Towards Good Health and Well-Being; Risk Factors Assessment for Side Effects of Spinal Anesthesia

Rania Abd Elmohsen Abo El nour [1&2] and M.A. Abdelzaher [3]

[1] Community Health Nursing Department, Beni-Suef Health Technical Institute, Ministry of Health, Beni-Suef 62511, Egypt.
[2] Anesthesia Techniques Department, College of Health and Medical Techniques, Al-Mustaqbal University, 51001, Babylon, Iraq.
[3] Environmental Science and Industrial Development Department, Faculty of Postgraduate Studies for Advanced Sciences, Beni-Suef University, Beni-Suef 62511, Egypt.
*Correspondence: m.abuelseoud@psas.bsu.edu.eg

Abstract

Introduction: SDG optimization is the main goal of the current research, focusing on SDG#3, good health and well-being. Spinal anesthesia is a technique widely used for its efficacy and safety, and it is also known as spinal, subarachnoid, intra-dural, or intra-thecal anesthesia. It is characterized by the administration of an anesthetic in the subarachnoid space that is located between the pia mater and arachnoid meninges to generate a sequential block in the nerve fibers. **Aim of study**: This review aims to investigate and identify the risk factors associated with administering spinal anesthesia. **Method**: We conducted a clinical study in 100 patients to determine the incidence of hypotension (systolic blood pressure less than 90 mmHg), bradycardia (heart rate less than 60 beats/min), nausea, vomiting, and tachycardia during spinal anesthesia. **Results and Findings**: The data were analyzed and organized statistically according to The objective of the current study (the objectives of this study were to identify risk factors and the occurrence of complications during spinal anesthesia) using the SPSS program. Version 28. **Conclusion**: The present study concludes that BMI and the dose of SA were the factors associated with SA-induced hypotension during a CS, and the site of the SA puncture equal to or lower than L2 was the only risk factor associated with spinal anesthesia-induced bradycardia. **Recommendation**; based on the study, the following recommendations are suggested: Health education program about risk factors. and Complication of Spinal anesthesia.

Keywords Good Health and Well-Being; Risk Factor, Spinal Anesthesia

Introduction

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 to generate a sequential block in the nerve fibers. The neurological complications of spinal anesthesia are of great importance in anesthesiology because some can be serious and be due to multiple previous patients, and pharmacological, and genetic factors that can intervene in the complications, as it is a technique widely used in surgery and anesthesiology. When it is necessary to perform a surgical intervention, whose objective is to interrupt the connection between the peripheral nervous system and the brain, spinal anesthesia is used to block painful stimuli **(Acosta et al., 2024), (Doelakeh, & Chandak, 2023), (Al-Husban et al., 2021).**

Spinal anesthesia is commonly used in various surgical procedures, including hernia repair, different types of hysterectomy, cesarean section, prostate surgery, and urological bladder surgeries. In vascular surgeries, it is also frequently utilized for procedures involving the arteries in the legs to treat vascular diseases such as atherosclerosis or deep vein thrombosis Surgery involving areas below the level of the umbilicus (belly button) and lower extremities is recommended for the use of spinal anesthesia **(Casey, 2000).** There are some absolute contraindications, such as patient refusal, infection at the injection site, real medication allergies, intracranial pressure, and coagulation disorders. Furthermore, it presents contraindications such as aortic stenosis, brain-related illnesses, situations of unchanging heart rate, and related restrictions against spinal anesthesia. Additionally, spinal anesthesia should not be used when it is expected that the procedure will extend beyond the duration of the sensory block. Spinal anesthesia can cause a reduction in blood pressure due to vasodilation, and when paired with significant blood loss, it heightens the risk of severe hypotension and potential hypovolemia which may compromise organ perfusion **(Chin & van Zundert, 2023).**

The spinal cord usually ends at the level of L2 in adults and L3 in children. Dural puncture above these levels is associated with a slight risk of damaging the spinal cord and is best avoided. An important landmark to remember is that a line joining the top of the iliac crests is at L4 to L4/5. Remember the structures that the needle will pierce before reaching the CSF (fig 1.). The skin. It is wise to inject a small bleb of local anesthetic into the skin before inserting the spinal needle. Subcutaneous fat. This, of course, is of variable thickness. Identifying the intervertebral spaces is far easier in thin patients. The supraspinous ligament joins the tips of the spinous processes together. The interspinous ligament is a thin flat band of ligament running between the spinous processes **(Javed, 2011), (Al-Thakafy et al., 2024), (Chumpathong et al., 2006),**

