The changes in Blood Pressure in Patients Undergoing Spinal Anesthesia According to the Size of Spinal Needle (G22 versus G24): Case Reference Study

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Abstract

Background: Previous studies of patients with spinal anesthesia prior to sympathectomy revealed that vasodilatation and hypotension, with subsequent reduction in arterial pressure, were the most common side effects (observed in more than 30% of patients). Hypotension in epidural anesthesia was stated to be more gradual and less extreme than in spinal anesthesia when a comparable amount of anesthesia was given.

Aim of the study: In the current study, we are aiming to evaluate the effect of different size of spinal needle on development of possible blood pressure changes throughout the spinal anesthesia procedure.

Patients and Methods: The current observational case reference study was carried out at Al-Diwaniyah Teaching Hospital in Al-Diwaniyah Province, Iraq. The beginning of the study is dated back to the 3rd of April 2018 and the study continued till September the 15th 2019. It included 60 patients undergoing spinal anesthesia for various surgical operations. In 30 patients a spinal needle of 22 gauge was used whereas in the second group (n = 30), a spinal needle of gauge 24 was used. All patients were instructed to be nil by mouth overnight.

Results: In group 1 (22G), mean systolic blood pressure showed gradual reduction, 139.00 ±8.35 mmHG, 120.67 ±11.43 mmHg, 106.00 ±11.02 mmHG and 97.33 ±10.15 mmHg; similarly, in group 2 (24G) mean systolic blood pressure showed gradual reduction, 144.00 ±10.37 mmHG, 138.00 ± 7.61 mmHg, 131.33 ±9.00 mmHG and 131.67 ±11.40 mmHg**;** however, the rate of reduction in group 2 (G24) was less than that seen in case of group 1 (G22). In group 1 (22G), mean diastolic blood pressure showed gradual reduction, 84.00 ±7.24 mmHG, 72.00 ±6.64 mmHg, 61.33 ±9.73 mmHG and 54.00 ±8.94 mmHg; similarly, in group 2 (24G) mean diastolic blood pressure showed gradual reduction, 87.33 ±7.85 mmHG, 81.33 ±7.30 mmHg, 77.33 ±10.15 mmHG and 78.00 ±5.51 mmHg**;** however, the rate of reduction in group 2 (G24) was less than that seen in case of group 1 (G22).

Conclusion: It appears that the use of narrower spinal needle is recommended as it is associated with significantly less drop in both systolic and diastolic blood pressure, thus less hemodynamic disturbances in patients undergoing spinal anesthesia for various indications

Key words: *blood pressure, spinal anesthesia according, spinal needle (G22 versus G24)*

Introduction

The introduction of regional anesthesia accompanied the isolation of local anesthetic agents, cocaine being the first one, and the first regional technique can be traced back in time to 1898 when the German doctor August Bier did the an operation using spinal anesthesia [1]. The spinal anesthesia is included within the umbrella of neuraxial type of anesthesia in which the local anesthetic agent is introduced directly into the subarachnoid space (intrathecal space) [2,3]. The form of anesthesia procedure used depends on different factors, such as the desires of the anesthesiologist and patient, in addition to the age of the patient, the type of operation, underlying disorders,

the location of the body intraoperatively, the length of the surgery and the methods of pain management [4-6]. Regional anesthesia (spinal and epidural) is often used for surgery involving the lower abdomen or limbs to produce the sensory levels required while having minimal effects on the sympathetic nervous system [7-8]. Spinal and epidural anesthesia contraindications include patient resistance, sepsis, site infection, increased intracranial pressure, local anesthetic allergies and inability to maintain the required body position [4]. A range of advantages have been identified in conjunction with spinal anesthesia, such as negligible failure rate, anesthesia onset is very rapid, pain relief is satisfactory due to dense neuronal blockage and patient morbidity avoidance after major surgery [9-11] ; however, solid opinion about these benefits is lacking. This form of anesthesia is actually preferred for the procedure of the cesarean section due to the rapid start of action. The results of some meta-analyses and randomized controlled clinical trials are uncertain about the outcome and benefits of spinal anesthesia [11-12]

