Investigation and Evaluation of Blood Pressure after Spinal Anesthesia

Aous Hani Nief [1], Mohammed Abdullah Jassim [1], Zaidoon Abdulwahab Mohsin [1], Manar Hazim Shahad [2], Maythum Ali Shallan [1], Rawaa Awad Kadhum [1], Qusay Abdulazahra Yaqoob [3] and Rania Abd Elmohsen Abo El Nour [1&4]

[1] Anesthesia Techniques Department, College of Health and Medical Techniques, Al-Mustaqbal University, 51001, Babylon, Iraq.

[2] Department of Applied Medical Physics, Faculty of science, Al-Mustaqbal University, 51001, Babylon, Iraq.

[3] Department of Surgery, College of Medicine, University of Kufa, Al-Kufa Street, Najaf, Iraq.

[4] Community Health Nursing Department, Beni-Suef Health Technical Institute, Ministry of Health, Beni-Suef 62511, Egypt

Abstract

Objective: Regional anesthesia is preferred by most anesthetists for the majority of caesarean sections. The major advantage of regional anesthesia is the avoidance of maternal morbidity and mortality associated with general anesthesia. **Aim of the study**: The aim of our study was to determine the effects of spinal anesthesia on blood pressure**. Patients and methods:** This prospective study was carried out at Hila hospital, Imam Sadiq Hospital, Babil from January 2024 to march 2024. One hundred fifty (150) patients between (17– 45) years old were enrolled in this study. Scheduled for spinal anesthesia for caesarian section to delivery baby and different type of surgery. **Statistical Analysis:** Data were analyzed through the application of appropriate statistical methods by using statistical package of social sciences (SPSS) version 28 which suitable with study results, in order to analyze and evaluate the results of the present study. Demographic data are reported as mean values with SD and p. value. **Discussion:** In this study, it was attempted to assess and determine the blood pressure of subarachnoid block spinal anesthesia. From the results, a decision is made to reject the null hypothesis and accept the alternative hypothesis Which proves that there is a high significant or significance data variable on blood pressure 10 and 20 minutes after spinal anesthesia. This is due to the data with the higher average, as shown in the tables and graphs. **Conclusion:** From these results we can conclude that there are a significance data variable on effect of spinal anesthesia or subarachnoid block on blood pressure when we collected the data on four-time interval… some patients treated this drop on blood pressure as a physiological (N/S) or a pharmacological (ephedrine) vasopressor drug. **Recommendation:** On the basis of the study, the following recommendations are suggested: Health educational program about how to deal with the effect of spinal anesthesia on blood pressure, ongoing researches about how to decrease the effect of spinal anesthesia on blood pressure.

Keywords: Blood Pressure, Spinal, Anesthesia, Patient.

1. Introduction

Spinal anesthesia also called spinal block, subarachnoid block, intradural block and intrathecal block is a form of neuraxial regional anesthesia involving the injection of a local anesthetic or opioid into the subarachnoid space, generally through a fine needle, usually 9 cm (3.5 in) long. It is a safe and effective form of anesthesia usually performed by anesthesiologists that can be used as an alternative to general anesthesia commonly in surgeries involving the lower extremities and surgeries below the umbilicus **(Chin & van Zundert, 2023)**.

Spinal anesthesia is commonly used in various surgical procedures, including hernia repair, different types of hysterectomy, cesarean section, prostate surgery, and urological bladder surgeries. Spinal anesthesia is a technique widely used for its efficacy and safety, and it is also known as spinal, subarachnoid, intradural, or intrathecal anesthesia. It is characterized by the administration of an anesthetic in the subarachnoid space that is located between the pia mater and arachnoid meninges in order to generate a sequential block in the nerve fibers **(Abo El nour& Abdelzaher, 2024).**

