal anesthesia.

Data expressed as Mean & SD showed that there was no statistical difference in demographic data between the two groups regarding (age, weight, height, Body Mass Index "BMI") (Table 1).

Table (1): Demographic data of patients in the study.

	Group P Phenyl-epherine group Mean (SD)	Group N Norepinephrine group Mean (SD)	*p*-value
Age years	36.56 (11.68)	30.05 (10.74)	0.086
Weight kilograms	74.17 (9.12)	75.05 (11.57)	0.798
Height centimeter	172.61 (6.12)	173.68 (7.30)	0.632
BMI Kg/m^2	24.76 (1.81)	24.73 (2.77)	0.977

p-value <0.05 denotes statistical significance.
BMI = Body mass index.

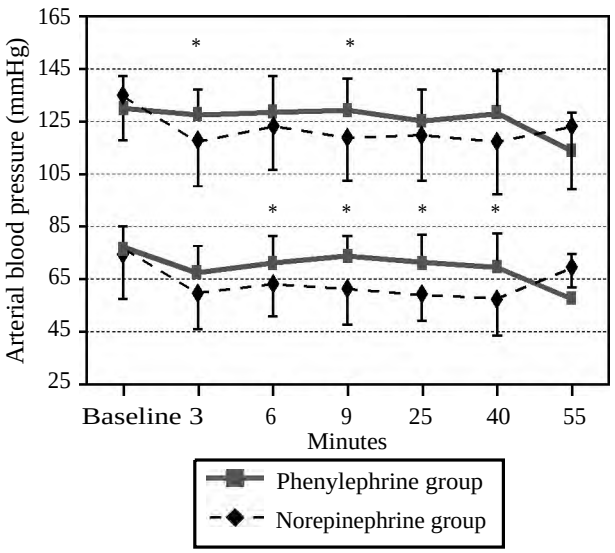

Fig. (1): SBP and DBP, or systolic and diastolic blood pressure, respectively. Markers represent means, error bars represent standard deviations, and an asterisk (*) Indicates statistical significance for both groups.

Intraoperative data:

Phenylephrine group showed higher SBP (at 3-minute and 9-minute readings) and DBP (starting from 6-minute reading till 40-minute reading) compared to norepinephrine group. Regarding intra-group comparison, there was no significant change in SBP nor DBP compared to the baseline reading (Fig. 1).

Table (2): Mean arterial pressure "MAP" in both phenylephrine and norepinephrine groups.

	Group P Phenyl-epherine group Mean (SD)	Group N Norepinephrine group Mean (SD)	*p*-value
MAP baseline	92.67 (6.72)	96.47 (13.57)	0.291
3 minutes	88.50 (9.51)	81.05 (13.43)	0.061
6 minutes	91.67 (8.38)	85.32 (10.75)	*0.051
9 minutes	92.83 (8.57)	82.84 (12.60)	*0.008
25 minutes	91.50 (11.01)	83.28 (11.80)	*0.03 8
40 minutes	88.92 (13.73)	80.90 (13.78)	0.180
55 minutes	77.00 (18.38)	87.25 (8.81)	0.378

**p*-value <0.05 denotes statistical significance.
SD = Standard deviation.

Both group were comparable in mean arterial pressure "MAP" in all readings and showed that phenylephrine group had higher MAP than norepinephrine group (at 6-minute, 9-minute and 25-minute); however, intra-group analysis showed decreased MAP compared to the baseline reading within norepinephrine group (at 3-minutes, 6-minutes, 40 minutes, and 55 minutes readings) Table (2).

The primary outcome:

The lowest MAP during the first 10 minutes from intrathecal injection was recorded with norepinephrine group in comparison to phenyl epherine group.

Table (3): Least Mean Arterial Pressure" MAP" during the 1st 10 minutes in both phenylephrine and norepinephrine groups.

	Group P Phenyl-epherine group Mean (SD)	Group N Norepinephrine group Mean (SD)	*p*-value
Lowest MAP during 1st 10 min	84.00 (6.75)	76.05 (11.25)	*0.014

**p*-value <0.05 denotes statistical significance.
MAP = Mean arterial blood pressure.
Min = Minutes. SD = Standard deviation.

Intra operative heart rate "HR" was measured at baseline and every 3 minutes in the first 10 minutes then every 15 minutes till the end of the operation.

Table (4): Heart rate "HR" beat per minute (bpm) in both phenylephrine and norepinephrine groups.

