European Journal of Molecular & Clinical Medicine

ISSN 2515-8260 Volume 9, Issue 6, 2022

ORIGINAL RESEARCH

Anatomical predictors of difficult spinal anaesthesia among women who underwent cesarean section in a tertiary care institute – A cross-sectional analytical study

[1]Dr Kangchai Chaudhuri, [2]Dr Sankari Roy, [3]Dr Bappaditya Som, [4]Dr Kaushik Tripura

[1]Assistant Professor, [2,3,4]Associate Professor, Tripura Medical College & Dr BRAM Teaching Hospital, Tripura, India

Correspondence:
Dr Kaushik Tripura
Associate Professor, Tripura Medical College & Dr BRAM Teaching Hospital, Tripura, India
Email: tripurakaushik@gmail.com

ABSTRACT

Introduction: Spinal anaesthesia is one of the widely used anaesthetic techniques among obstetric patients due to its safety. Despite having high success, there are several instances where anaesthetists have found spinal anaesthesia difficult. Several factors influence the anaesthetic difficulty during the technique. We did this study to determine the anatomical factors influencing difficult spinal anaesthesia among women who underwent cesarean section

Methods: We included a total of 100 pregnant women who underwent spinal anaesthesia during the cesarean section. The women were enrolled consecutively during the study period using specific inclusion and exclusion criteria. Difficult spinal anaesthesia was determined based on the scores developed through various parameters. Adjusted analysis was done to determine the independent factors influencing difficult spinal anaesthesia.

Results: All women consented for the study. In multivariable logistic regression analysis, we observed that age group of >35 years, (aOR 1.3 95% CI 1.1 – 1.9), being overweight/obese (aOR 1.7 95% CI 1.2 – 2.3), with previous history of spinal anaesthesia (aOR 1.9 95% CI 1.2 – 2.3), having scoliosis (aOR 1.7 95% CI 1.1 – 2.4), lordosis (aOR 2.9 95% CI 1.7 – 5.3) and kyphosis (aOR 1.8 95% CI 1.2 – 2.7), non-palpable anatomical signs (aOR 1.7 95% CI 1.1 – 3.1) and less narrow non-palpable intervertebral space (aOR 1.9 95% CI 1.2 – 3.8) as independent risk factors for spinal anaesthesia.

Conclusion: Our study results highlight the importance of pre anaesthetic determination of anatomical indices among women who undergo C section to predict difficult spinal anaesthesia among them

Keywords: Caesarean Section, Anatomical Indices, Spinal anesthesia, Anaesthetists

INTRODUCTION

Spinal anaesthesia, introduced by Bier in 1898, is an age-old technique that mainly relies on anatomical landmarks. (1) Owing to its simple technique and success, it emerged as the most common and safe method for obstetric patients and other lower abdominal surgeries (2,3)There are several factors that influence the anesthesiologist's decision to perform spinal anaesthesia namely, the experience of the anesthesiologist, difficulty in securing the airway in obstetric patients, and anatomical signs of the patients undergoing anaesthesia. (4,5) A few

studies have established the role of anatomical parameters of patients as a crucial tool for predicting difficult spinal anaesthesia. (6,7)

Difficult spinalanaesthesia results in multiple attempts for needle placement leading to several complications like hematoma, neurological trauma, post-dural headache and even permanent neurological damage. To overcome the same, it is advocated to use a smaller gauge needle (27G) and conduct a comprehensive pre-operative assessment to identify key features that result in difficult spinal anaesthesia. Evidence from various studies has shown that patients related factors like age, body habitus, position including anatomical features of the back, spinal cord, the extent of visibility of the vertebra, radiological features of lumbar vertebra,the distance between subarachnoid and the epidural space etc. are the most important independent determining factors of difficult spinal anaesthesia. Thus, in general, these factors can be subcategorized as patient factors, anaesthetist related factors, and equipment related factors.(8,9) The most common variable used in different studies, to define the degree of difficulty in performing spinal anaesthesia is graded through the number of attempts/skin punctures made to give the spinal. (10)

Studies have documented those efforts taken to predict the difficult spinal anaesthesia prenatally, using anatomical parameters, not only increases the easiness of performing the procedure but also increases the success rates, reduce patient complications, thereby increasing the quality of care provided. (11,12) However, these prediction studies are highly region-specific, and its accuracy varies according to the type of study population. There is a paucity of literature in understanding the factors associated with difficult spinal anaesthesia especially from an Indian setting. Thus, this study was undertaken to determine the various factors associated with difficult spinal anaesthesia, with a special focus on anatomical parameters, among women who underwent cesarean section in a tertiary care institute.