A number of drawbacks have been identified in connection with spinal anesthesia, such as short-term pain relief, increased incidence of hypotension and post-spinal puncture headache (**Erdem et al., 2018; Uchino, 2018; Zorrilla-Vaca et al., 2018**). Previous studies of patients with spinal anesthesia prior to sympathectomy revealed that vasodilatation and hypotension, with subsequent reduction in arterial pressure, were the most common side effects (observed in more than 30% of patients) (**Kang et al., 2014; Agarwal and Kishore, 2009; Schewe et al., 2009**). Hypotension in epidural anesthesia was stated to be more gradual and less extreme than in spinal anesthesia when a comparable amount of anesthesia was given (Agarwal and Kishore, 2009).

In the current study, we are aiming to evaluate the effect of different size of spinal needle on development of possible blood pressure changes throughout the spinal anesthesia procedure.

Patients and Methods

The current observational case reference study was carried out at Al-Diwaniyah Teaching Hospital in Al-Diwaniyah Province, Iraq. The beginning of the study is dated back to the 3rd of April 2018 and the study continued till September the 15th 2019. It included 60 patients undergoing spinal anesthesia for various surgical operations. In 30 patients a spinal needle of 22 gauge was used whereas in the second group (n = 30), a spinal needle of gauge 24 was used. All patients were instructed to be nil by mouth overnight.

They were given the following premedications: ranitidine 50 mg and metoclopramide 10 mg. An intravenous line was established using the antecubital vein by an 18 gauge cannula on arrival to operative room. Monitering included: pulse oximeter, blood pressure, pulse rate and ECG. An intravenous fluid in the form of ringer lactate was given in a dose of 10mg/kg for 10 minutes before starting subarachnoid block. A midline approach was used with the patient in sitting position at L3-L4 or L4-L5 level with a Quincke spinal needle (22G or 24G). Keeping the needle bevel parallel to dural fiber was assured. Injection of heavy bupivacaine 9-12.5 mg (1.8-2.5ml) was performed once clear CSF fluid was obtained.

The approval of this study was made by the institutional ethical approval committee and a verbal consent was made by every participant. Variables included in the current study were gender, age, type of operation and successive measurements of blood pressure. The obtained data were transformed into an SPSS (IBM, Chicago, USA, version 23) spread sheet for purpose of statistical description and analysis. Chi-square test was used to study association between categorical variables whereas, independent samples t-test was used to study mean difference of quantitative variables between the two study groups. The level of significance was set at $P \leq 0.05$.

Results

The present study included 60 patients undergoing spinal anesthesia for various types of operations who were randomly allocated into two groups according to spinal need caliber size (gauge 22 versus gauge 24). The age range and mean age in addition to frequency distribution of patients according to gender are shown in table 1. There was no significant difference in mean age and frequency distribution according to gender between both study groups ($P > 0.05$), table 1. Table 2 shows the frequency distribution of patients according to type of surgical operation.

Table 3 showed the mean systolic blood pressure readings at baseline, 10 minutes, 20 minutes and 30 minutes. In group 1 (22G), mean systolic blood pressure showed gradual reduction, 139.00 ±8.35 mmHG, 120.67 ±11.43 mmHg, 106.00 ±11.02 mmHG and 97.33 ±10.15 mmHg; similarly, in group 2 (24G) mean systolic blood pressure showed gradual reduction, 144.00 ±10.37 mmHG, 138.00 ± 7.61 mmHg, 131.33 ±9.00 mmHG and 131.67 ±11.40 mmHg**;** however, the rate of reduction in group 2 (G24) was less than that seen in case of group 1 (G22), table 3 and figure 1.