	Group P Phenyl-epherine group Mean (SD)	Group N Norepinephrine group Mean (SD)	*p*-value
HR baseline	72.56 (8.05)	88.42 (18.16)	*0.002
3 minutes	69.72 (8.93)	84.11 (20.77)	*0.011
6 minutes	69.67 (12.79)	77.79 (19.82)	0.150
9 minutes	61.61 (11.15)	74.84 (19.28)	*0.015
25 minutes	60.11 (8.32)	72.83 (19.56)	*0.018
40 minutes	59.23 (7.07)	76.60 (23.91)	0.050
55 minutes	52.00 (1.41)	65.50 (9.04)	0.118

**p*-value <0.05 denotes statistical significance.
SD = Standard deviation.

Norepinephrine showed significantly higher Heart Rate " HR" (at 3-minutes, 9-minutes, 25-minutes) compared to phenylephrine group. Regarding intra-group analysis showed decreased HR compared to the baseline reading within norepinephrine group (at 9-minutes, 25-minutes).

Cardiac Output "CO" was measured with Electrical Cardiometry every 5 minutes.

Both group were comparable in Cardiac Output "CO" in all readings with no statistical difference; however, intra-group analysis showed decreased CO compared to the baseline reading within norepinephrine group (at 10-minutes, 35-minutes, 40 minutes, 45-minutes and 55 minutes readings) and within phenylephrine group (at 20-minutes, 25 minutes, 30-minutes, 35-minutes, 50-minutes and 55 minutes reading).

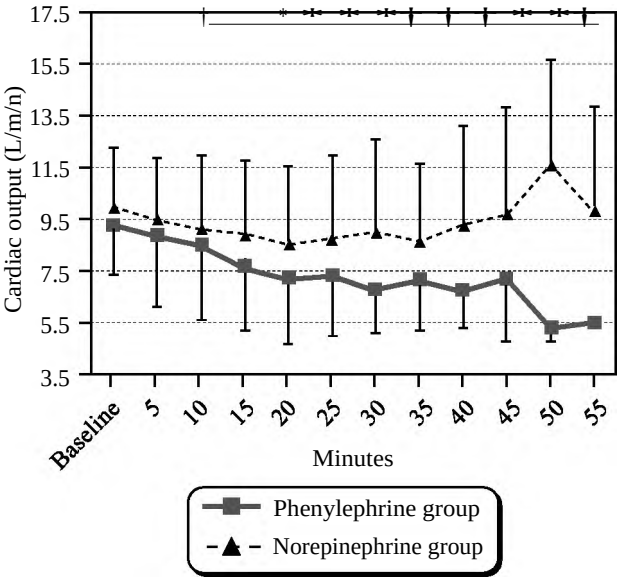

Fig. (2): CO," the cardiac output" Markers are means, error bars are standard deviations, and * indicate statistical significance in comparison to the baseline value in the norepinephrine group and phenylephrine group, respectively.

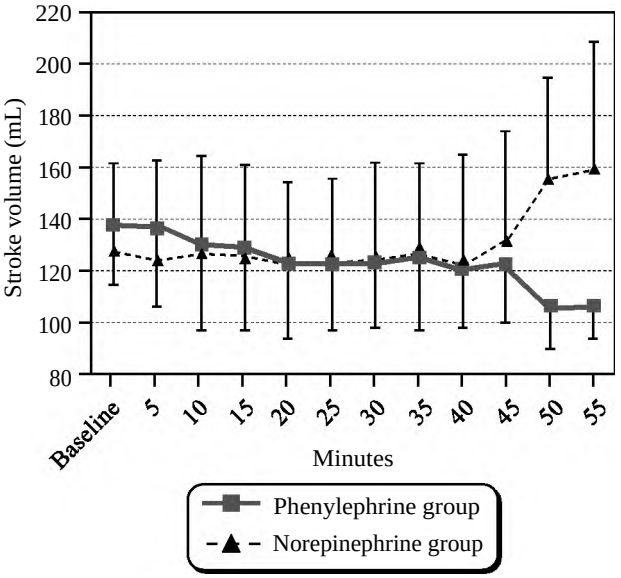

Fig. (3): Stroke volume. Markers are means, error bars are standard deviations.

Both group were comparable in Stroke Volume "SV" (milliliter) in all readings with no statistical difference.

Table (5): Index of Cardiac Output Number" ICON" in both phenylephrine and norepinephrine groups.