METHODS

We conducted a cross-sectionalanalytical study among women who underwent spinal anaesthesia before their C section surgery at the Tripura Medical College and Dr Bram Teaching Hospital. We recruited all patients consecutively until the same size was reached. The data collection was done over a period of 3 months from the major surgical operation theatre of the obstetrics department.

The study participants were recruited with inclusion criteria of all adult pregnant women who were operated elective or as an emergency cesarean section with lumbar spinal anaesthesia. Women who had ASA III/IV, not consenting to the study, hadcontraindications for spinal such as coagulopathy, h/o spinal surgery, and who were planned general anaesthesia for cesarean were excluded. The sample size was calculated based on a previous that estimated the proportion of difficult spinal anaesthesia to be 52%, with 10% relative precision, 95% CI, the sample size was calculated to be 95 based on OpenEpi software version 3.01, however, we included around 100 participants for our study. (13)The study was undertaken after obtaining ethics approval from the Institute Ethics Committee. A pretested semi-structured questionnaire was used to record all the sociodemographic characteristics, patients' characteristics and the anatomical parameters of the study participants. We measured the body parameters of women categorized as underweight, normal and obese based on pre-pregnant BMI. Maximal flexor strength in standing position was used to express the abdominal flexors, and the extent of bending was measured as concave, straight and convex, with concave and straight were again reconciled as the inability to bend back. The patient position during the spinal was done according to recommended guidelines. (Sitting with head on the chest, curved towards their lumbar side and forwarded shoulders) Spinal anaesthesia was performed by well-experienced anesthesiologists with a mean experience of more than 10 years at the intervertebral level of L4-L5 or L3-L4 using the midline methods along with

bupivacaine heavy 0.5%. Lumbar spine's anatomy was evaluated based on observation of the spinous process as i) Grade I (presence of carnation) ii) Grade-II (palpable crop) iii) Grade III (cropping is not palpable or visible). The intervertebral space was graded based on the degree of touching as good (easy to touch), weak (difficult to touch) and none (not palpable at all). Difficult spinal anaesthesia is a complex phenomenon encompassing a combined observatory note on the presence of a lumbar deformity, by the touch of spinous process grading, and through any visible deviationsin the lumbar spine such as scoliosis or kyphosis etc. The outcome variable that is difficult spinal anaesthesia was defined for this study was based on the scoring system developed based on the above parameters. Factors such as the number of redirections or attempts made, nature of needles used, the approach used for SA, and the final score obtained ranged from 0-6. Score 0 was defined as SA done in the first attempt without any difficulty or movement, score 1 as SA done in the first attempt within 1 or 2 redirections, Score 3 as a new attempt tried in the same space or at another level, Score 4 as a new paramedian approach, and Scores 5 and 6 as new attempt with a new larger needle and failure in performing SA respectively. After which these scores were then regrouped into 0-2 as easy and moderate, and scores 3-6 as difficult SA. Finally, information on the complications of SA was also noted among the study participants.

Data was entered into excel and analyzed using SPSS 20. Numerical variables were expressed as mean± standard deviation, while categorical variables were summarised as frequency and proportions. Comparison between the outcome variable and the independent variable was done using Chi-square test or the fischer exact test. Variables with p values less than 0.20 in univariate analysis were taken for multivariable logistic regression. A *P*-value <0.05 was considered statistically significant.