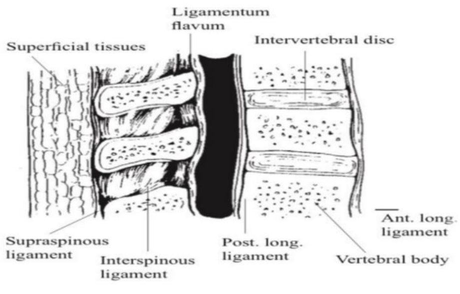

Figure 1. Section of lumbar vertebrae to show the ligaments.

(Abdelzaher et al., 2023).

Figure 1. Section of lumbar vertebrae to show the ligaments

Complications of spinal block are often divided into major and minor complications. Reassuringly, most major complications are rare. Minor complications, however, are common and therefore should not be dismissed. Minor complications include nausea, vomiting, mild hypotension, shivering, itch, hearing impairment, and urinary retention. PDPH and failed spinal block are significant, and not uncommon, complications of spinal anesthesia. We therefore consider them as moderate complications **(Ebner et al., 1960), (Zimpfer, 2012), (Chamberlain& Chamberlain, 1986).**

The first successful spinal anesthetic by August Bier was accompanied by a classic description of PDPH. Bier speculated that this headache was related to loss of CSF and this concept for the mechanism of PDPH and resultant prevention has not changed up to the present **(Norris, 1988).** SA leads to bradycardia and a drop in blood pressure by causing a sympathovagal imbalance in favor of the parasympathetic tone. This bradycardia/hypotension could represent a dysregulation of cardiovascular function or could alternatively be interpreted as an adaptive response (lengthening of the duration of diastole to promote ventricular filling) ***(Harten et al., 2005)***, ***(Pandey et al., 2022).***

Aim of study

This study aims to assess the incidence and risk factors for side effects of spinal anesthesia, through the following objectives: -

1) To assess the risk factor for side effects of spinal anesthesia.
2) To assess complications during and after surgery.

Subjects and methods

Research design:

- A descriptive research design was used to conduct the present study.

Research setting:

- The study was conducted in:
  I. Al-Hilla Teaching Hospital
  II. Dhu Al-Kifl General Hospital
  III. Imam Al-Sadiq Hospital

Subjects

- The subjects of the existing study were 100 patients

➢ Sampling technique

- Convenience sample

➢ Tools of data collection

- The observational checklist was developed by the investigators to collect the necessary data

Ethical considerations

- Official approval was obtained from the College of Medical and Health Techniques, Al-Mustaqbal University. The aim of the study was explained to each patient to gain their confidence and trust. Oral consent was obtained from each patient to participate in the study, after ensuring that the data collected were treated confidentially and he had the chance for withdrawal at any time.

Method

This study was conducted during the period from 20/12/2023 to 15/2/2024 in the hospitals mentioned. The study was performed for 100 patients to determine the incidence of hypotension (systolic blood pressure less than 90 mmHg), bradycardia (heart rate less than 60 beats/min), nausea, vomiting, and arrhythmia during spinal anesthesia, and any other side effects (***DeLeon & Wong, 2020)***

1. Results and Findings

This chapter includes the results of the research, which can be organized in the form of tables through which the objective of the study is clarified, where the data is analyzed for the variables in the research problem, which are as follows. Table 1: Reveals that half the percentage (50%) of patients in the age group (20-30) years old had a higher percentage of female participants in the study sample (81%). Regarding the body mass index, the highest percentage 42% were Very obese. About The American Society of Anesthesiologists (66%) of the study sample at normal health

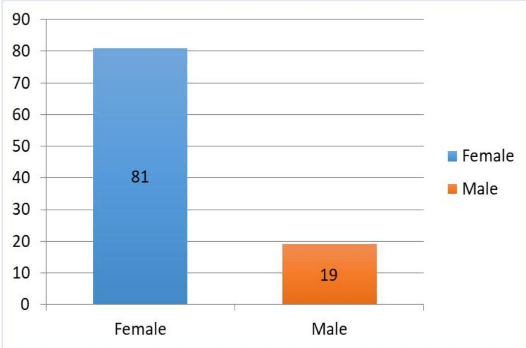

Figure 2. Distribution of the study sample by sex

Figure 2: Reveals that 81% of the study sample were female.