	Group P Phenyl-epherine group Mean (SD)	Group N Norepinephrine group Mean (SD)	*p*-value
ICON Baseline	86.06 (22)	79.01 (35.83)	0.343
5 minutes	89.43 (29.45)	80.12 (34.44)	0.313
10 minutes	85.46 (29.06)	80.97 (38.35)	0.391
15 minutes	83.60 (29.96)	80.05 (33.94)	0.578
20 minutes	77.99 (28.87)	77.34 (30.33)	0.916
25 minutes	79.56 (27.77)	76.51 (31.48)	0.732
30 minutes	78.56 (22.17)	86.87 (20.26)	0.260
35 minutes	81.59 (27.63)	87.20 (26.35)	0.560
40 minutes	75.23 (19.69)	92.07 (34.54)	0.431
45 minutes	83.35 (18.74)	98.04 (31.14)	0.808
50 minutes	69.65 (16.19)	115.05 (40.92)	0.143
55 minutes	71.05 (17.75)	119.72 (48.28)	0.533

*p-value <0.05 denotes statistical significance.
SD = Standard deviation.

Both group were comparable in "ICON" in all readings with no statistical difference.

Discussion

The results of the present study demonstrated that both prophylactic phenylephrine infusion and prophylactic norepinephrine infusion both maintained intraoperative hemodynamics, however prophylactic phenylephrine infusion showed higher SBP, DBP and MAP than prophylactic norepinephrine infusion, although norepinephrine infusion showed higher heart rate readings compared to prophylactic phenylepherine infusion.

The lower blood pressure in one infusion and the lower heart rate in the other didn't require the rescue plan of ephedrine bolus nor atropine bolus.

To the best of our knowledge this study is the first to compare prophylactic vasopressors to maintain hemodynamics after spinal anesthesia in non-obstetric procedures.

When the surgical site is in the lower extremities, perineum, or abdominal wall, spinal anesthesia (subarachnoid block) provides a secure and efficient substitute for general anesthesia (e.g., inguinal herniorrhaphy). Through the injection of local anaesthetics into the spinal CSF, SA generates strong sensory and motor blockade as well as sympathetic blockade and permits access to sites of action both inside the spinal cord and the peripheral nerve roots.

Spinal-induced hypotension resulting from sympathetic blockade is a dangerous physiological condition that, if addressed, can result in cardiovascular collapse. Hypotension affects around one-third of patients receiving spinal anesthesia (systolic arterial blood pressure 90mm Hg). In contrast to severe hypotension, moderate hypotension (20mmHg) is usually caused by changes in systemic vascular resistance. The use of vasopressors, crystalloids, or colloid preloading by the medical professionals has helped to avoid or reduce post-spinal anaesthetic hypotension. Unfortunately, no fluid treatment has been shown to adequately prevent hypotension following spinal anesthesia **[12,13]**.

The regular bolus injection of crystalloid fluids is not always successful and can soon result in volume overload and symptoms of congestive heart failure after the effects of SA subside, making the avoidance of arterial hypotension following SA a hard undertaking. Because of this, some writers have suggested using vasopressors instead. Instead of depending only on rescue dose, prophylactic continuous infusion of vasopressors with rescue bolus dosing improves hemodynamic stability while reducing physician burden **[14]**.

I In a study by Warwick et al., on 104 obstetric patients who underwent spinal anesthesia, it was found that heart rate and cardiac output were higher in the norepinephrine group, and that the need for a rescue vasopressor bolus was higher in the norepinephrine group, despite similar systolic blood pressure and stroke volume between the phenylepherine and norepinephrine groups **[15]**.

In our study with non-obstetric patients, phenylephrine group had higher SBP and DBP compared to norepinephrine group in some readings and the difference between both groups in MAP readings showed higher numbers with phenylephrine group during first 25 minutes after SA. Although regarding HR: Norepinephrine infusion group showed higher HR compared to phenylephrine infusion group which was expected due to its weak 0-adrenergic agonist activity; however, bradycardia was more with phenylephrine infusion group but it wasn't significant enough to use IV atropine.

Currently, phenylephrine is recognised as the preferred first-line vasopressor for preserving blood pressure (BP) during spinal anesthesia **[16]**; however, due to phenylephrine's pure vasoconstrictive properties, its use is frequently linked to a reflex decrease in heart rate (HR) and an associated decrease in cardiac output (CO) **[18]**. This has prompted research into alternate substances such diluted norepinephrine **[17,18]**. Although norepine-

phrine and phenylephrine are both strong-adrenergic agonists, norepinephrine also exhibits mild-adrenergic agonist action. When norepinephrine is utilised to maintain BP during SA, the latter counteracts the reflex slowing of HR, perhaps leading to a more stable hemodynamic profile **[19]**.

