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The incidence and causes of failed spinal anesthesia in a tertiary care Hospital: A retrospective observational study

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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 Hospital were comparing to those published in the current literature.
Material and Method: This study was conducted in Department of Anesthesia, MGMMC and M Y Hospital, Indore, Madhya Pradesh, India. It was a one year retrospective study from January 2019 to December 2019. All the parturient undergoing surgery section was included in the study.
Results: Of all anesthesia procedures, SA was applied at a rate of 25.97%. Our SA failure rate was calculated as 17.14%. Considering a single surgical procedure, obstetric anesthesia was the most common surgery with failed SA (27.77%). The most common cause of failure was insufficient analgesia (31.25%) and Unsuccessful lumbar puncture (27.07%)
Conclusion: the incidence of failed spinal anesthesia was found to be higher compared to previous studies with the implication that we should give attention for this disgusting event. Since the study tried to identify risk factors for failure, we should act accordingly to minimize the failure rate.

Keywords: failed spinal anesthesia, obstetric anesthesia, lumbar puncture

Introduction
Spinal anesthesia is one of the most reliable regional technique with minimum risk of failure [1]. Insertion of needle is relatively easy and straightforward and CSF provides a clear indication of successful placement. There is rapid onset of drugs action and excellent anaesthesia [2]. Along with the cheaper cost of spinal anesthesia compared to epidural technique is another reason for its increasing use. However spinal anesthesia is not without complications. One disadvantage of it is the possibility of failed spinal block [3]. At times when despite easy insertion and drug administration there may be no block or inadequate block. Inadequacy may relate to extent quality or duration of local anesthetic agent [1]. Failed spinal anesthesia (FSA) is defined as partial or incomplete spinal block requiring supplemental analgesia or include conversion to general anesthesia, conversion to any different form of anesthesia or pain during surgery [4-7]. 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 post anesthetic headache [8].
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 [8]. Studies have reported that the SA failure rate is widely distributed with a range from 1 to 17% [9].
A study conducted in South Africa showed that the incidence of failed spinal was 11.7% (12.3% in emergency and 9.35% in elective cases) [10]. Which is higher than recommended

by the association of the Royal college of Anesthetists (3% versus 1%). In contrast to the above,

Kinsella reported that the incidence of failed spinal was 0.8% for electives and 4.9% for emergency caesarean sections [11]. The rate of failure was 8% with spinal alone and 18% in combined spinal epidural technique. In UK, Garry and Davies found that the overall incidence of failed spinal was 11.6% [12]. Researchers from United States found that the incidence of failure was 2.7%, of which 1.2% of them were converted to general anesthesia and conversion to general anesthesia has been decreasing from 8% to 4.3% over the three year period [13]. In rural India, failed spinal anesthesia was reported as 5.7% among which only 1.1% of them were converted to general anesthesia and 3.18% of them were managed with successful repeated spinal anesthesia [14]. Others were managed by intravenous analgesia, entonox or by simple manipulation of the operation table. In Nigeria, the overall incidence of failed spinal anesthesia was 9.1%. Among failed cases, 22.8% were converted to general anesthesia, 23.1% were managed by repeated spinal and 54.1% of them were managed using intravenous analgesics [8]. Our study aimed to determine the incidence and causes of Spinal Anesthesia failure in MGMMC and M Y Hospital, Indore, Madhya Pradesh, India.

Material and Method

This study was conducted in the Department of Anesthesia, in MGMMC and M Y Hospital, Indore, Madhya Pradesh, India. It was a one year observational study from January 2019 to December 2019. All the parturient undergoing surgery section was included in the study. 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. Block success was significantly different between 22- and 26-gauge needles. A free flowing clear CSF was confirmed and 10-12 mg of injection bupivacaine heavy 0.5% with 25 µg inj. Fentanyl was injected into intrathecal space. Gauge of spinal needle and drug doses were changed according to the patient weight and height. After performing the block, the patient was placed in supine position and wedge under right buttock was placed. Level of sensory blockage was assessed by loss of sensation to pin prick. Bromage score was used to assess motor block. Surgery was allowed when there was loss of pin prick sensation upto the level of T5. If T5 level was not achieved even after 10 mins of spinal When sensory level was below T10, it was complete failure and managed with general anesthesia with intubation or repeat spinal depending upon the situation at that time. When sensory level was < T5 to T10 it was partial failure and supplemental analgesia was given. 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 re- corded as a failure. The patient's age and position, type of surgery, needle thickness, and amount of medication were examined. Intra-operative complications related to anesthesia were recorded for the study. Patients whose age and position, operation type, needle thickness, drug dose, or number of trials was 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.

Statistical Analysis

The recorded data was compiled and entered in a spreadsheet computer program (Microsoft Excel 2010) and then exported to data editor page of SPSS version 19 (SPSS Inc., Chicago, Illinois, USA). Descriptive statistics included computation of percentages and means.

Results

Table 1: Demographic data of the study population

Gender	N = 840	%a ge
Male	375	44.65%
Female	465	55.35%
Variables	Mean ± SD	Range
Age (years)	45 ± 20.19	12-87
Height (cm)	166.84 ± 9.02	148-188
Weight (kg.)	77.5 ± 11.8	40-120

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

Operation type	Failed SA (N=144)	Failed SA (%)	Total operations (N=840)	SA failed by surgery types (%)
Obstetric surgery (cesarean delivery)	44	27.77	198	22.22
Orthopedic surgery				
Geriatric	31	21.52	163	19.01
Nongeriatric	17	11.80	94	18.08
Urologic surgery				
Geriatric	22	15.27	143	15.38
Nongeriatric	11	7.63	84	13.09
Gynecologic surgery (nonobstetric)	6	4.16	54	11.11
General surgery	7	4.86	69	10.14
Vascular surgery	4	2.77	22	18.18
Pediatric surgery	2	1.38	13	15.38

Table 3: Causes of spinal anesthesia failure

Causes of spinal anaesthesia failure	N=144	%age
Insufficient block for surgery/inadequate duration	45	31.25
Unsuccessful lumbar puncture	39	27.08
Success after several trials	36	25
Unilateral block/ patchy block	10	6.94
Pseudo successful lumbar puncture	8	5.55
Inactive Local Anaesthetic Solution	4	2.77
Experience of practitioner	2	1.38

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 [15].

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 [16, 17]. However, in our study, the rate of SA failure was calculated as 17.14%, 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* [8]. 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* [18, 19]. Defined SA failure if the block was attempted but no block ensued or if the block is present but inadequate for the surgery, and besides a relatively successful block, a block that could not be created despite successful dural puncture and injection [19]. Oldman *et al* [17]. 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%. In our study, >3 attempts and the need for peri-operative 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 at- tempt 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. In our study, the need for sedation to complete the operation was determined as a criterion for SA failure [19]. Orthopedic patients are an- other 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* [20]. 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* [21]. And De Cassai [22]. 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 and 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 [23]. 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 pro- vide 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

Conclusion

Spinal anesthesia is safe, simple and reliable technique but failure can occur at any time by any anesthesiologist, no matter how experienced. Failure can be minimized by proper evaluation of patient anatomy related to procedure, proper storage of anesthetic agents, and appropriate selection of dose along with correct positioning during puncture and immediately after the administration until it is fixed to the tissue. We conclude that most common cause of failure of SA is insufficient block for surgery/inadequate duration, and unsuccessful lumbar puncture. Minimizing the incidence of failure is obviously a prerequisite for gaining the benefits of spinal anesthesia.

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