Incidence and Causes of Failed Spinal Anesthesia

Ahmet Yüksek Ökkeş Hakan Miniksar Mehtap Honca Hakan Öz

Department of Anesthesiology and Reanimation, Faculty of Medicine, Bozok University, Yozgat, Turkey

Keywords

Spinal anesthesia · Failed anesthesia · Subarachnoid block

Abstract

Introduction: Spinal anesthesia (SA) is one of the most frequently applied anesthesia procedures today. However, SA failure rate varies between 1 and 17%. The age of the patient, the position at which the procedure is performed, or the characteristics of the technical operation can affect success. In this study, we aimed to compare the most frequent SA failures according to the types of surgery and causes of failure. The results of SA procedures performed in a university hospital were compared to those published in the current literature.

Materials and Methods: After obtaining ethics committee approval for our study, the hospital archives were examined retrospectively for 1 year with respect to SA procedures. SA application and failure rates were examined. Three or more SA attempts, failed dural puncture, or unsuccessful injection, and anesthesia applications that did not provide sufficient sensory block for surgery despite successful drug treatment were defined as failure. **Results:** Of all anesthesia procedures, SA was applied at a rate of 23.5%. Our SA failure rate was calculated as 16.6%. Considering a single surgical procedure, obstetric anesthesia was the most common surgery with failed SA (28.7%). The most common cause of failure was insufficient analgesia (32.9%). **Discussion:** SA failure rates were observed to be in a variable distribution range in the literature, and in some studies, SA failure was defined as a block that did not

occur despite a full dose and successful injection, and this rate was found to be 3.9%. The high rate in our study group may be explained by differences in the definition of SA: blocks performed with several trials and any block that could not be applied were also recorded as SA failure. The reasons for failing to apply this procedure is an issue that is worth examining also in terms of patient satisfaction and safety, which is an important issue. **Conclusion:** Although the definition of unsuccessful SA is confusing, SA failure rates are worth examining and improving for each hospital.

© 2020 The Author(s)
Published by S. Karger AG, Basel

Introduction

A spinal block is a central regional block method characterized by transient sensory, motor, and sympathetic block, which is formed by injection of local anesthetic and additive agents into the subarachnoid space. Spinal anesthesia (SA) blocks the nerve roots through the subarachnoid space [1].

SA is one of the most commonly used anesthesia techniques. It is preferred for both patients and anesthesiologists with the advantages of providing anesthesia and analgesia together, prevention of serious respiratory complications of general anesthesia (GA), and high patient satisfaction [2].

It is the first choice of anesthesiologists especially for cesarean sections because the Apgar score of the newborn

does not decrease, and the awake mother can see her baby. Besides, the main disadvantages of the spinal block are fixed anesthesia duration, hypotension due to vasodilatation, and postanesthetic headache [3].

SA failure may occur when the subarachnoid space is not reached, or analgesia is not sufficient for surgery after drug injection. Repeated trials after failed dural puncture, conversion to GA in patients with high respiratory risk, and the need for sedation after positioning the patient may increase anesthesia-related complications [3, 4].

SA success may be affected by the experience of the practitioner, the characteristics of the patient group, or the patient position. The most common reason for not accessing the subdural space is reported as an inappropriate patient posture. The dose of the drug administered after dural puncture may vary with the technical characteristics of the selected drug, baricity, patient position, duration of surgery, and patient characteristics. Successful SA requires the prediction of these variables and the administration of the appropriate medication dose. These settings are also related to the practitioner's experience [5].

Studies have reported that the SA failure rate is widely distributed with a range from 1 to 17% [6]. Our study aimed to determine the incidence and causes of SA failure in a university hospital and to compare our results with those published in the literature.

Materials and Methods

After approval from the local ethics committee (2017-KAEK-2019-11-27) and obtaining permission to use the hospital archives, the records of SA performed in the same hospital between January 1, 2018, and December 12, 2019, and related data were included in our study.