In their study, Vallee et al., compared the effectiveness of phenylephrine and norepinephrine boluses in treating post-general anesthesia hypotension in non-obstetric patients. They discovered that norepinephrine, compared to phenylephrine, might cure general anesthesia-induced arterial hypotension with a lesser fall in SV and arterial compliance when injected as a bolus in a peripheral venous line **[20]**.

In our study, both infusion groups were comparable in Cardiac Output "CO", Index Of Cardiac Output Number "ICON" and Stroke Volume "SV" in all readings with no statistical difference, however cardiac output decreased in both groups that may be due to the decrease in venous return associated with spinal anesthesia.

As previously mentioned, Warwick et al. **[15]** came to the conclusion that the norepinephrine group's cardiac output increased. This finding may be explained by the fact that the study's population consisted of obstetric patients with hyperdynamic circulation in the third trimester, or it may be the result of the need to include a fluid rescue in our protocol, which we advise in future studies in this area of interest.

Regarding intra-group comparison, there was no significant change in SBP nor DBP compared to the baseline reading that can be because both had similar efficacy for maintaining blood pressure within accepted values with no need for further boluses of IV ephedrine.

Limitations:

We recommend a third group with crystalloid infusion regimen in fore-coming studies with the same interest. Heart rate baseline values in this study were statistically significantly different so any difference in HR between both groups are supposed to be inconclusive and need further investigations on a wider scale with higher number of patients.

Conclusion:

The current study findings demonstrated that prophylactic norepinephrine infusion, an alternate vasopressor to prophylactic phenylephrine infusion, avoided post spinal hypotension in non-obestetric patients and maintained intraoperative hemodynamics. In further research with the same interest and more patients undergoing other surgical procedures, we advise adding a third group with a crystalloid infusion regimen.

References

1- VARSHNEY R. and JAIN G.: Comparison of colloid preload versus coload under low dose spinal anesthesia for cesarean delivery. Anesth. Essays Res., 7: 376-80, 2013.

2- SEYEDHEJAZI M. and MADAREK E.: The effect of small dose bupivacaine-fentanyl in spinal anesthesia on hemodynamic nausea and vomiting in cesarean section. Pak. J. Med. Sci., 23:747-50, 2007.

3- CHRISTENSEN E.F., SØGAARD P., et al.: Myocardial ischaemia and spinal analgesia in patients with angina pectoris. Br. J. Anaesth., 71: 472-5, 1993.

4- MCCRAE A.F. and WILDSMITH J.A.: Prevention and treatment of hypotension during central neural block. Br. J. Anaesth., 70: 672-80, 1993.

5- BUTTERWORTH J.F., PICCIONE W., et al.: Augmentation of venous return by adrenergic agonists during spinal anesthesia. Anesth. Analg., 65: 612-6, 1986.

6- RÅDSTRÖM M., BENGTSSON J., et al.: Effects of ephedrine on oxygen consumption and cardiac output. Acta. Anaesthesiol. Scand, 39: 1084-7, 1995.

7- NGAN KEE W.D., KHAW K.S., et al.: Prophylactic phenylephrine infusion for preventing hypotension during spinal anesthesia for cesarean delivery. Anesth. Analg., 101: 1512, 2005.

8- NGAN KEE W.D., LEE S.W., et al.: Randomized double-blinded comparison of norepinephrine and phenylephrine for maintenance of blood pressure during spinal anesthesia for cesarean delivery. Anesthesiology, 122: 736-45, 2015.

9- VALLEJO M.C., ATTAALLAH A.F., et al.: An open-label randomized controlled clinical trail for comparison of continuous phenylephrine versus norepinephrine infusion in prevention of spinal hypotention during cesarean delivery. Int. J. Obstet. Anesth., 29: 18-25, 2017.

10- LEE H-M., KIM S-H., et al.: The effect of prophylactic bolus phenylephrine on hypotention during low-dose spinal anesthesia for cesarean section. Int. J. Obstet. Anesth., 25: 17-22, 2016.

11- LEE A., NGAN KEE W.D., et al.: A quantitative, systematic review of randomized controlled trials of ephedrine versus phenylephrine for the management of hypotension during spinal anesthesia for cesarean delivery. Anesth. Analg., 94: 920-6, 2002.