The sitting position is often used for patients undergoing spinal anesthesia especially when lower lumbar and sacral levels of sensory anesthesia are required. An advantage of this position is that the complications associated with it can be reduced. The present study assesses the relation between saddle block anesthesia and the duration spent in sitting posture Advantages of subarachnoid block include patient remaining fully awake, maintenance of normal physiology, and lesser incidence of deep vein thrombosis and aspiration syndrome. The disadvantages include hypotension, bradycardia, and urinary retention and unduly prolonged motor paralysis. Hypotension and bradycardia were treated with ephedrine and atropine respectively **(Paria et al., 2014).**

Spinal anesthesia is a commonly used technique, either on its own or in combination with sedation or general anesthesia. It is most commonly used for surgeries below the umbilicus, however recently its uses have extended to some surgeries above the umbilicus as well as for postoperative analgesia. Procedures which use spinal anesthesia include: Orthopedic surgery on the pelvis, hip, femur, knee, tibia, and ankle, Vascular surgery on the legs, Endovascular aortic aneurysm repair, Hernia (inguinal or epigastric), Hemorrhoidectomy, Nephrectomy, cystectomy in combination with general anesthesia, Transurethral resection of the prostate and transurethral resection of

bladder tumors, Hysterectomy, Caesarean sections, Pain management during vaginal birth and delivery, Urology cases and Examinations under anesthesia **(Jonayed et al.,2021).**

With the discovery of new short-acting local anesthetics, spinal anesthesia has a rapid onset of action, rapid cessation of action with rapid recovery of motor function, adequate analgesia (better than with general anesthesia) with minimal side effects, making it an ideal anesthesia for day surgery. Other benefits of spinal anesthesia include a lower incidence of postoperative nausea and vomiting, the possibility of early oral hydration and food intake, which is especially important in diabetics, as well as the possibility of intraoperative or early postoperative communication with the surgeon **(Magdić et al.,2022).**

Blood pressure is the most common methods for blood pressure measurement are through the use of an external cuff or through a catheter-based system. The fundamental reasons that these methods fail for long term, continuous pressure measurement are comfort, intermittent measurement, occlusion of blood flow, and percutaneous connections **(Paul G. et, al. 2017).** The use of any anesthetic is an indication for arterial blood pressure measurement. The techniques and frequency of pressure determination will depend on the patient's condition and the type of surgical procedure. A noninvasive blood pressure measurement every 3 to 5 min is adequate in most cases **(John F. et, al. 2018).**

Hypotension is an inevitable complication of spinal anesthesia that occurs when the sympathetic chain becomes blocked, especially when higher dermatome levels are needed. A drop in blood pressure may initiate nausea and vomiting, indicating ischemia on the spinal cord, which in turn induces an undesired condition for the patient and operating staff. Blood pressure changes between the left lateral to supine position has been determined as an indicator for predicting a perioperative decrease in obstetric patients undergoing caesarean delivery under spinal anesthesia **(Paul G. et, al. 2017).**

Spinal anesthesia (SA) is considered a safe procedure, but it may have some side effects including hypotension and bradycardia. Sympathetic fiber blockade and vasodilation are the main causes of hypotension. SA is performed more frequent in elderly patients despite the higher risk of hypotension and its consequences. The percentage of hypotension in elderly patients is estimated to be over 70%. For prevention of hypotensive side effect may have risk of hypervolemia or myocardial ischemia in elderly population. Shivering is a common association with spinal anesthesia during intra and postoperative periods. The causes of shivering are not clearly understood it may be due to union of some mechanisms including modulation of thermoregulatory thresholds, decreasing body core temperature, body heat distribution changes and the cooling effect of the injected fluids into neuraxis. While patients feel very uncomfortable due to shivering, it causes monitors artifacts and increases the postoperative pain, heart rate, oxygen consumption and metabolic rate. These effects may lead to myocardial ischemia, hypoxemia, hypercarbia and lactic acidosis **(Mostafa et al., 2021).**

Aim of the study:

The aim of our study was to determine the effects of spinal anesthesia on blood pressure.