With the data obtained from patient files and anesthesia records, SA failure was determined as inability to perform dural puncture, dose error, injection failure, failure to administer the full dose, absence of block formation despite administration of the full dose, and the need for >3 attempts to perform dural puncture and injection; the need for sedation to finish the operation was also recorded as a failure [5]. The patient's age and position, type of surgery, needle thickness, and amount of medication were examined. Intraoperative complications related to anesthesia were recorded for the study. Patients whose age and position, operation type, needle thickness, drug dose, or number of trials were not available from the records were excluded from the study.

The most common types of surgery performed with SA and failure rates according to these surgery types were determined. With the data obtained, the most frequent SA failures according to the type of surgery and factors such as patient age and practitioner experience were compared with results published in the literature.

Table 1. Demographic data of the study population

	Mean $\pm$ SD	Range
Age, years	45 $\pm$ 20.19	14–91
Height, cm	166.84 $\pm$ 9.02	150–192
Weight, kg	77.5 $\pm$ 11.8	50–130

The *t* test was used to analyze independent variables. Numerical variables are given in percent. The SPSS program (version 22; IBM, Chicago, IL, USA) was used for statistical analysis.

Results

A total of 1,004 patients were included in the study. Demographic information on these patients (e.g., age and gender) is summarized in Table 1.

Quince-type needles were used in all patients. The most commonly used spinal needles were 24-g needles. The thickest needles had 22 g and the thinnest needle size was 26 g, while there was no difference in success between 22- and 24-g needles ($p = 0.08$). Block success was significantly different between 22- and 26-gauge needles ($p = 0.001$).

Previously, 352 patients were operated under SA or GA, and 652 patients were anesthetized for the first time. There was no difference in SA success rates between these 2 groups ($p > 0.005$).

SA was performed for 34 different operations in a total of 6 different surgical departments. Orthopedic surgeries (geriatric and nongeriatric surgeries) were the most common type with 34.12%, obstetric operations amounted to 28.7%, and urologic operations to 22.08%. These were followed by nonobstetric gynecologic procedures (5.98%), general surgical procedures (4.7%), vascular surgeries (2.9%), and pediatric surgeries (1.1%). Compared to a single surgical procedure, obstetric anesthesia was the most common surgery with a failed SA rate (28.7%) (Table 2).

In our study, anesthesia was applied for 4,264 procedures performed in the same period: 2,436 surgeries were performed under GA; 1,004 operations under SA; 642 procedures under sedation; and 182 procedures with regional anesthesia techniques. The rate of SA was 23.5% in all anesthesia procedures, and the overall failure rate in these 1,004 SA procedures was 16.6% (167 cases).

The most common cause of failure was inadequate SA to initiate or complete surgery 55/167 (32.9%). This was

Table 2. Unsuccessful spinal anesthesia (SA) by type of surgical operation

Operation type	Failed SA		Total operations, <i>n</i>	SA failure according to surgery type, %
	<i>n</i>	%		
Obstetric surgery (cesarean delivery)	48	28.7	242	19.8
Orthopedic surgery				
Geriatric	35	20.95	184	19.0
Nongeriatric	22	13.17	114	19.2
Urologic surgery				
Geriatric	25	14.9	178	14.0
Nongeriatric	12	7.18	98	12.2
Gynecologic surgery (nonobstetric)	10	5.98	69	14.4
General surgery	8	4.7	77	10.3
Vascular surgery	5	2.9	28	17.8
Pediatric surgery	2	1.1	14	14.2
Total	167	100	1,004	–

followed by difficult spinal ($n = 44$) and incomplete intrathecal injection achieved by >3 attempts ($n = 38$). The causes of SA failure are given in Table 3.

The most inexperienced practitioner had 2 years of anesthesia experience, and the most experienced practitioner had 8 years of anesthesia experience, which corresponded to SA failure rates of 15.4 and 15.8, respectively. Intraoperative complications were hypotension (26.2%), bradycardia (26%), nausea and vomiting (22.4%), and agitation (14.2%).

Discussion

Service quality, performance measurements, and patient safety are increasingly prominent and continuous measurements. For this reason, SA success rates should be assessed regularly, and attempts should be made to improve the quality of the procedure [7].