12- JACKSON R., REID J.A., et al.: Volume preloading is not essential to prevent spinal-induced hypotension at cesarean section. Br. J. Anaesth., 75: 262-5, 1995.

13- CHRISTENSEN E.F., SØGAARD P., et al.: Myocardial ischaemiaand spinal analgesia in patients with angina pectoris. Br. J. Anaesth., 71: 472-5, 1993.

14- LEE A., NGAN KEE W.D., et al.: A quantitative, systematic review of randomized controlled trials of ephedrine versus phenylephrine for the management of hypotension during spinal anesthesia for cesarean delivery. Anesth. Analg., 94: 920-6, 2002.

15- WARWICK D., NGAN KEE, et al.: Randomized Double-blinded Comparison of Norepinephrine and Phenylephrine for Maintenance of Blood Pressure during Spinal Anesthesia for Cesarean Delivery. Anesthesiology, 122: 736-45, 2015.

16- NGAN KEE W.D. and KHAW K.S.: Vasopressors in obstetrics: What should we be using? Curr. Opin. Anaesthesiol., 19: 238-43, 2006.

17- NGAN KEE W.D., LEE S.W., et al.: Randomized double-blinded comparison of norepinephrine and phenylepherine for maintenance of blood pressure during spinal anesthesia for cesarean delivery. Anesthesiology, 122: 736-45, 2015.

18- ONWOCHEI D.N., NGAN KEE W.D., et al.: Norepinephrine intermittent intravenous boluses to prevent hypotension during spinal anesthesia for cesarean delivery: A Sequential allocation dose-finding study. Anesth. Analg., 125: 212-8, 2017.

19- VALLEJO M.C., ATTAALLAH A.F., et al.: An open-label randomized controlled clinical trial for comparison of continuous phenylephrine versus norepinephrine infusion in prevention of spinal hypotension during cesarean delivery. Int. J. Obstet. Anesth., 29: 18-25, 2017.

20- VALLEE F., PASSOUANT O., et al.: Norepinephrine reduces arterial compliance less that phenylephrine when treating general anesthesia-induced arterial hypotension. Acta. Anaesthesiologica Scandinavica, 61: 590-600, 2017.

مقارنة التقطير الوريدى المستمر لكل من عقار الفينايل إفرين وعقار النور إبينيفرين فى منع إنخفاض ضغط الدم أثناء التخدير النصفى للعمليات الجراحية فيما عدا عمليات الولادة

فى هذا البحث تمت دراسة مقارنة التقطير الوريدى المستمر لكل من عقار الفينايل إفرين وعقار النور إبينيفرين فى منع إنخفاض ضغط الدم أثناء التخدير النصفى للعمليات الجراحية فيما عدا عمليات الولادة.

أجريت الدراسة فى مستشفى القصر العينى التعليمى فى ٢٠١٨ بعد موافقة اللجنة الأخلا قية وموافقة المرضى كتابيا وقد تضمنت الدراسة مجموع ٣٨ مريض صحيح بالغ من عمر ١٨ إلى ٥٠ عاماً وASA 3 والمقرر خضوعهم لإجراء عمليات جراحية بالجزء السفلى من الجسم تحت تأثير التخدير النصفى.

تم تقسيم المرضى المشاركون فى البحث إلى مجموعتين متساويتين مجموعة الفينايل إفرين ومجموعة النور إبينيفرين ١٩ لكليهما وطبقاً لضوابط الإدخال والإخراج.

وتمت المقارنة بين تأثير التقطير الوريدى السمتمر لكل عقار على ضغط الدم وسرعة نبضات القلب وبإستخدام جهاز Cardiometry Electrical قد تم تسجيل حجم ضربة القلب الواحدة وحجم النتاج القلبى فى الدقيقة الواحدة والمؤشر القلبى لكل مجموعة والمقارنة بينهما.

وأظهرت نتائج البحث أن عقار النور إبينيفرن يستطيع منع إنخفاض ضغط الدم بعد التخدير النصفى بكفائة مقاربة لعقار الفينايل إفرين دون الحاجة إلى جرعات زائدة من عقار الايفدرين، وكان لكلا المجموعتين نفس النتائج على حجم ضربة القلب الواحدة وحجم النتاج القلبى فى الدقيقة الواحدة والمؤشر القلبى مما يجعل عقار النور إبينيفرين بديل جيد لعقار الفينايل إيفرين فى منع إنخفاض ضغط الدم بعد التخدير النصفى.