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Research Article

Title predictors of difficult subarachnoid block

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ABSTRACT

Background: The aim of this prospective randomised study was to evaluate the association of four patient variables with difficulty in subarachnoid block. These variables are age, BMI, quality of bony landmarks and anatomical abnormality of spine. An attempt was made to prepare a difficulty score to predict this difficulty and assess it's predictive value.
Methods: 498 patients scheduled for surgical procedures under subarachnoid block were included. Each patient was assigned a difficulty score according to gradation of four variables. The difficulty was assessed in terms of number of levels, number of attempts, and completeness of anaesthesia. Since all these variables operated simultaneously and randomly in each patient, multivariate analysis was used with SPSS version 11.5. ROC curves were used to evaluate the sensitivity and specificity of the score. ROC curves were plotted at scores of 2, 3, 4 and 5 and AUC was compared.
Results: This study was successful in preparing a score to predict difficulty in subarachnoid block. A score of 4 or more is indicative of difficulty as far as number of attempts and levels is concerned. However, completeness of anaesthesia could not be predicted with this score.
Conclusions: This difficulty score can enable the anaesthetist to predict a difficult spinal puncture. This is a distinct advantage as multiple attempts are not without hazards.

Keywords: Difficult subarachnoid block, Difficulty score, Predictive value

INTRODUCTION

Due to the possibility of severe complications, there is an extensive body of work devoted to the prediction of difficult intubation. In contrast, there are few studies devoted to prediction of difficult subarachnoid block.

Subarachnoid block is an attractive option because of several distinct advantages. To list a few it is quick and has a definite end point. It is associated with low stress response to surgery. But complications can lead to patient dissatisfaction, neurological sequelae and hematoma.[1,2] Multiple attempts at spinal puncture can be hazardous; therefore, predicting a difficult spinal puncture and block seems essential. Accurate preoperative prediction of difficulty would definitely add to the quality of patient care.

This study was conducted to determine whether any patient characteristics would be useful in predicting a difficult subarachnoid block. This study was designed to determine statistically the association of certain patient variables with a difficult subarachnoid block and develop a simple accurate and easily applicable "difficulty score" for subarachnoid block as well as assess its predictive value.

The objective of the study was to determine statistically the association of certain patient variables with a difficult subarachnoid block, to develop a simple accurate and easily applicable "difficulty score" for subarachnoid block as well as it's predictive value.

METHODS

This was a prospective study undertaken after clearance from local institutional ethics committee. The study population included 498 patients undergoing gynecological, surgical, orthopedic and urological procedures.

Exclusion criteria

- Any condition in which subarachnoid block is relatively or absolutely contraindicated
- Pregnancy

Preoperative evaluation was done as per departmental protocol. Written informed consent was taken.

Determining difficulty score

Preoperative difficulty score was assigned for each patient taking into consideration the factors known to have an effect on the success of lumbar puncture. The rationale behind the definition of each difficulty category is based on accepted knowledge of spinal anesthesia.

These included some subjective and some objective characteristics.

- Age of patient in years and
- Body mass index (BMI) in kg/m^2.
- Assessment of spinal bony landmarks (subjective).
- Anatomical abnormality of spine, which included presence of kyphosis and/or lordosis.

Table 1: Scoring patient variables.

	0	1	2
AGE (years)	20 -40	41 -60	>60
BMI (Kg/m^2)	<20 or 20	21 -27	>27
Spinal bony landmark	Clear	Unclear	
Spinal bony deformity	Absent	Present	

For example, a 65 year old (2 points), obese (2 points), patient with unclear bony landmarks (1 point) and kyphosis of the spine (1 point) will have a score of 6.

The investigator carried out this assessment before the procedure. The investigator was either the chief investigator or any other senior anesthesiologist. The spinous process was designated as "felt clearly" or "felt unclearly".

The difficulty encountered in performing subarachnoid puncture was evaluated by three variables:

- Number of attempts required to have a successful lumbar puncture at initial spinal level or subsequent successful level.
- Number of spinal levels tried to achieve a successful lumbar puncture if it failed at initial level.
- Completeness of spinal anaesthesia.

Each new skin puncture was considered as a new attempt. Redirection of spinal needle in the same space through the same prick was not considered as a new attempt. Paramedian approach was used if initial midline approach was unsuccessful. Number of vertebral levels required for a successful puncture was noted. Completeness of anesthesia was judged according to the blockade. Full sensory and motor blockade was considered as complete anaesthesia. No supplemental analgesia or anaesthesia was required for the patient with "complete" blockade.

Statistical analysis was done by statistical package for social sciences. (SPSS) Version 11.5.