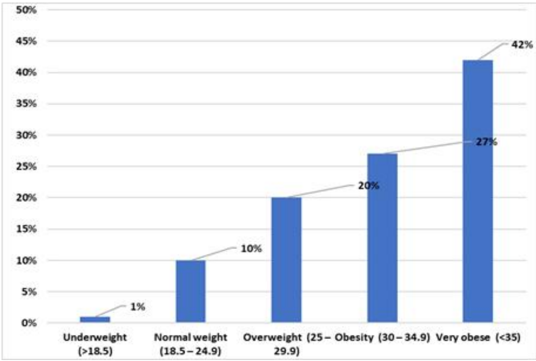

Figure 3. Distribution of the study sample by the BMI

Figure 3: Reveals that 42% of the study sample were very obese their BMI more than 35

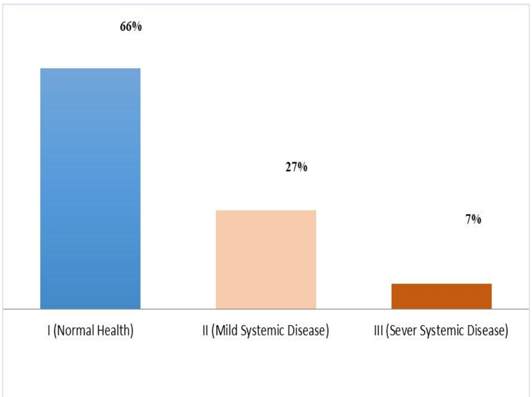

Figure 4. Distribution of the study sample by the ASA

Figure 4: Illustrate the distribution of the study sample by the ASA about 66% of the study sample was normal health.
Table (2) indicates the result of parameters in pre-; intra & post-operative The lowest value in the operative period was, systolic blood pressure (116.31 mmHg); and diastolic blood pressure (73.48 mmHg). The level of oxygen saturation (97.1%) and the heart rate was (83.31 bpm) in the post-operative period.
Table (3): Shows the surgical Procedure of the study sample 66% were cesarean
Table (4): *S*hows the complication during surgery which indicate, no complication (11%); Headache (31%), Hypotension (48%), N.V(8%), Backache (26%), Bradycardia (14%), Shivering (6%), Hypertension (3%), Tachycardia (16%), and all other complications (2%).
Figure (5): shows that about 48% of the study sample had hypotension as a complication during surgery

Table (5), shows the complication after surgery which indicate, N.V (38%), Hypotension (14%), Headache (51%), Tachycardia, Backache (21%), Bradycardia (3%), Shivering (1%).

Table 1: Distribution of the Study Sample by their Socio-demographic Characteristics (n=100)

Socio-demographic Data		**F**	**%**
Age (years)	20 – 30	50	50
	31 – 40	27	27
	41- 50	11	11
	51 – 60	4	4
	61 +	8	8
	Mean ± SD	**(34.98 ±14.57)**	
Sex	Female	81	81
	Male	19	19
BMI	Underweight (>18.5)	1	1
	Normal weight (18.5 – 24.9)	10	10
	Overweight (25 – 29.9)	20	20
	Obesity (30 – 34.9)	27	27
	Very obese (<35)	42	42
ASA	I (Normal Health)	66	66
	II (Mild Systemic Disease)	27	27
	III (Sever Systemic Disease)	7	7

***BMI** (body mass index); **ASA** (American Society of Anesthesiologists); **F**(Frequency); (Percent)*

Table 2: Overall Main of Parameters Measurement

Parameters	**Pre-operative**	**Intraoperative**	**Postoperative**
SBP (mmHg)	129.4	116.31	116.83
DBP (mmHg)	83.92	73.48	76.52
HR (bpm)	84.71	86.45	83.31
SpO_2 (%)	97.1%		