Table 4 showed the mean diastolic blood pressure readings at baseline, 10 minutes, 20 minutes and 30 minutes. In group 1 (22G), mean diastolic blood pressure showed gradual reduction, 84.00 ±7.24 mmHG, 72.00 ±6.64 mmHg, 61.33 ±9.73 mmHG and 54.00 ±8.94 mmHg; similarly, in group 2 (24G) mean diastolic blood pressure showed gradual reduction, 87.33 ±7.85 mmHG, 81.33 ±7.30 mmHg, 77.33 ±10.15 mmHG and 78.00 ±5.51 mmHg**;** however, the rate of reduction in group 2 (G24) was less than that seen in case of group 1 (G22), table 4 and figure 2.

The difference in mean blood pressure, whether systolic or diastolic, at similar occasions (10, 20 and 30 minutes) was highly significant between group 1 and group 2 ($P < 0.001$), tables 3 and 4.

Table 1: General characteristics of patients enrolled in the current study

Characteristic	Group 1 (Gauge 22) n = 30	Group 2 (Gauge 24) n = 30	P
Age (years)			
Range	30 - 80	38 - 75	0.119 † NS
Mean ±SD	51.60 ±14.02	56.87 ±11.63	
Gender			
Male, n (%)	22 (73.3 %)	24 (80.0 %)	0.542 ¥ NS
Female, n (%)	8 (26.7 %)	6 (20.0 %)	

n: number of cases; SD: standard deviation; †: independent samples t-test; ¥: Chi-square test; NS: not significant at $P > 0.05$

Table 2: Types of operations according to group

Operation type	Group 1 (Gauge 22) n = 30	Group 2 (Gauge 24) n = 30
Anal fissure	0 (0.0 %)	2 (6.7 %)
Bilateral inguinal hernia	0 (0.0 %)	2 (6.7 %)
Cesarean section	4 (13.3 %)	2 (6.7 %)
Fistula in ano	0 (0.0 %)	4 (13.3 %)
Gluteal mass	2 (6.7 %)	0 (0.0 %)

Cont... **Table 2: Types of operations according to group**

Hemorrhoidectomy	4 (13.3 %)	2 (6.7 %)
Hydrocelectomy	4 (13.3 %)	0 (0.0 %)
Percutaneous nephrolithotomy	4 (13.3 %)	2 (6.7 %)
Pilonidal sinus	2 (6.7 %)	0 (0.0 %)
Prostatectomy	2 (6.7 %)	0 (0.0 %)
Right inguinal hernia	2 (6.7 %)	6 (20.0 %)
Total abdominal hysterectomy	0 (0.0 %)	2 (6.7 %)
Transurethral resection of the prostate (TURP)	2 (6.7 %)	0 (0.0 %)
Ureteroscopy	4 (13.3 %)	4 (13.3 %)
Vesical stone	0 (0.0 %)	4 (13.3 %)

Table 3: Changes in mean systolic blood pressure during operation time according to spinal needle size

Systolic blood pressure (mm Hg)	**Group 1 (Gauge 22) n = 30**	**Group 2 (Gauge 24) n = 30**	**P**
Baseline			
Mean ±SD	139.00 ±8.35	144.00 ±10.37	0.054 † NS
Range	130.00 -150.00	130 -160	
10 minutes			
Mean ±SD	120.67 ±11.43	138.00 ± 7.61	< 0.001 † HS
Range	100.00 -140.00	130 - 150	
20 minutes			
Mean ±SD	106.00 ±11.02	131.33 ±9.00	< 0.001 † HS
Range	90.00 -130.00	120 -150	
30 minutes			
Mean ±SD	97.33 ±10.15	131.67 ±11.40	< 0.001 † HS
Range	80.00 -110.00	110 -150	

n: number of cases; SD: standard deviation; †: independent samples t-test; NS: not significant at $P > 0.05$; HS: Highly significant difference at $P \leq 0.01$