2. Methodology and Participants

2.1 Patients and methods

This prospective study was carried out at Hila hospital, Imam Sadiq Hospital, Babil from January 2024 to March 2024. After obtaining local ethics committee approval and written consent Under the supervision of the department of anesthesia technologies in college of health and medical technology in Al-mustaqbal university. One hundred fifty (150) patients between (17– 45) years old were enrolled in this study. scheduled for spinal anesthesia for caesarian section to delivery baby and different type of surgery.

2.2 Study Protocol

The age, gender, weight, type of operation, chronic disease and smoking for each patient was recorded. Each patient was evaluated preoperatively by one of four individuals (1 staff anesthesiologist, 3 anesthesiology residents) having at least two years' clinical experience.

2.3 Study parameters

The patients were checked according to the study questionnaire about age, gender, Wight, type of operation, chronic disease and smoking and measure blood pressure in four-time interval (pre-operative, after administration of spinal anesthesia, after 10 min and after 20 min).

2.4 Materials and equipment used in this study

1) Pulse oximeter
2) non-invasive blood pressure (NIBP)
3) Monitor equipment
4) Spinal needle
5) Local anesthesia
6) Foley catheter

2.5 Spinal anesthesia method

The subarachnoid space was punctured with a 25 G Whitacre needle in the lateral or setting position at

L3/4 or L4/5 using a median or Para median approach until there was free backflow of cerebrospinal fluid, and 3 ml or some time less from this dose hyperbaric bupivacaine 0.5 % was administered. Patients will be restored to a supine position after 1-3 minutes. If needed, ephedrine, midazolam, or both were given intravenously throughout the procedure.

2.6 Inclusive criteria and exclusive criteria

We used in inclusive criteria the variable data from study questionnaire (age, gender, weight, height, type of operation and measure the blood pressure in four-time interval (pre-operative, after administration of spinal anesthesia, after 10 min and after 20 min). And we are excluded cardiac disease except hypertension and any drug using to treat hypotension just ephedrine.

2.7 Statistical Analysis.

Data were analyzed through the application of appropriate statistical methods by using statistical package of social sciences (**SPSS**) version 28 which suitable with study results, in order to analyze and evaluate the results of the present study. Demographic data are reported as mean values with SD and p.value.

3. Results

The data have been analyzed and organized statistically according to the aim of the current study (The aims of this study were to determine or assessment effects of subarachnoid block on blood pressure in patients.) by using spss. version 28.

3.1 The Null hypothesis

There is no significant in effect of spinal anesthesia on blood pressure in a significant level of **0.05** and above.

M2≠: M1 H0

3.2 The alternative hypothesis

There is a significant in effect of spinal anesthesia on blood pressure in a significant level of 0.05 and below.

M2=: M1 H1

To verify the above hypotheses, we conducted a test T-test independent samples the results were as follows:

Table 1. Descriptive Statistics for demographic data of the study.

Descriptive Statistics				
N = 150 case	Minimum	Maximum	Mean	Std. Deviation
Age	17	63	31.19	10.139
Weight	53	105	72.78	11.209
Gender	45 males	105 females	1.30	0.460
Type of Operation	2 hip replacement	95 C/S	3.49	0.961
Chronic Disease	2 asthmas	96 none	3.56	0.746
Smoking	37	33	1.25	0.433

In the table (1) shown the Descriptive Statistics minimum, maximum, mean and std. deviation for demographic data of the study age, weight, gender, type of operation, chronic disease and smoking patients under one hundred fifty cases, enrolled (150) case in this research which age from 17-63 and 45 male and 105 female in different type of operation and chronic disease.