***SBP** (systolic blood pressure**); DBP**(diastolic blood pressure);**HR (**heart rate; **SpO_2**(oxygen saturation)*

Table 3. Surgical Procedure during Surgery

No.	Surgical Procedure	F	%
1.	Cesarean	66	66
2.	Hernia	16	16
3.	Orthopedic	10	10
4.	Hemorrhoidectomy	2	2
5.	Urologic	2	2
6.	Appendectomy	1	1
7.	Oophorectomy	1	1
8.	Fistulotomy	1	1
9.	Rectal Prolapse Fistula	1	1
Total		100	100

Table 4. Complication during Surgery

No.	Complication	F	%
1.	No	11	11
2.	Headache	31	31
3.	Hypotension	48	48
4.	Nausea and Vomiting	8	8
5.	Backache	26	26
6.	Bradycardia	14	14
7.	Shivering	6	6
8.	Hypertension	3	3
9.	Tachycardia	16	16
10.	Other complications	2	2

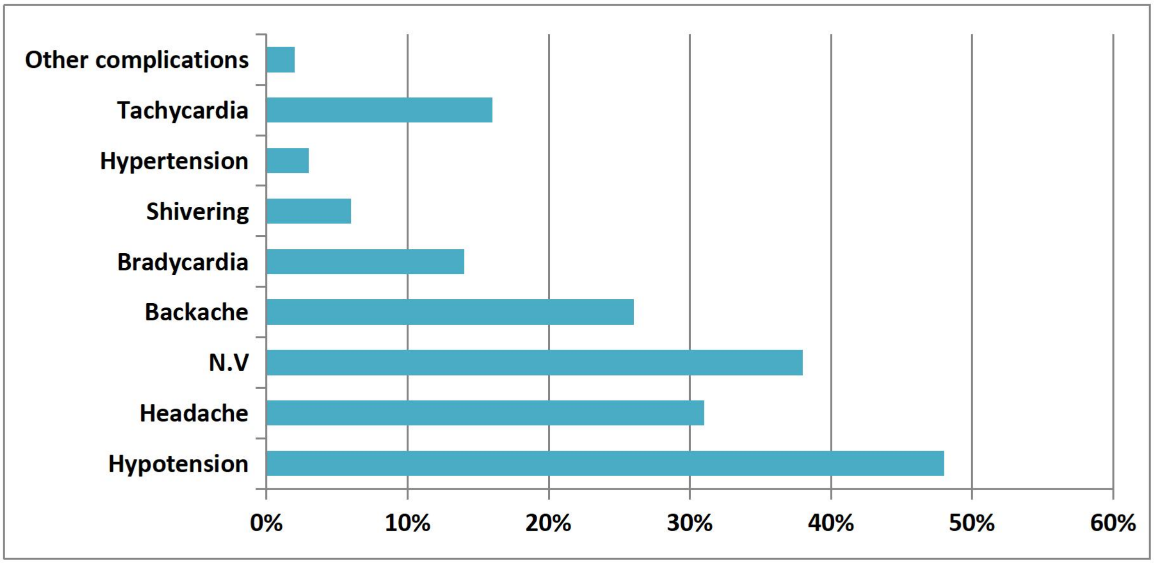

Figure 5. Complication during surgery flowchart

Table 5. Complication after surgery

No.	Complication	F	%
1.	Nausea and Vomiting	38	38
2.	Hypotension	14	14
3.	Headache	51	51
4.	Tachycardia	4	4
5.	Backache	21	21
6.	Bradycardia	3	3
7.	Shivering	1	1

Discussion

Spinal anesthesia is commonly used in various surgical procedures, including hernia repair, different types of hysterectomy, cesarean section, prostate surgery, and urological bladder surgeries The current study findings revealed that about onset of side effect hypotension occurred 28 ± 34 min after subarachnoid injection of local anesthetic. This time of onset is consistent with **(Ferré et al., 2020), (Shitemaw et al., 2020),** (**Aziz et al., 2024), (and Shikur et al., 2018).** in volunteers and surgical patients in which the greatest magnitude of decrease in blood pressure was noted to occur 15-30 min after initiating spinal anesthesia. In patients who had more than one side effect, bradycardia, nausea, and vomiting usually occurred after hypotension.

These mean times should not mislead one, however. Side effects occurred at all times during spinal anesthesia in patients who had been stable for 1h or longer, and occurred in different orders. Thus, this data suggests that interventions to treat side effects may be required at any time during spinal anesthesia.