RESULTS

Each of the patient variables was statistically evaluated with outcome variable by Pearson's chi-square test. During this analysis,

- Age was found to be associated significantly with all the outcome variables like number of attempts, number of levels and completeness of anaesthesia.
- BMI was found to be associated significantly with the number of levels.
- Quality of bony landmarks was significantly associated with number of attempts and number of levels but not with completeness of anaesthesia.
- Anatomical abnormality of the spine was found to be significantly associated with number of attempts and number of levels but not with completeness of anesthesia

Predictive Value of the difficulty score

Since all these variables operated simultaneously and randomly in each patient, multivariate analysis was used. ROC curves were used to evaluate the sensitivity and the specificity of the score.

ROC curves were plotted at difficulty score 2, 3, 4, 5 and AUC (area under curve) was compared.

At a difficulty score of 4, AUC was more than 0.7 for number of attempts and the number of levels suggestive of a good predictive value.

AUC for completeness of anaesthesia was less than 0.6. Thus this score cannot predict the completeness of anesthesia.

Table 2: Age distribution of study population.

AGE-group (years)	No.	Percent
a) 20 to 40	187	37.6
b) 40 to 60	226	45.4
c) ≥ 60	85	17.1
Total	498	100

Table 3: Distribution of body mass index of study population.

BMI (Kg/m2)	No.	Percent
a) ≤ 20	143	28.7
b) 21 to 27	303	60.8
c) > 27	52	10.4
Total	498	100

Table 4: Clarity of bony landmarks of study population.

Bony landmark	No.	Percent
Clear	430	86.3
Unclear	68	13.7
Total	498	100

Table 5: Presence of anatomic spinal abnormality of study population.

Anatomic abnormality	No.	Percent
No	476	95.6
Yes	22	4.4
Total	498	100

Table 6: Details of anatomic spinal abnormality of study population.

Anatomic abnormality	No.	Percent
Ank. Spondy	1	0.2
Kyphosis	6	1.2
Lordosis	1	0.2
Scoliosis	14	2.8
Nil	476	95.6
Total	498	100

Table 7: Distribution of difficulty score.

Difficulty score	No.	Percent
0	65	13.1
1	148	29.7
2	160	32.1
3	84	16.9
4	32	6.4
5	9	1.8
Total	498	100

Table 8: Percentage distribution of number of attempts.

No. of attempts	No.	Percent
1	358	71.9
2	68	13.7
3	33	6.6
4	13	2.6
5	12	2.4
6	6	1.2
7	2	0.4
8	4	0.8
9	1	0.2
10	1	0.2
Total	498	100

Table 9: Percentage distribution of number of levels.

No. of levels	No.	Percent
1	445	89.4
2	49	9.8
3	4	0.8
Total	498	100

Table 10: Percentage distribution of completeness of anaesthesia.

Anesthesia	No.	Percent
Complete	485	97.4
Incomplete	13	2.6
Total	498	100

DISCUSSION

In the present study, the factors considered were age, body mass index (BMI), anatomical abnormality of spine and quality of bony landmarks. We have made an attempt to evaluate the impact of each factor and develop a score to predict "difficult" subarachnoid block just as a difficult intubation can be predicted. However it is difficult to evaluate each factor independently as these factors operated randomly and simultaneously in each patient. Hence the method of multivariate analysis and receiver operating characteristics (ROC) curves was chosen.

Our study showed that association between number of attempts and age is significant. p=1.36E-05, LR=5.03E-05. Comparison of number of levels and age shows that association between number of levels and age is significant p=0.001, LR=0.001. When we compared completeness of anesthesia with age, the p value was 0.031 and LR was 0.023. Thus it was significant. It can be said that age increases the difficulty of subarachnoid block. However, the fact that prevalence of osteoporosis, degenerative and other pathological processes of spine increases with age have to be kept in mind.

The accuracy with which a particular lumbar interspace can be identified by palpation is adversely affected by obesity.[3,4] Marking intervertebral space can be done by identification of Tuffier's line or by palpating the vertebra attached to the 12th rib. Palpating the vertebra attached to the 12th rib is difficult in obese patients and Tuffier's is more accurately identified at radiography than by palpation, especially in the obese.[5] Our study showed that body mass index, considered alone is not significantly associated with the outcome in terms of number of attempts or completeness of anesthesia. However, BMI is found to be associated with number of levels required to get successful puncture p=0.020, LR=0.021. Recent studies have concluded that the quality of bony landmarks is a sensitive predictor of technical difficulty of subarachnoid puncture and block. Our study showed that number of attempts and quality of bony landmarks are significantly associated p=6.52 E-21, LR=6.69 E-27.Number of levels and quality of bony landmark are also significantly associated p=6.25 E-21, LR=7.98 E-15. However, completeness of anesthesia is not significantly associated with quality of bony landmark.

