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A Study on Factors Determining the Difficulty in Subarachnoid Block in Patients Undergoing Lower Limb Surgeries

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Abstract: ***Background: Spinal anesthesia is the most common regional anesthesia widely used for many surgical abdominal, lower limb surgeries. Multiple spinal needle placement attempts may be hazardous. Appropriate preoperative prediction of difficulty helps to the delivery of high quality care. Aims and Objectives: The aim of the study is to predict the difficulty score of spinal anesthesia, by which to reduce the complications and improve the anesthesia quality. Materials and Methods: An observational study was done in the department of Anesthesiology of a rural tertiary care hospital between February 2021 and June 2022. A total of 122 patients scheduled for elective lower limb surgeries were considered and relevant data was taken from it. Results: As the age and Body mass index increases the difficulty score, number of attempts, number of new skin pricks increases. As the Body mass index increases, difficult to palpate spinous process. Conclusion: The proper clinical examination of patients before spinal anesthesia focusing on Lumbar spinous process, presence of lumbar deformity, calculation of BMI and radiological signs of lumbar vertebrae can be helpful in predicting spinal anesthesia difficulty.***

Keywords: spinal anesthesia, spinal needle, difficulty score, Body mass index

1. Introduction

Spinal anesthesia is widely used regional anesthesia technique for many surgical procedures. Multiple spinal needle punctures may cause patient discomfort, a higher incidence of spinal hematoma, post-dural puncture headache, and trauma to neural structures. Many factors influence the anesthesiologist's decision to perform spinal anesthesia. Strong or absolute factors for the subarachnoid block are-the site of surgery, patient acceptance, local site infection, and uncorrected hypovolemia. Other issues are pre-existing neurological disease, coagulopathy, bacteremia, pulmonary disease, mental status, postoperative analgesia, the anesthesiologist experience, and the procedure's anticipated difficulty. The study is to identify the factors that are associated with the technical difficulty of spinal anesthesia. Prevention of a lengthy, difficult, and painful procedure is not the only reason for this study's interest. The technique should be considered for a patient with "difficult block, " and that more experienced provider should take over the difficult procedure at an early stage. The Patient should agree to the next subarachnoid block for any surgical procedure which the patient undergoes in the future. This study aims to determine whether any patient characteristics allow the prediction of the technically difficult neuraxial block. There is a Mallampatti scoring system for the airway assessment, which is clinical and does not require any investigation.

The patients' characteristics have been classified according to their age, B. M. I., spinal bony landmarks to assess interspinous space, and any spinal bony deformity like kyphosis, scoliosis[1]. With these characteristics, a difficult score for the subarachnoid block is developed preoperatively.

2. Materials and Methods

Source of data:
Patients scheduled for elective lower limb surgeries at PES institute of medical sciences and research (PESIMSR), kuppam from February 2021 to June 2022 were included in this study.

Method of collection of data:

Study Population:
After obtaining clearance from the institutional ethical committee and written informed consent from the patient, 122 patients aged 20-80 years of American Society of Anaesthesiologists (ASA) physical status I & II scheduled for elective lower limb surgeries under spinal anaesthesia.

Study Design: Observational study

Sampling Method: Purposive sampling method.

Inclusion criteria:
1) Patients with the American Society of anesthesiologists (A. S. A.) grade I and II of either gender.
2) Patients age >20 years and < 80 years of age undergoing procedure under spinal anesthesia.

Exclusion criteria:
1) Patient refusal
2) Patients below 20 years
3) Patients with A. S. A. grade III, IV of either gender
4) Patients with bleeding diathesis or clotting abnormality
5) Local infection at the site of spinal block spaces
6) Progressive neurological diseases like multiple sclerosis

7) Uncorrected electrolyte imbalance
8) Patients undergoing cesarean section
9) Increased intracranial pressure
10) Systemic sepsis

Procedure for data collection

- The written consent and informed consent from the patients were obtained. The patients will be subjected to detailed pre-anesthetic check-up which includes clinical examination and detailed workup including the patient's age, gender, weight, height, Body mass index (BMI), anatomy of spinous process to assess interspinous space, spine deformity like kyphosis, scoliosis, lordosis were noted.
- Patients will be nil per oral for 6 hours before surgical procedure. Tablet Pantoprazole 40 mg and Tablet Alprazolam 0.5mg (except caesarean section cases) was given to all patients night before surgery.
- Patients will receive an intradermal test dose of inj. Bupivacaine and inj. lignocaine 2 hours before surgical procedure.
- Height is measured to the nearest 0.5cm by asking the study group to stand with heels, buttocks, and the shoulders resting lightly against the wall so that the Frankfurt plane is horizontal. Weight is measured to nearest 0.1kg.
- BMI was calculated by weight (kg)/height (m^2)

Patient Characteristics	0	1	2	3
Age (yr.)	20-40	41-60	>60	
BMI	<18.5	18.5-24.9	>25-29.9	>30
Spinal bony landmarks	Clear	Unclear		
Spinal bony deformity	No	Yes		

Based on these scores, a predictive score is derived.