In a study conducted in 1985, the SA failure rate was found to be 17%, and in studies of 2019 and 2020, rates of 3.9 and 3.8% were reported [8, 9]. However, in our study, the rate of SA failure was calculated as 16.6%, which is quite high compared to results in the current literature, but this may also be explained by differences in the definition of an unsuccessful SA.

Rukewe et al. [3] described successful SA as a painless anesthetic that allows surgery. According to this definition, their failure rate in obstetric anesthesia was 9.1%. Fettes et al. [10] defined SA failure if the block was attempted but no block ensued or if the block is present but inadequate

Table 3. Causes of spinal anesthesia failure

Reasons	Patients, <i>n</i> (<i>n</i> = 167)
Insufficient block for surgery/inadequate duration	55 (32.9%)
Success after several trials	44 (26.3%)
Unsuccessful lumbar puncture	38 (22.7%)
Unilateral block/patchy block	12 (7.1%)
Pseudosuccessful lumbar puncture	11 (6.5%)
Solution injection errors	7 (4.1%)

for the surgery, and besides a relatively successful block, a block that could not be created despite successful dural puncture and injection [10]. Oldman et al. [9] defined failed SA as no blocking after a successful dural puncture without technical or dose error. According to this definition, the rate of unsuccessful SA was 3.9% [9]. In our study, >3 attempts and the need for perioperative sedation were also evaluated as unsuccessful SA. We agree with the idea that so far, SA after >3 attempts is not accepted as failed anesthesia. However, in terms of quality and patient satisfaction, a block application performed with a single attempt can be regarded as more successful than multiple attempts. For this reason, we deliberately recorded the number of attempts during SA. Perhaps the definition of failure should also be questioned in this respect.

The most common failures occurred in obstetric surgeries, where the reason for SA failure was recorded as not being able to provide adequate analgesia for surgery after a successful dural puncture. Applying pressure to the uterus causes pain in the mother during delivery, which may cause

the need for sedation after delivery. In our study, the need for sedation to complete the operation was determined as a criterion for SA failure [11]. Orthopedic patients are another group of patients with frequent failures. For these patients, calcified tissue complicates the procedure. A dural puncture can be provided after multiple attempts. Besides, the number of trials may increase in SA performed in the lateral position for the procedures related to the hip fracture. The increase in the number of attempts here was also recorded as a reason for failure. Colish et al. [12] reported a mean failure rate of 3.8% in hip and knee surgeries in their study. This rate is very successful compared to our patient group. However, in this study, repeated SA and >3 attempts are not counted as failure. Only, when the sensory block achieved was not sufficient to initiate or continue the surgical procedure it was regarded as SA failure. This may be the reason for this high difference.

In their studies in 2020, Wilson et al. [1] and De Cassai [13] stated that the use of SA in high-risk patients is higher than expected. These studies support our idea that the performance of this procedure, which is more difficult in patients with risk factors, should be monitored more closely. Although both SA or GA can be preferred in healthy and young patients, for some patient groups, such as pregnant or elderly patients, GA has to be the last option sometimes. In this case, in these special patient groups, SA is more important to avoid complications related to GA. Besides, in these patient groups, the anesthesiologist applying the block may need to be more experienced, and more detailed information should be given to patients regarding the failure rate and its consequences [14].

Although the procedures performed in a university hospital are under professional supervision, the success rate may have decreased since some procedures were performed by less experienced assistants.

The variety, number, and characteristics of the surgical patients may differ from hospital to hospital. In this respect, our data cannot be used to generalize, but they provide valuable information. This point can be considered

as a limitation. In our opinion, the failure to block should be examined in terms of quality in health care as well as patient safety and surgical success. However, the other limitation of our study is that failed SA procedures are not followed up after surgery, and postoperative complications are not included in the study, and the relationship between failure rates and patient satisfaction was not assessed. Unfortunately, these parameters could not be included due to the retrospective design of our study.

SA failure varies according to the characteristics of the procedure and the patient. In light of the current literature, it is considered necessary to determine and reduce failure rates in each anesthesia clinic to improve patient safety and service quality.