Anatomical abnormalities of spine increase the difficulty of subarachnoid block.[6] It is accepted that regional anesthesia poses a challenge in cases of ankylosing spondylitis, rheumatoid arthritis and altered spinal curvature. We found that the number of attempts is significantly associated with the abnormality of spine. P=2.47E-09, LR=0.00021. Number of levels and anatomical abnormality of spine are also associated significantly. P=5.75 E-08, LR=0.0002. However completeness of spinal anesthesia is found not to be associated with anatomical abnormality of spine.

It is well known and generally accepted that certain patient factors are associated with increased difficulty to achieve a successful subarachnoid puncture. However, achieving a successful puncture is dependent on multiple factors. The relative impact of a single factor can only be quantified by multivariate analysis to account for other compounding factors. Therefore, all these factors were considered simultaneously in the form of a "difficulty score". In our study, the association between patient's variable and the outcome was determined by univariate analysis using Pearson's chi-square test. Predictive accuracy of the difficulty score was assessed by ROC (Receiver operating characteristic) curve.[7,8] Thus ROC curves were drawn for difficulty scores at 2, 3, 4, 5 and the "area under curve" was calculated. AUC values of 0.5-0.7 suggest low accuracy and values greater than 0.7 confirm the utility of the score as a predictor. In the present study, we found that BMI is not a very good predictor of difficulty of subarachnoid block, considered alone. The difficulty risk score had a better predictive value. However, except age, none of the difficulty variables were associated with completeness of anesthesia.

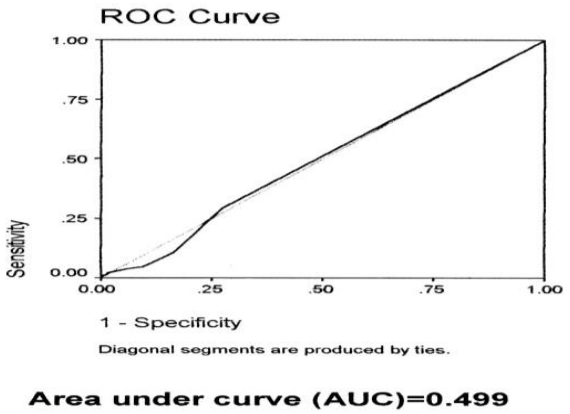

Figure 1: ROC for number of attempts at difficulty score 2.

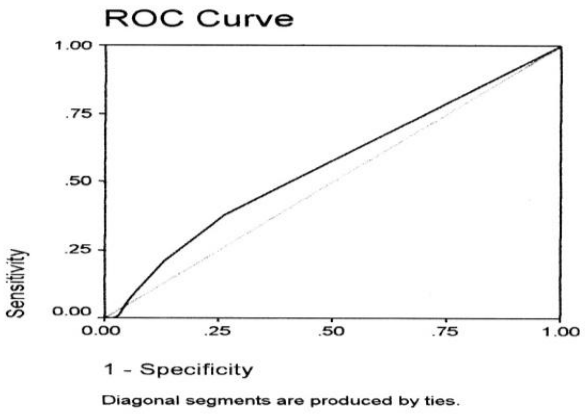

Figure 2: ROC curve for number of attempts at difficulty score 3.

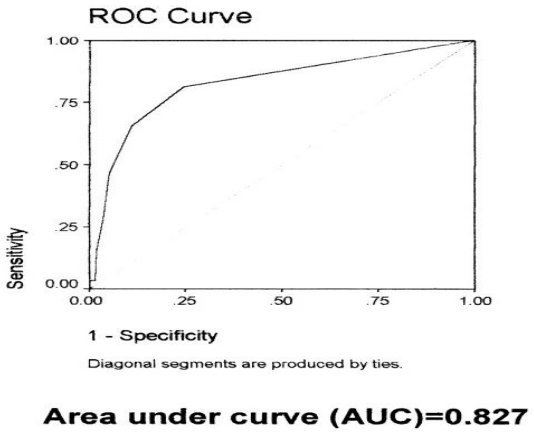

Figure 3: ROC curve for number of attempts at difficulty score 4.