Each patient is given a score from 0-7 according to patient characteristics. This score is calculated before the performance of the subarachnoid block. A score of 4 and > 4 indicates a difficulty in the performance of the subarachnoid block.

On the day of surgery, patients were shifted to a preoperative room and the I. V line was secured with 18G cannula, IV fluids administered. In the operating room Anaesthesia workstation checked, resuscitation equipment kept ready. Patient shifted to the operation theatre, multichannel monitors were connected and baseline parameters systolic blood pressure, diastolic blood pressure, mean arterial pressure, heart rate, sp02, ECG, respiratory rate were recorded.

Patients were premedicated with iv Ondansetron 4mg. A lumbar subarachnoid block was performed under strict aseptic precautions in all patients in the sitting position. Lumbar puncture was done in L3-L4 intervertebral space with 25G Quincke's needle after local infiltration of the skin using 2% xylocaine 2 cc.

The number of attempts made and the number of new skin pricks made for a successful flow of clear CSF was noted.

Statistical Analysis of Data

- The data will be entered in MS excel 2007 version and further analyzed using SPSS version 21
- Descriptive statistics will be analyzed as follows: the categorical data will be analyzed using percentages, and the continuous data using mean and standard deviation.
- Inferential statistics will be analyzed as follows: Chi-square test, 't' test, etc. will be used. A probability value of <0.05 will be considered statistically significant.

3. Results

Age: In this study, 122 patients with an age group above 20 years were randomly selected. These patients were categorized into 21-40 yrs-30 patients (24.5%), 41-60 yrs-54 patients (44.5%) and > 60yrs-38 patients (31%). There was no statistical significance and was comparable.

Gender: The majority of cases were males-73.5%. The sex difference was statistically insignificant P>0.05. Both males and females were comparable.

BMI: They were categorized into BMI < 18.5-14 patients (11%), BMI 18.5-24.9-25. Patients (20.5%), BMI 25-29.9-78 patients (64%) and BMI > 30-5 patients (4.5%). There was no statistical significance and were comparable.

Spinal Landmark
The spinal landmark was palpable in 38% of patients, and it was not palpable in 62% of patients. There is no statistical significance in spinal landmark palpability P>0.05.

Table 1: Score and attempt

Score	One attempt	> 1 attempt
<4	73.8	16.4
4 and > 4	26.2	83.6

There is a statistically significant association with P<0.000 between the score and number of attempts. As the score is four or > 4 (which indicates a difficult subarachnoid block performance), the number of attempts to perform a successful block increases.

Age with total score

Age (years)	<4	4 and> 4
21-40	53.1	5
41-60	40.7	47.1
60+	6.2	47.9

There is a statistically significant association between age and score. As age increases, the score also increases.

Table 3: Age with number of attempts

Age (years)	1 attempt	> 1 attempt
21-40	48.8	6.9
41-60	33.3	52.6
60+	17.9	40.5

There is a statistical significance between the age and number of attempts P<0.000. As the age increases, the number of attempts increases in performing the subarachnoid block.

Association of BMI with score, number of attempts, spinal landmark, and new skin prick

Table 4: BMI with Total Score

BMI	<4	4 and > 4
<18.5	24.7	1.7
18.5-24.9	38.3	8.4
25-29.9	37	82.4
30+	0	7.6

There is a statistical significance between BMI and the total score P<0.000. As BMI increases, the total score increases.

Table 5: BMI with number of attempts

BMI	1 attempt	> 1 attempt
<18.5	15.5	7.8
18.5-24.9	32.1	12.1
25-29.9	50	74.1
30+	2.4	6

There is a statistical significance between B. M. I. and the number of attempts with P<0.000. As the B. M. I. increases, the number of attempts needed for successful subarachnoid block increases.

Table 6: BMI with spinal landmark

BMI	P	N. P.
<18.5	19.7	5.6
18.5-24.9	32.9	12
25-29.9	47.4	74.2
30+	0	7.3

There is a statistical significance between B. M. I. and the spinal landmark with a P<0.000. As BMI increases, the palpability of the spinal landmark is difficult.

Table 7: BMI and number of New Skin Pricks

BMI	No new prick	New prick present
<18.5	13.2	8.1
18.5-24.9	28.1	10.5
25-29.9	57	73.3
30+	1.8	8.1

There is a statistical significance between B. M. I. and the number of new skin pricks with a P<0.002. As the B. M. I. increases, the number of skin pricks made for successful subarachnoid block increases.