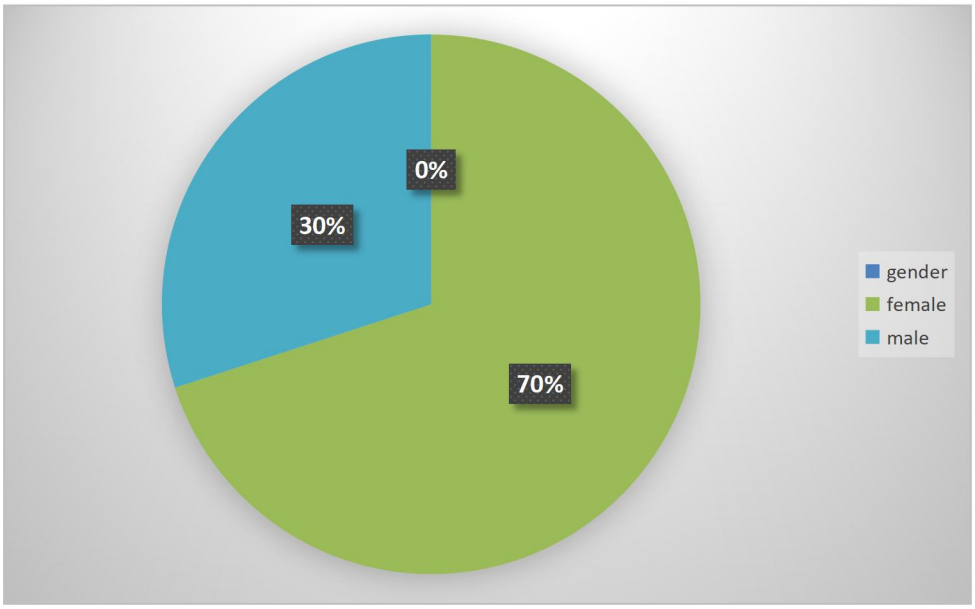

Figure 1. Distribution of gender in the study.

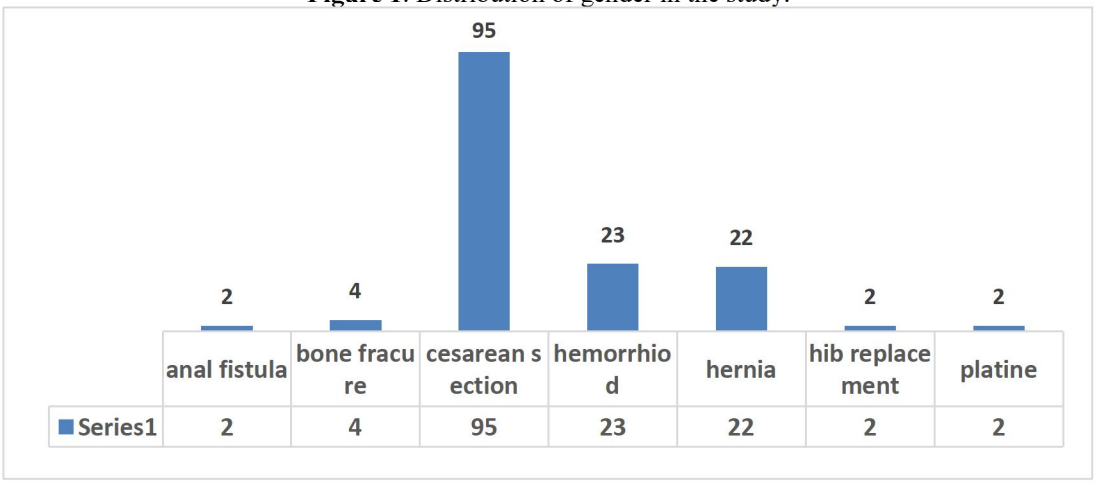

Figure 2. Distribution of surgery in the study.