RESULTS

We finally recruited around 100 patients whounderwent a C section with spinal anaesthesia for our study. Table 1 depicts the demographic and anatomical characteristics of the study participants. We found that the majority (69%) of the study participants belonged to the age group between 25-30 years, with a mean age distribution of 28.3 ± 7.6 years. Around 62% of the study participants had normal BMI, whereas 27% were underweight according to prepregnant BMI. Around 89% of the study participants were given spinal in sitting position, and 15% had previous spinal anaesthesia done for prior pregnancies. Around 85% did not have any spinal deformity, while three individuals have kyphosis, scoliosis and 9 had lordosis. Around 71% were able to bend the waist, 74% had hardly palpable anatomical signs, and 72% % had hardly palpable intervertebral interval

Table 1: Demographic and anatomical characteristics of the study participants (N=100)

Characteristics	Frequency (%)
Age group	
<25 years	21(21.0)
25-30 years	69 (69.0)
>35 years	10 (10.0)
BMI	
Undernourished	27 (27.0)
Normal	62 (62.0)

Overweight/Obese	11 (11.0)
Position of the patient	
Lateral	11 (11.0)
Sitting	89 (89.0)
Occupation	
Employed	19 (19.0)
Unemployed/housewife	81 (81.0)
Previous history of Spinal anaesthesia	
Yes	15 (15.0)
No	85 (85.0)
Lumbar deformity	
Normal	85 (80.0)
Scoliosis	3 (3.0)
Kyphosis	3 (3.0)
Lordosis	9 (9.0)
Ability to bend the waist	
Straight	71 (71.0)
Concave	14 (14.0)
Convex	15 (15.0)
Anatomical signs	
Visible and touchy	18 (18.0)
Hardly palpable	74 (74.0)
Not palpable	8 (8.0)
Intervertebral interval	
Palpable	19 (19.0)
Hardly palpable	72 (72.0)
Not palpable	9 (9.0)

With respect to the outcome variable based on the score devised we found that around 23 individuals (23%) had difficult spinal anaesthesia. Table 2 describes the univariate and multivariate association between the independent variables (demographic and anatomical characteristics) with the outcome (difficult spinal anaesthesia)

Table 2 explains the multivariable regression between socio-demographic, anatomical characteristics with difficult spinal anaesthesia. We found that age group of >35 years,

(aOR1.395% CI 1.1 – 1.9), being overweight/obese (aOR 1.795% CI 1.2 – 2.3), with previous history of spinal anaesthesia (aOR 1.995% CI 1.2 – 2.3), having scoliosis (aOR 1.795% CI 1.1 – 2.4), lordosis (aOR2.995% CI 1.7 – 5.3) and kyphosis (aOR 1.895% CI 1.2 – 2.7), non-palpable anatomical signs (aOR 1.795% CI 1.1 – 3.1) and less narrow non-palpable intervertebral space (aOR 1.995% CI 1.2 – 3.8) to be independent risk factors for spinal anaesthesia after adjusting for the variables included in the model.

Table 2: Multivariable regression between socio-demographic, anatomical characteristics with difficult spinal anaesthesia, N=100

Characteristics	Difficult SA n (%)	Unadjusted OR	Adjusted OR	P value
Age group				
<25 years	3 (14.2)	1	1	-
25-30 years	12 (17.4)	1.4 (0.9 – 1.7)	1.1 (0.8 – 1.6)	0.08
>35 years	8 (80.0)	1.7 (1.1 – 2.1)	1.3 (1.1 – 1.9)	0.04
BMI				
Undernourished	5 (18.5)	0.9 (0.5 – 1.3)	0.6 (0.4 – 1.1)	0.09
Normal	10 (16.1)	1	1	-
Overweight/Obese	8 (72.7)	1.8 (1.2 – 2.3)	1.7 (1.2 – 2.3)	0.03
Position of the patient				
Lateral	3 (27.8)	1.1 (0.7 – 1.2)	Not included in the model	
Sitting	20 (22.4)	1		
Occupation				
Employed	4 (21.3)	1.1 (0.7 – 1.2)	Not included in the model	
Unemployed/housewife	19 (23.4)	1		
Previous history of Spinal anaesthesia				
Yes	10 (66.7)	2.3 (1.7 – 4.9)	1.9 (1.2 – 2.3)	0.001
No	13 (15.2)	1	1	-
Lumbar deformity				
Normal	12 (14.1)	1	1	-
Scoliosis	2 (66.7)	2.1 (1.6 – 4.7)	1.7 (1.1 – 2.4)	0.001
Kyphosis	2 (66.7)	2.1 (1.6 – 4.7)	1.8 (1.2 – 2.7)	0.001
Lordosis	7 (77.7)	4.4 (2.7 – 7.9)	2.9 (1.7 – 5.3)	0.001
Ability to bend the waist				
Straight	17 (23.9)	1.3 (0.8 – 1.7)	Not included in the model	
Concave	2 (14.2)	1		
Convex	4 (26.6)	1.2 (0.7 – 1.9)		
Anatomical signs				