Also, the current study findings clarify that the heart rate slowed to less than 60 beats/min in 14% of our patients. Bradycardia during spinal anesthesia is believed to result from at least two causes: blockade of sympathetic cardio accelerator fibers and decreased venous return to the heart.

The overall incidence of bradycardia less than 50 bpm during spinal anesthesia found in this study (10.2%) is similar to that found (13%) **(Somboonviboon, 2008)** Sympathetic cardiac accelerator fibers arise from the first four thoracic spinal segments so that a sympathetic block height to T1 should eliminate sympathetic flow to the heart. However, this level of sympathetic blockade during spinal anesthesia is often associated with peripheral vasodilation and a reduction in preload. Patients classified as ASA physical status 1 had more than a 3-fold increase in the odds of developing bradycardia, when compared to those classified as ASA physical This may result from the increased vagal tone that is typically present in younger, healthier patients. In contrast, a peak sensory block height greater than T5 confers less than a 2-fold increase in the odds of developing bradycardia. Thus, peak block height, the traditional risk factor, has the weakest correlation to bradycardia, whereas three simple factors (baseline heart rate, ß-blockade, and ASA physical status) are the strongest predictors.

In a previous study, the incidence of severe bradycardia during spinal anesthesia was 13.4% in patients receiving beta-blockers. Hematological instability did not occur with bradycardia. However non-diabetic patients with allow heart rate were susceptible **(Upadya et al., 2016)**.

Nausea and vomiting also occurred commonly during spinal anesthesia (8%) The etiology of nausea during spinal anesthesia is unknown. Some authors have suggested that unopposed vagal activity, which occurs when sympathetic nerves are blocked during spinal anesthesia, is the cause. Other authors have speculated cerebral hypoxia is the primary cause of nausea during spinal anesthesia. These authors suggest that decreased blood pressure ultimately reduces cerebral blood flow to the extent that cerebral hypoxia occurs and causes nausea. In support of this theory, the authors noted that the incidence of nausea was significantly increased when systolic blood pressure decreased below 80 mmHg and that the incidence of nausea could be decreased by administration of supplemental oxygen .In a previous study patients receiving intrathecal morphine are at increased risk of developing PONV. The cumulative risk during the first 3 postoperative days showed that nearly half of the patients experienced PONV **(Lee et al., 2015), (Moraitis et al., 2020),(May et al., 1949), (Kennedy,2020).** Hypotension occurred frequently during spinal anesthesia (48%) and with an incidence similar to that in previous reports. Physiologic research indicates that hypotension results from a peripheral pooling of blood that decreases venous return to the heart and decreases cardiac output, from a decrease in systemic vascular resistance, or a combination of both, Minor decreases in blood pressure are believed to result primarily from decreases in peripheral vascular resistance, whereas large decreases in blood pressure are believed to be the result of decreases in cardiac output. Although hypotension is clearly defined as "subnormal arterial blood pressure," the definition of subnormal remains controversial, and some readers will likely dispute our choice of 90 mmHg. Indeed, some of our patients were alert and coherent and in no distress even though their systolic blood pressure was less than this threshold. However, previous studies support our choice of 90 mmHg as the definition of hypotension, and in his textbook on spinal anesthesia **(Venn et al., 1989).** The overall incidence of hypotension among mothers who underwent cesarean section with spinal anesthesia in this study was 64%. The incidence of hypotension after spinal anesthesia has been examined for different outcomes. A study in Ethiopia also observed a 36% drop in blood pressure after spinal anesthesia. Other studies in different parts of the world; reported 65.1%, 76.7%, 80%, and 56.5% incidence of hypotension **(Carpenter et al., 1992).**

Conclusion

Research findings revealed that BMI and the dose of the SA were associated risk factors for hypotension associated with induction of SA during CS. However, the site of the SA puncture was the only identifiable risk factor associated with bradycardia. We advise healthcare practitioners and anesthetists to recognize and manage these risk factors to prevent SA-induced hypotension and bradycardia. Although more studies are needed to confirm the association between these findings, the risk factors identified could be a useful tool for decreasing the risk levels of SA complications.

Recommendation

Based on the study, the following recommendations are suggested:

- Health education program about risk factors and complications of spinal anesthesia.
- Ongoing research about how to decrease complications of spinal anesthesia.

Conflict of Interest

The authors declare no conflict of interest.

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