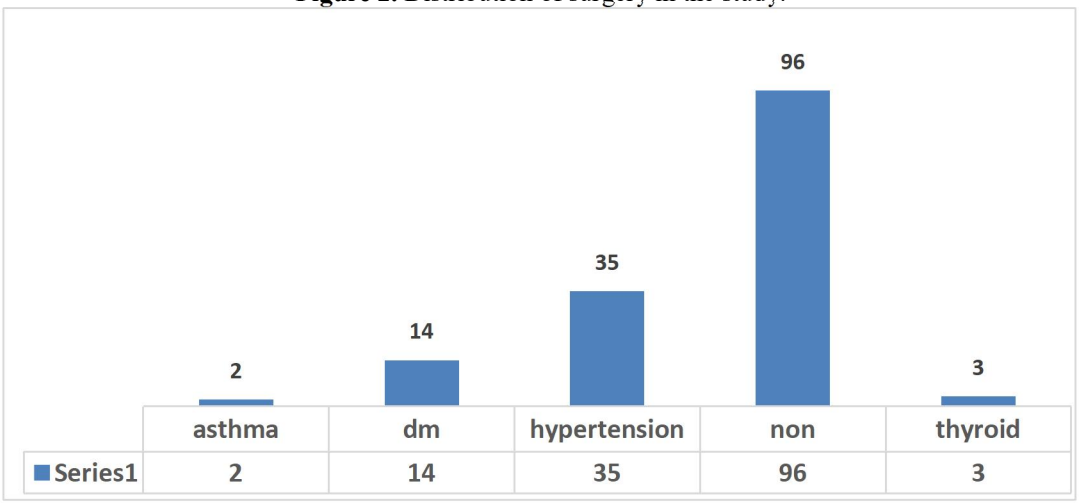

Figure 3. Distribution of chronic disease in the study.

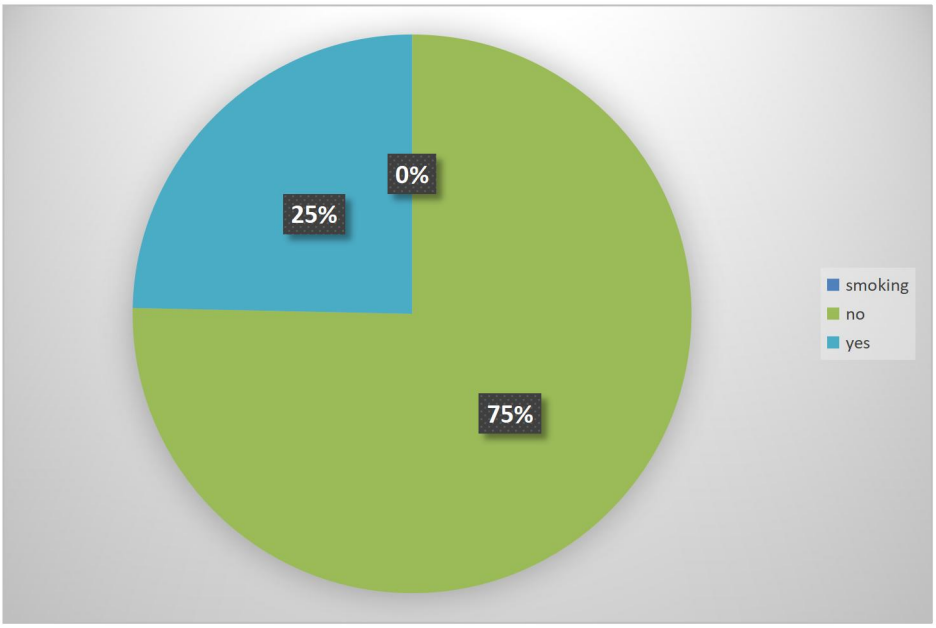

Figure 4. Distribution of smoking patients in the study.

In the table (2) note the relation between gender and smoking in this research respectively at p. value 0.001 high-significance data relation between this variable, which was:

1) In female gender: there was 95 without smoking and 10 patients with smoking.
2) In male gender: there was 18 without smoking and 27 patients with smoking.

Table 2. Cross tab between gender and smoking.

gender * smoking Cross tabulation				
		Smoking		Total
		No	Yes	
Gender	Female	95	10	105
	Male	18	27	45
Total		113	37	150

p. value0.001 HS

In the table (3), the results show the statistical analysis means and std. deviation for the variable data in pre-operative (pre-anesthesia) (sys. BP, dia. BP) respectively at p. value (0.79 NS, 0.46 NS). Non-significant data.

Table 3. Statistical description of blood pressure during pre-operative.