Statement of Ethics

The local ethics committee of the Bozok University approved the study (2017-KAEK-2019-11-27), and permission to use hospital archives for the study was obtained.

The study was carried out in accordance with the confidentiality commitment.

Disclosure Statement

The authors have no conflicts of interest to declare.

Funding Sources

There are no funding sources to declare.

Author Contributions

Dr. Ahmet Yüksek designed the study and wrote the article. Drs. Ökkeş Hakan Miniksar and Hakan Öz collected and analyzed the data. Dr. Mehtap Honca reviewed and interpreted the article.

References

- 1 Wilson JM, Farley KX, Bradbury TL, Guild GN. Is Spinal Anesthesia Safer than General Anesthesia for Patients Undergoing Revision THA? Analysis of the ACS-NSQIP Database. *Clin Orthop Relat Res*. 2020 Jan;478(1):80–7.
- 2 Lessing NL, Edwards CC 2nd, Brown CH 4th, Ledford EC, Dean CL, Lin C, et al. Spinal Anesthesia in Elderly Patients Undergoing Lumbar Spine Surgery. *Orthopedics*. 2017 Mar; 40(2):e317–22.
- 3 Rukew A, Adebayo OK, Fatiregun AA. Failed Obstetric Spinal Anesthesia in a Nigerian Teaching Hospital: Incidence and Risk Factors. *Anesth Analg*. 2015 Nov;121(5):1301–5.
- 4 Aasvang EK, Laursen MB, Madsen J, Kroigaard M, Solgaard S, Kjaersgaard-Andersen P, et al. Incidence and related factors for intraoperative failed spinal anaesthesia for lower limb arthroplasty. *Acta Anaesthesiol Scand*. 2018 Aug;62(7):993–1000.
- 5 Turan Z, Bombaci E, Yilmaz M, And Ömür Y. The Effective Factors on Block Success. *Turkiye Klin J Anesthesiol Reanim*. 2017;15(1):9–14.
- 6 Fuzier R, Bataille B, Fuzier V, Richez AS, Maguès JP, Choquet O, et al. Spinal anesthesia failure after local anesthetic injection into cerebrospinal fluid: a multicenter prospective analysis of its incidence and related risk factors in 1214 patients. *Reg Anesth Pain Med*. 2011 Jul-Aug;36(4):322–6.

- 7 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 Dec; 10(12):e3715–3715.
- 8 Levy JH, Islas JA, Ghia JN, Turnbull C. A retrospective study of the incidence and causes of failed spinal anesthetics in a university hospital. *Anesth Analg*. 1985 Jul;64(7):705–10.
- 9 Singh V, Lal S, Thomas J, Narayanan N. ESRA19-0621 Incidence of failed epidural anaesthesia for emergency cesarean section and conversion rate to spinal or general anaesthesia. *Reg Anesth Pain Med*. 2019;44(Suppl 1):A261–62.
- 10 Fettes P, Jansson J, and Wildsmith J. Failed spinal anaesthesia: Mechanisms, management, and prevention. *Br J Anaesth*. 2009 Jun; 102(6):739–48.
- 11 Hoppe J, Popham P. Complete failure of spinal anaesthesia in obstetrics. *Int J Obstet Anesth*. 2007 Jul;16(3):250–5.
- 12 Colish J, Milne AD, Brousseau P, Uppal V. Factors Associated With Failure of Spinal Anesthetic: An 8-Year Retrospective Analysis of Patients Undergoing Elective Hip and Knee Joint Arthroplasty. *Anesth Analg*. 2019 Jul; 130(1):1.
- 13 De Cassai A, Bertencello F, Correale C, Sandei L. Spinal anesthesia is a viable option for emergent laparoscopic procedure in high-risk patients. *Saudi J Anaesth*. 2020 Jan-Mar; 14(1):115–6.
- 14 Tosuner Akpınar V, Koroglu L, Gurbuz Aytuluk H. Evaluation of factors associated with patient satisfaction and mood-state in regional anesthesia. *Agri*. 2019 Apr;31(2):57–62.