Visible and touchy	5 (27.7)	1	1	-
Hardly palpable	14 (18.9)	1.4 (0.9 – 2.1)	1.2 (1.0 – 2.2)	0.06
Not palpable	4 (50.0)	2.1 (1.6 – 4.4)	1.7 (1.1 – 3.1)	0.001
Intervertebral interval				
Palpable	3 (15.7)	1	1	-
Hardly palpable	15 (20.8)	1.4 (0.9 – 2.6)	1.3 (1.0 – 2.6)	0.05
Not palpable	5 (55.5)	2.2 (1.6 – 4.1)	1.9 (1.2 – 3.8)	0.001

DISCUSSION

We performed a cross-sectional analytical study to determine the sociodemographic and anatomical factors associated with difficult spinal anaesthesia among women who deliver through caesarean section in a tertiary care institute. We finally found that anatomical factors played a major deterministic role in predicting difficult spinal anaesthesia.

In our study the proportion of difficult spinal anaesthesia as experienced by the anaesthesiologists was found to be 23% (95% CI 13.4% – 31.4%). This prevalence was found to be comparable to findings from other different studies done by Buono et al and Prakash et al. (13,14) But this proportion was found to be lesser than the prevalence seen in a study by Atashkoei et al, which could be explained by variations in the patient characteristics and anaesthetist characteristics like anaesthetists experience in performing spinal anaesthesia. (15)

Our results showed that increased age is an important determinant of difficult spinal anaesthesia. A previous study done by Atashkoei et al from Iran also showed that increasing age is an indicator for difficult anaesthesia. (15) We found that women in BMI category of overweight and obese during their pre pregnancy had an increased chances of having difficult SA, this finding was also supported by other studies done in varied study settings. (ref) Our finding of increased chances of recurrence of difficult SA is a very well documented evidence from various other studies done previously. (16,17)

With respect to the anatomical factors, we included we found that anaesthetists had difficult SA with women who had spinal deformities like scoliosis, kyphosis and lordosis, this proves the fact that the presence of spinal deformities tends to increase the inability of anaesthetists to perform a single correct puncture, thereby warranting an increase in the number of attempts and need of different gauge needle. This finding is also well documented and proved through other studies. (15,18)

We observed that anaesthetists had difficult SA with women who had non/difficult palpable anatomical indices (aOR 1.795% CI 1.1 – 3.1) when compared to women who had easily palpable anatomical indices. This finding is again shouldered by studies done by Atashkoei et al from Iran and Prakash et al from India. (14,15) Though the other studies found significance even for hardly palpable anatomical indices, we did not observe the same, which could be explained by the differences in physical structure, height, weight, race, ethnicity and other patient characteristics between the study participants included in the comparator studies.

With respect to the intervertebral interval, we found that the anaesthetists had difficult SA with the women who had non-palpable or very narrow intervertebral interval or space, i.e anaesthetists have 1.9 times higher chances of experiencing difficult spinal anaesthesia among women with narrow intervertebral space when compared to women who have normal or wider intervertebral space. These findings are also found to be comparable with other studies done in varied study settings. (14,19)

Thus our study findings highlight the importance of evaluating the anatomical indices preoperatively for the prediction of difficult spinal anaesthesia.
Our study had the strength of evaluating the role of anatomical parameters in determining difficult spinal anaesthesia among women from the Northeastern part of India as there is a paucity of literature available among this specific ethnicity of India. Our study had a few limitations. First, our sample size was small to capture all the factors associated with difficulty SA, secondly, we did not include all anatomical indices into account for the study. Thirdly, our findings were from a single tertiary care hospital from northeastern India, so it is generalisable only to similar settings. Lastly, we did not factor in other determinants of difficult intubation such as anaesthetist and equipment-related factors.

CONCLUSION

Thus through our study results, we conclude that anatomical indices and patient characteristics like age and previous history of spinal anaesthesia play a deterministic role in predicting difficulty spinal anaesthesia among anaesthetists. Thus, predicting difficult SA preoperatively would enable the clinician to take necessary precautions during the surgery. Furthermore, we encourage future research to comprehensively include the anaesthetist and equipment-related factors for determining difficult SA.