Group Statistics				
Blood pressure in pre-operative	N	Mean	Std. Deviation	p. value
Sys. BP pre-operative	150	133.26	16.360	0.79 NS
Dia. BP pre-operative	150	88.89	11.685	0.46 NS

In the table (4), the results show the statistical analysis means and std. deviation for the variable data After administration of spinal anesthesia (sys. BP, dia. BP) respectively at p. value (0.71 NS, 0.77 NS). Non-significant data.

Table 4. Statistical description of blood pressure After administration of spinal anesthesia.

Group Statistics				
Blood pressure After administration of spinal anesthesia	N	Mean	Std. Deviation	p. value
Sys. BP After administration of spinal anesthesia	150	91.74	9.825	0.71 NS
Dia. BP After administration of spinal anesthesia	150	50.53	9.377	0.77 NS

Table 5. Statistical description of blood pressure After 10 min.

Group Statistics				
Blood pressure after 10 min	N	Mean	Std. Deviation	p. value
Sys. BP After 10 min	150	119.68	20.028	0.01 HS
Dia. BP After 10 min	150	77.95	14.124	0.02 S

In the table (5), the results show the statistical analysis means and std. deviation for the variable data After 10 min from spinal anesthesia (sys. BP, dia. BP) respectively at p. value (0.01 HS, 0.02 S). significant data.

In the table (6), the results show the statistical analysis means and std. deviation for the variable data After 20 min from spinal anesthesia (sys. BP, dia. BP) respectively at p. value (0.04 S, 0.04 S). significant data.

Table 6. Statistical description of blood pressure after 20 min.

Group Statistics				
Blood pressure after 20 min	N	Mean	Std. Deviation	p. value
Sys. BP after 20 min	150	128.63	19.042	0.04 S
Dia. BP after 20 min	150	82.53	14.592	0.04 S

From the results above, a decision is made to reject the null hypothesis and accept the alternative hypothesis Which proves that there is a high significant or significance data variable in effect of spinal anesthesia on blood pressure with statistical significance this is due to the data with the higher average, as shown in the tables and graphs above.

4. Discussion

Spinal anaesthesia results from pharmacologic denervation at the level of the spinal cord by introducing a concentrated local anaesthetic into the subarachnoid space, resulting in profound sensory, motor, and sympathetic blockade. In theory, spinal anaesthesia can be performed at most of the thoracic and lumbar spinal levels, but is considered safer if it is performed below the termination of the spinal cord to avoid iatrogenic injury to the cord itself. In adults, the spinal cord is believed to terminate at L1/L2 in the majority of patients. spinal anaesthesia performed at spinal levels above L1/L2, known as thoracic spinal anaesthesia, is perhaps the most controversial of all NA techniques (**Le Roux et al., 2023**).

This study showed that more than two third of participants were female. This result was in accordance with (**Yüksek et al.,2020**) who conducted a study entitled " Incidence and causes of failed spinal anesthesia" who found that 72% of participants were female from the researcher point of view this due to all hospital every day

accepted pregnant women for cesarean section with spinal anesthesia.

This study showed that less than two third of participants were doing cesarean section. This result was in agreement with (**Renaningtyastutik et al., 2022**) who conducted a study entitled "The relationship between operation duration and shivering in post-spinal anesthesia patients" who found that 70% of participants were admitted for cesarean section .On the other hand, This result was in disagreement with (**Watanabe et al., 2024**) who conducted a study entitled "Gender differences on preoperative psychologic factors affecting acute postoperative pain in patients with lumbar spinal disorders " who found that most of participants were admitted for musculoskeletal disorder.

This study showed that less than two third of participants hadn't chronic disease. This result was in agreement with **(Zhong et al., 2020)** who conducted a study entitled "Spinal anaesthesia for patients with coronavirus disease 2019 and possible transmission rates in anaesthetists: retrospective, single-Centre, observational cohort study " who found that only 30 % of participants had chronic disease.