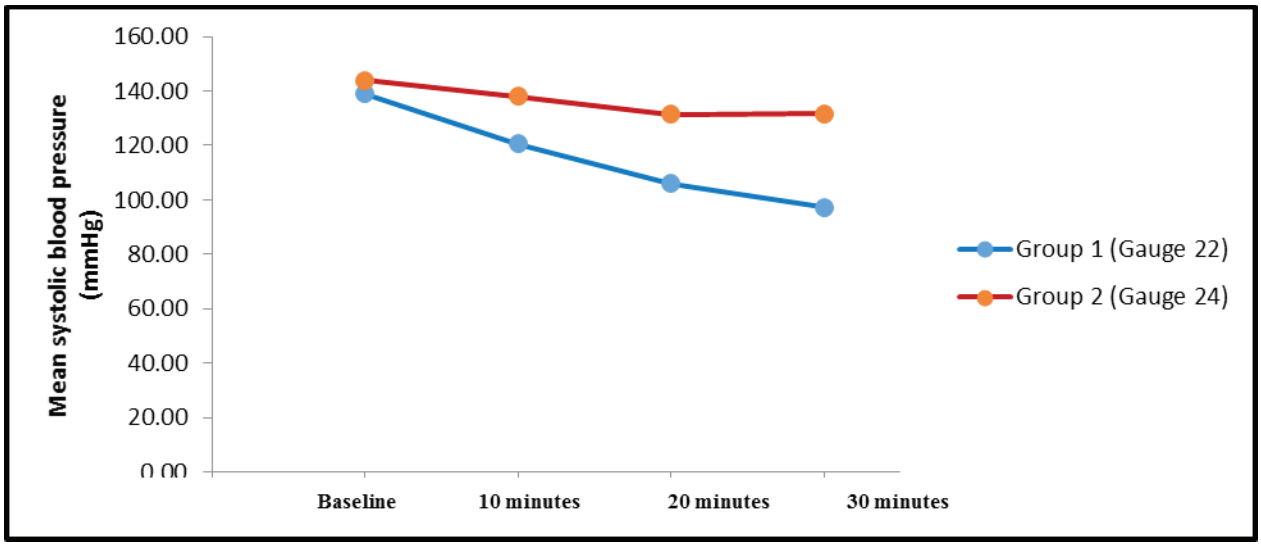

Figure 1: Changes in mean systolic blood pressure during operation time according to spinal needle size

Table 4: Changes in mean diastolic blood pressure during operation time according to spinal needle size

Diastolic blood pressure (mm Hg)	**Group 1 (Gauge 22) n = 30**	**Group 2 (Gauge 24) n = 30**	**P**
Baseline			
Mean ±SD	84.00 ±7.24	87.33 ±7.85	0.093 † NS
Range	70 -100	80 -100	
10 minutes			
Mean ±SD	72.00 ±6.64	81.33 ±7.30	< 0.001 † HS
Range	60 -80	60 -90	
20 minutes			
Mean ±SD			
Range	61.33 ±9.73	77.33 ±10.15	< 0.001 † HS
30 minutes	40 -70	50 -90	
Mean ±SD			
Range	54.00 ±8.94	78.00 ±5.51	< 0.001 † HS
	40 -70	70 -90	

n: number of cases; SD: standard deviation; †: independent samples t-test; NS: not significant at $P > 0.05$; HS: Highly significant difference at $P \leq 0.01$