Table 8: Spinal Landmark and Total Score

Spinal landmark	<4	4 and > 4
P	82.7	7.6
NP	17.3	92.4

There is a statistical significance between the spinal landmark and the total score with a P<0.000. As the total score increases, the palpability of the spinal landmark is difficult.

Table 9: Spinal Landmark and number of attempts

Spinal landmark	1 attempt	> 1 attempt
P	72.6	12.9
Np	27.4	87.1

There is a statistical significance between the spinal landmark and the number of attempts with a P<0.000. As the spinal landmark's palpability is difficult, the number of attempts needed to perform the successful subarachnoid block increases.

Table 10: Spinal Landmark with New Skin Prick

Spinal landmark	No new prick	New prick present
P	63.2	4.7
NP	36.8	95.3

There is a statistical significance between the spinal landmark and the new skin prick with a P<0.000. As the spinal landmark's palpability is difficult, the number of new skin prick needed to perform the successful subarachnoid block increases.

Table 11: Number of new skin prick with number of attempts

Number of new skin prick	1 attempt	> 1 attempt
No new prick	98.8	26.7
New prick present	1.2	73.3

There is a statistical significance between the number of new skin prick and the number of attempts made for a successful subarachnoid block with a P<0.000.

4. Discussion

Unpleasant experience to the patients at multiple attempts at subarachnoid block may be hazardous. The patient will not accept the subsequent subarachnoid blocks. The complications will increase. Accurate preoperative prediction of difficulty adds to the delivery of a high success rate. Hence a scoring system for the subarachnoid block was developed on the characteristics of the patients. A relatively simple, easy, and economical scoring system is devised preoperatively to assess the technical difficulty of performing subarachnoid block by the anesthesiologist.

The patients' characteristics have been classified according to their age, BMI, spinal bony landmarks to assess interspinous space, and any spinal bony deformity like kyphosis, scoliosis.

Age:
In this study of 122 patients, it was observed that as the age increased, the number of attempts for a successful subarachnoid block increased. As age increased, the total score also increased (4 and > 4). There is a statistically significant association with P < 0.000 between the age with the number of attempts and increased total score.

A study done by Atallah et al[5], 18 on 300 patients was subjected to urological procedures to assess the difficult predictors for performing a successful subarachnoid block. He found that age is not an independent predictor for a difficult subarachnoid block.

BMI
In this study, it was found as the BMI of the patient was increased; there was difficulty in performing a successful subarachnoid block. The total score (4 and > 4) increased,

the number of attempts needed for successful subarachnoid block also increased. The spinal landmark was not palpable as the BMI increased. The number of new skin pricks made for successful subarachnoid block also increased significantly.

In another study done by Sprung et al[1], 595 neuraxial blocks were done to predict difficulty in performing the procedure. They concluded that the body habitus is an independent predictor for the difficulty in performing the subarachnoid block.

Spinal Landmark

In this study, as the age increased the palpability of the interspinous landmark was difficult. An increase in BMI also increased the nonpalpability of the interspinous space. The number of attempts needed for a successful subarachnoid block also increased, and the number of new skin pricks made also increased as the interspinous is difficult to palpate.

Observations made by Atallah et al.5 and Sprung et al.1 showed that interspinous landmark is an independent predictor of the difficult subarachnoid block.

Karzzan M[4] has also observed that the spinal landmark is an important predictor of the difficult subarachnoid block.

De Oliveira et al[3] had concluded in their study that the successful location of the subarachnoid block at the first attempt is largely influenced by the quality of patients anatomical landmark, the adequacy of patient positioning, and providers' level of experience.

Spinal Deformities Like 'Scoliosis'

For any spinal deformity like scoliosis score of 1 is added. If the anesthesia provider understands and is comfortable with the patient's anatomy, then the provider may cautiously proceed with placement.

In the study by Gupta et al[10]and Misra S et al[9]. More failures in spinal anesthesia occurred in kyphoscoliosis patients and resulted in more failures of SA which was more common in patients with a past spinal surgery.

5. Conclusion

The anticipated technical difficulty is one factor that can influence the anesthesiologist's decision to perform the subarachnoid block. So a relatively simple, easy, and economical scoring system is devised preoperatively to assess the technical difficulty of performing the subarachnoid block.

In conclusion, this study showed that by devising a score by considering patient characteristics preoperatively,

1) The total score increases with age, BMI, no palpability of spinal landmarks, and abnormal spine presence.
2) As the score increases to 4 and > 4, the difficulty in performing a successful subarachnoid block increases.
3) The number (No.) of attempts and the number of new skin pricks increased with an increase in the total score to 4 and >4.
4) Age, BMI, and spinal landmark are independent predictors of the difficult subarachnoid block.

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