ACKNOWLEDGEMENTS

The authors declare that they have no conflicts of interest.

REFERENCES

1. Khraise WN, Allouh MZ, El-Radaideh KM, Said RS, Al-Rusan AM. Assessment of risk factors for postdural puncture headache in women undergoing cesarean delivery in Jordan: a retrospective analytical study. Local Reg Anesth 2017; **10**: 9-13
2. Sprung J, Bourke DL, Grass J, et al. Predicting the difficult neuraxial block: a prospective study. Anesthanalg 1999; **89**: 384-9
3. Shankar H, Rajput K, Murugiah K. Correlation between spinous process dimensions and ease of spinal anaesthesia. Ind J of Anaesth. 2012;56(3):250-254.
4. Bajwa SJ, Bajwa SK. Anaesthetic challenges and management during pregnancy: Strategies revisited. Anesth Essays Res. 2013;7(2):160-167.
5. Parish M, Panahi JR, Afhami MR, Pour AM. Role for the second anesthesiologist in failed intubations. AnesthAnalg. 2006;102(3):971.
6. Sprung J, Bourke DL, Grass J, Hammel J, Mascha E, Thomas P, et al. Predicting the Difficult Neuraxial Block: A Prospective Study. AnesthAnalg. 1999;89:384-389.
7. Chien I, Lu IC, Wang FY, Soo LY, Yu KL, Tang CS. Spinal Process for Difficult Epidural Block: A Prospective Study in Taiwanese Patients. Kaohsiung J Med Sci. 2003;19:563-568.
8. Shah KH, McGillicuddy D, Spearb J, Edlow JA. Predicting difficult and traumatic lumbar punctures. Am J Emerg Med. 2007;25:608-611.
9. Khoshrang H, Falahatkar S, Heidarzadeh A, Abad M, RastjouHerfeh N, Naderi Nabi B. Predicting difficulty score for spinal anesthesia in transurethral lithotripsy surgery. Anesth Pain Med 2014; **4**: e16244
10. Weed JT, Taenzer1 AH, Finkel KJ, Sites BD. Evaluation of pre-procedure ultrasound examination as ascreening tool for difficult spinal anaesthesia. Anaesth. 2011;66:925-930.
11. Ranjini1 SS, Malarvizhi AC. Ultrasonographic guidance in the prediction of difficult spinal anesthesia in older patients. J Evol Med Dent Sci. 2014;3(30):8340-8354.

12. Kopacz DJ, Neal JM, Pollock JE. The regional anesthesia "learning curve." What is the minimum number of epidural and spinal blocks to reach consistency? Reg Anesth 1996;21:182-90.
13. Buono R, Pascarella G, Costa F, Terranova G, Leoni ML, Barbara E, et al. Predicting Difficult Spinal Anesthesia: Development Of A Neuraxial. Minerva Anestesiol. 2020 Dec 16.
14. Prakash S, Mullick P, Kumar SS, Diwan S, Singh R. Factors predicting difficult spinal block: A single centre study. J Anaesthesiol Clin Pharmacol. 2021 Jul;37(3):395.
15. Atashkhoei S, Samudi S, Abedini N, Khoshmaram N, Minayi M. Anatomical predicting factors of difficult spinal anesthesia in patients undergoing cesarean section: An observational study. Pak J Med Sci. 2019;35(6):1707-1711.
16. Ranjini1 SS, Malarvizhi AC. Ultrasonographic guidance in the prediction of difficult spinal anesthesia in older patients. J Evol Med Dent Sci. 2014;3(30):8340-8354.
17. Duniec L, Nowakowski P, Kosson D, Lazowski T. Anatomical landmarks based assessment of intravertebral space level for lumbar puncture is misleading in more than 30%. Anaesthesiol Intensive Ther. 2013;45(1):1-6.
18. Fettes PD, Jansson JR, Wildsmith JA. Failed spinal anaesthesia: Mechanisms, management, and prevention. Br J Anaesth 2009;102:739-48.
19. Allah MM, Demian AD, Shorrab AA. Development of a difficulty score for spinal anaesthesia. Br J Anaesth 2004; **92**: 354-60