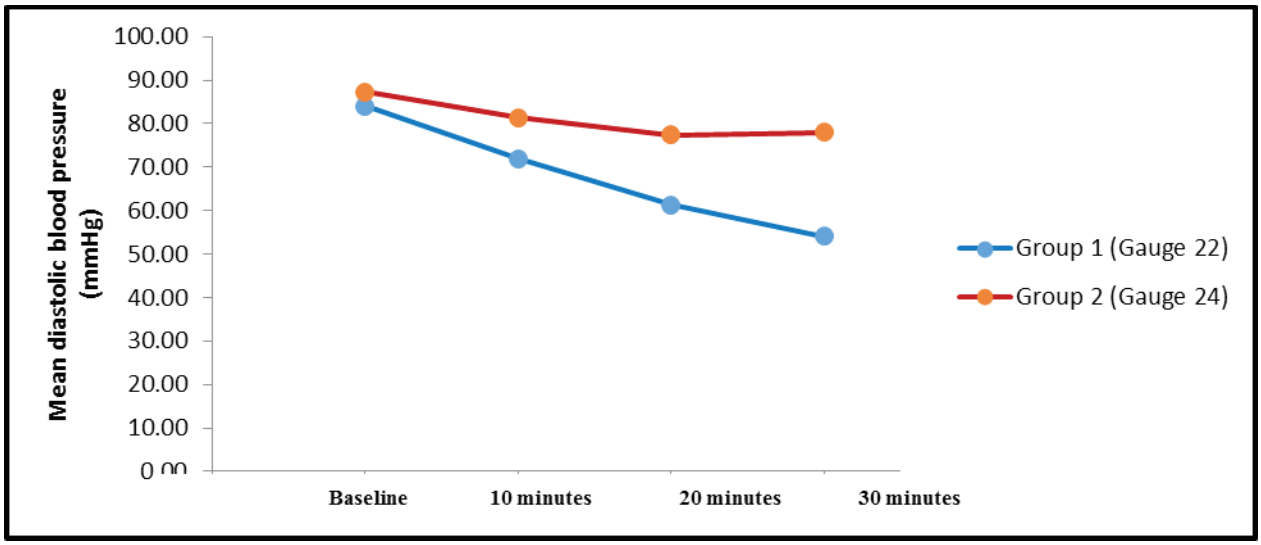

Figure 2: Changes in mean diastolic blood pressure during operation time according to spinal needle size

Discussion

Despite being widely accepted by both patients and doctors, spinal anesthesia has some disadvantages that limit its use a universal technique of anesthesia replacing the need for general anesthesia in daily surgical practice. Based on our clinical experience in Al-Diwaniyah teaching hospital, probably the most feared complication seen in association with spinal anesthesia is the development of hypotension. In the current study we demonstrated that blood pressure gets reduced with advancing time during spinal anesthesia; however, the magnitude of pressure reduction was clearly and significantly affected by needle size, being less with smaller caliber spinal needle of G24 in comparison with wider caliber spinal needle of G22.

Hypotension is a typical spinal anesthesia side effect and occurs in 16–33% of cases (Carpenter et al., 1992). This response is amplified in the elderly where a negative effect on a relatively higher sympathetic resting tone and reduced baroreceptor activity can explain the increased incidence of hypotension in response to spinal anesthesia (Salinas et al., 2003; Hartmann et al., 2002). Either a drop in systemic vascular resistance (SVR) or cardiac output (CO) or both are thought to cause hypotension after the onset of spinal anesthesia (Hofhuizen et al., 2019). A decrease in SVR has been identified by several previous studies as the main determinant of hypotension. In these previous studies patients were given fluid loading just after or before the onset of spinal anesthesia (**Lairez et al., 2015; Nakasuji et al., 2012**). The loading of the fluid will greatly increase the intravascular vloume and therefore the venous return (**Hofhuizen et al., 2019**).

Probably this study is the first study that raised the issue that smaller size spinal needle is associated with significantly less drop in blood pressure during spinal anesthesia technique. Indeed, more research work is needed, experimental and clinical, in order to know exactly the mechanism explaining the lower reduction in blood pressure in association with smaller size spinal needle; however, for the present time it appears that the use of narrower spinal needle is recommended as it is associated with significantly less drop in both systolic and diastolic blood pressure, thus less hemodynamic disturbances in patients undergoing spinal anesthesia for various indications.

Financial Disclosure: There is no financial disclosure.

Conflict of Interest: None to declare.

Ethical Clearance: All experimental protocols were approved under the Al-Diwaniyah Teaching Hospital and all experiments were carried out in accordance with approved guidelines.

References

1. Goerig M, Agarwal K, Schulte AM. Esch J. The versatile August Bier (1861-1949), father of spinal anesthesia. J Clin Anesth. 2000;12:561–9.