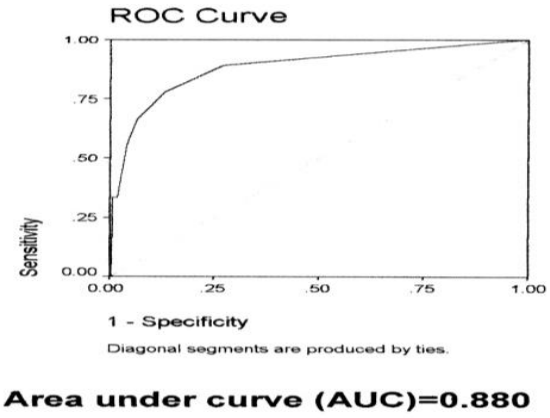

Figure 4: ROC curve for number of attempts at difficulty score 5

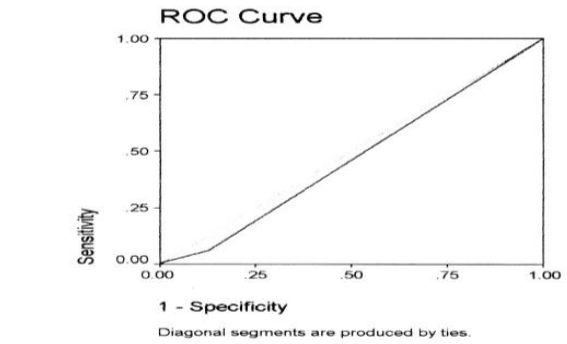

Figure 5: ROC curve for number of levels at difficulty score 2.

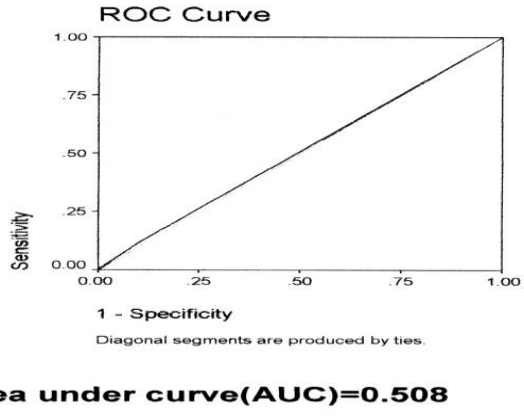

Figure 6: ROC curve for number of levels at difficulty score 3.

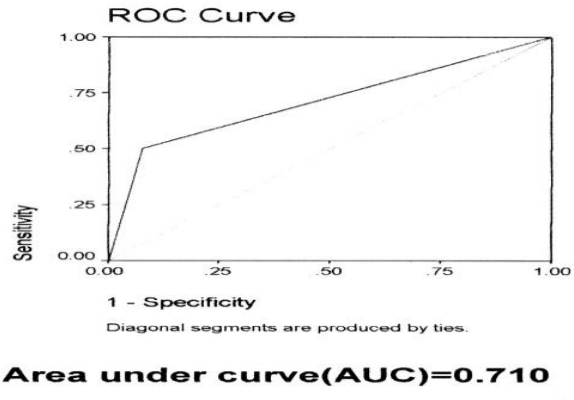

Figure 7: ROC curve for number of levels at difficulty score 4.

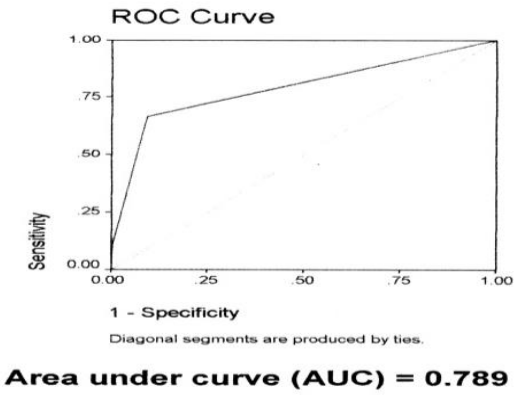

Figure 8: ROC curve for number of levels at difficulty score 5.

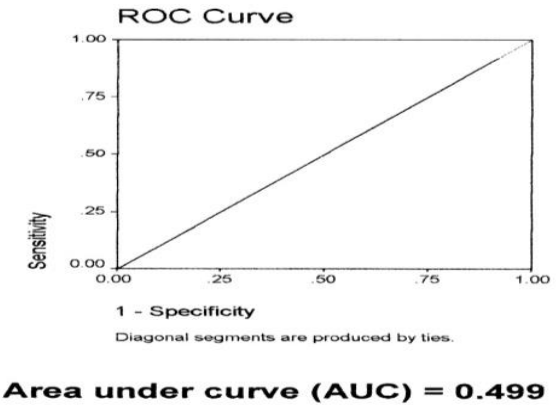

Figure 9: ROC curve for completeness of anesthesia at difficulty score 2.