This study showed that three forth of participants weren't smokers. This result was in agreement with **(Morgan et al., 2020)** who conducted a study entitled " Spinal or general anaesthesia for surgical repair of hip fracture and subsequent risk of mortality and morbidity: a database analysis using propensity score-matching" who found that 20% of participants were smoking. On the other hand, This result was in disagreement with (**Güneş et al., 2022**) who conducted a study entitled " Does smoking affect the onset time of sensory blocks or the duration of motor blocks in parturient women? A randomized controlled trial" who found that one half of participants were smokers.

In this study, it was attempted to assess and determine the blood pressure of subarachnoid block spinal anesthesia. In table (1) shown the Descriptive Statistics minimum, maximum, mean and std. deviation for demographic data of the study age, weight, gender, type of operation, chronic disease and smoking patients under one hundred fifty cases enrolled (150) case in this research which age from 17-63 and 45 males and 105 females in different type of operation and chronic disease .

In table (2) note the relation between gender and smoking in this research respectively at p. value 0.001 high-significance data relation between this variable, which was :

I. In female gender: there was 95 without smoking and 10 patients with smoking.
II. In male gender: there was 18 without smoking and 27 patients with smoking.

In table (3), the results show the statistical analysis means and std. deviation for the variable data in pre-operative (pre-anesthesia) (sys. BP, dia. BP) respectively at p. value (0.79 NS, 0.46 NS). Non-significant data. In table (4), the results show the statistical analysis means and std. deviation for the variable data After administration of spinal anesthesia (sys. BP, dia. BP) respectively at p. value (0.71 NS, 0.77 NS). Non-significant data. In table (5), the results show the statistical analysis means and std. deviation for the variable data After 10 min from spinal anesthesia (sys. BP, dia. BP) respectively at p. value (0.01 HS, 0.02 S). significant data. In table (6), the results show the statistical analysis means and std. deviation for the variable data After 20 min from spinal anesthesia (sys. BP, dia. BP) respectively at p. value (0.04 S, 0.04 S). significant data. significance and when it was less than 0.05 called a significance data relation.

Pre-existing hypovolemia can lead to cardiovascular collapse during SA and putting the patient level from Trendelenburg can precipitate a cardiac arrest. The possible cephalad extension of any hyperbaric solution must be carefully considered and its hemodynamic effects anticipated. In the parturient, the left lateral tilt position (5–10°) after SA favors venous return by limiting aortocaval compression (**Ferré, F., et. Al. 2020**). Use of the head-down tilt (Trendelenburg) position to increase arterial blood pressure after spinal anesthesia. However, there are few clinical data that show head-down tilt to be effective in increasing arterial blood pressure after spinal block.

Hypotension during spinal anesthesia results from pharmacological denervation of the preganglionic sympathetic fibers, leading to vasodilation and reduction in systemic vascular resistance (**Dezfulian, C., et. Al. 2021**). Since sympathetic block may extend two to six segments above the somatic sensory dermatome level, block height, particularly that which extends above T-8 (inhibiting the sympathetic supply to the adrenal medulla) or to the cardio accelerator sympathetic fibers (T1-4) may clearly impair cardiovascular compensatory reflexes and contribute to spinal hypotension.

In obstetrical patients, during caesarean section, fluid loading (FL) is frequently used either alone (44%) or in association with a vasopressor (53%). Different types of IV fluid and the timing of its administration have been studied (**Mercier FJ, et. Al. 2014**).

Conclusion

From these results we can conclude that there are a significance data variable on effect of spinal anesthesia or subarachnoid block on blood pressure 10 and 20 minutes after spinal anesthesia when we collected the data on four-time interval… some patients treated this drop on blood pressure as a physiological (N/S) or a pharmacological (ephedrine) vasopressor drug.

Recommendation

On the basis of the study, the following recommendation are suggested:

A. Health education program about how to deal with the effect of spinal anesthesia on blood pressure
B. Ongoing researches about how to decrease the effect of spinal anesthesia on blood pressure.

Conflict of Interest

The authors declare no conflict of interest.

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