2. Smith LM, Cozowicz C, Uda Y. Memtsoudis S G. Barrington M J. Neuraxial and combined neuraxial/general anesthesia compared to general anesthesia for major truncal and lower limb surgery: a systematic review and meta-analysis. *Anesth Analg*. 2017;125:1931–1945.
3. Cozowicz C, Poeran J, Zubizarreta N, Mazumdar M, Memtsoudis S G. Trends in the use of regional anesthesia: neuraxial and peripheral nerve blocks. Reg Anesth Pain Med. 2016;41:43–49.
4. Kiasari A Z. Babaei A. Alipour A. Motevalli S. Baradari A G. Comparison of Hemodynamic Changes in Unilateral Spinal Anesthesia Versus Epidural Anesthesia Below the T10 Sensory Level in Unilateral Surgeries: a Double-Blind Randomized Clinical Trial. Med Arch. 2017;71(4):274–279.
5. Habibi M, Baradari A, Soleimani A, Emami Zeydi A. Nia H S. Habibi A. et al. Hemodynamic responses to etomidate versus ketamine-thiopental sodium combination for anesthetic induction in coronary artery bypass graft surgery patients with low ejection fraction: a double-blind, randomized, clinical trial. J Clin Diagn Res. 2014;8(10):GC01–5.
6. Nordin P, Haapaniemi S, van der Linden W. Nilsson E. Choice of anesthesia and risk of reoperation for recurrence in groin hernia repair. Ann Surg. 2004;240:187–92.
7. Picard J. Meek T. Complications of regional anaesthesia. Anaesthesia. 2010; 65(1):105–15.
8. Faccenda K, Finucane B T. Complications of regional anaesthesia Incidence and prevention. Drug Saf. 2001;24:413–42.
9. Eroglu A. Apan A. Erturk E. Ben-Shlomo I. Comparison of the Anesthetic Techniques. ScientificWorldJournal. 2015;2015:650684.
10. Elakany M H. Abdelhamid S A. Segmental thoracic spinal has advantages over general anesthesia for breast cancer surgery. Anesth Essays Res. 2013;7(3):390–395.
11. Cook T M. Counsell D. Wildsmith J A. Royal College of Anaesthetists Third National Audit Project. Major complications of central neuraxial block: report on the Third National Audit Project of the Royal College of Anaesthetists. Br J Anaesth. 2009;102:179–90.
12. Rodgers A. Walker N. Schug S. Reduction of postoperative mortality and morbidity with epidural or spinal anaesthesia: results of overview of randomised trials. BMJ. 2000;321:1493–7.
13. Agarwal A. Kishore K. Complications and controversies of regional anaesthesia: a review. Indian J Anaesth. 2009;53:543–53.
14. Carpenter R L. Caplan R A Brown D L. Stephenson C. Wu R. Incidence and risk factors for side effects of spinal anesthesia. Anesthesiology. 1992;76(6):906–916.
15. Erdem V M. Donmez T. Uzman S. Ferahman S. Hatipoglu E. Sunamak O. Spinal/epidural block as an alternative to general anesthesia for laparoscopic appendectomy: a prospective randomized clinical study. Wideochir Inne Tech Maloinwazyjne. 2018;13(2):148–156.
16. Ghaffari S. Dehghanpisheh L. Tavakkoli F. Mahmoudi H. The Effect of Spinal versus General Anesthesia on Quality of Life in Women Undergoing Cesarean Delivery on Maternal Request. Cureus. 2018;10(12):e3715.
17. Hartmann B. Junger A. Klasen J. The incidence and risk factors for hypotension after spinal anesthesia induction: an analysis with automated data collection. Anesth Analg. 2002;94(6):1521–1529. table of contents.
18. Hofhuizen C. Lemson J. Snoeck M. Scheffer G J. Spinal anesthesia-induced hypotension is caused by a decrease in stroke volume in elderly patients. Local Reg Anesth. 2019;12:19–26.
19. Kang X H. Bao F P. Xiong X X. Major complications of epidural anesthesia: a prospective study of 5083 cases at a single hospital. Acta Anaesthesiol Scand. 2014;58:858–66.
20. Lairez O. Ferré F. Portet N. Cardiovascular effects of low-dose spinal anaesthesia as a function of age: an observational study using echocardiography. Anaesth Crit Care Pain Med. 2015;34(5):271–276.