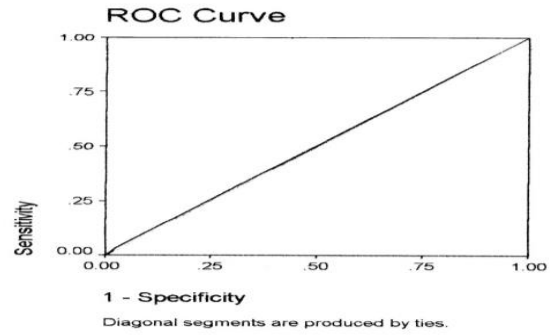

Figure 10: ROC curve for completeness of anesthesia at difficulty score 3.

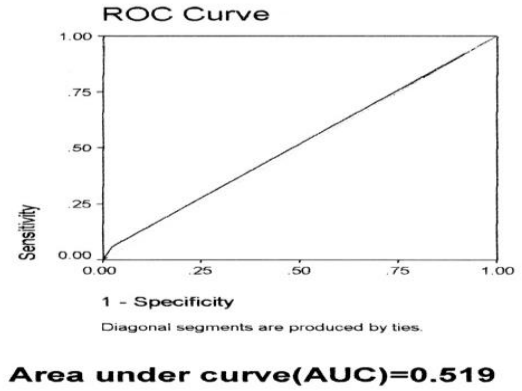

Figure 11: ROC curve for completeness of anesthesia at difficulty score 4.

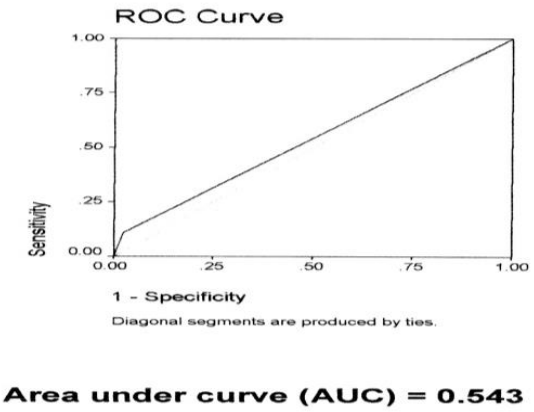

Figure 12: ROC curve for completeness of anesthesia at difficulty score 5.

ROC curves for number of levels at difficulty scores 2,3,4,5 show that area under curve (AUC) is more than 0.7 for score > or = 4 which is suggestive of good predictive value. But AUC for completeness of anesthesia at all difficulty scores is less than 0.6. Hence the difficulty score is not a good predictor for completeness of subarachnoid block. Thus grade 4 was the difficulty score at or above which difficulty in obtaining subarachnoid puncture in terms of number of attempts and number of levels increases.[9]

But this score cannot predict the outcome with respect to the completeness of the blockade. The failure to predict completeness of anesthesia in our study may be related to other factors. A few of these are selection of drug, rate of injection of drug and the dose of local anesthetic. Thus, a discriminate use of this "difficulty score" can help to select patients for subarachnoid puncture in a better manner. Multiple attempts and their sequelae can hopefully be avoided.

CONCLUSION

This study was successful in preparing a score to predict a difficult subarachnoid block. A score more than or equal to 4 is suggestive of increased difficulty in terms of the number of attempts made or the number of levels tried. However, completeness of anaesthesia cannot be predicted with this score.

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Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Renck H. Neurological complications of central nerve blockade. Acta Anesthesiology Scand. 1995;39:859-68.
2. Harrison DA. A survey of failure rate, postdural puncture headache and patient satisfaction. Anaesthesia. 1994;49:88-9.
3. Adams. Obesity and anaesthesia. British J Anaesthesia. 2000;85:91-108.
4. Hogan QH. Tuffier's line. The normal distribution of anatomical parameters. Anaesthesia Analg. 1994;78;194-5.
5. Logic in safe practice of spinal anaesthesia. Anaesthesia. 2000;55:1045-6.
6. Schlew BL. Ankylosing spondylitis and neuraxial block- a 10 year review. Canadian J Anaesth. 1996;43(1):65-8.
7. Armitage P, Berry G. Statistical methods in medical research. Blackwell Scientific Publications. 1987:326-9.
8. De Long, Long DM, Clarke P. Comparing the areas under two or more correlated receiver operating characteristic curves. Biometrics. 1988;44:837-45.
9. M M Atallah. Development of difficulty score for spinal anaesthesia. British J Anaesthesia. 2004;92:354-60.

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