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ORIGINAL ARTICLE

MRI Based Prediction of Difficult Neuraxial Anesthesia in Obese Women Undergoing Gynecologic Surgery

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ABSTRACT

Background: Gynecological operations often need the use of neuraxial anesthesia. Due to increased subcutaneous tissue, difficult-to-identify anatomical landmarks, and a larger skin-to-epidural distance, obesity may make the procedure more challenging.

Objective: The aim of this study was to find out MRI based prediction of difficult Neuraxial anesthesia in obese women undergoing gynecologic surgery

Material and Methods: The present prospective observational study was conducted at Gyanae / OBS Department Lady Reading Hospital Peshawar and Radiology Department Gomal medical college D I Khan from April 2023 to July 2023 to following approval from the ethical committee of the institute. A total of 150 obese (BMI of 30 kg/m² or above) women of different age groups with, planned for elective gynecological surgery with neuraxial anesthesia and Patients who had done lumbar MRI before surgery were included in this study**.** Data including, weight, age, medical history, previous history of difficult neuraxial anesthesia and BMI were recorded. Before surgical procedure clinical examination were assessed including lumbar spine anatomy, visible spinal abnormalities, palpability of spinous processes and back flexion**.** Anatomical features important to neuraxial anesthesia were assessed by reviewing preoperative lumbar MRI findings. MRI measures employing a consistent measuring methodology, carried out by a radiologist who was blind to the anesthetic results. Qualified anesthesiologists used institutional guidelines to administer neuraxial anesthesia. More than two needle attempts, more than ten minutes for effective placement, or inability to finish the desired neuraxial procedure were all considered indicators of difficult neuraxial anesthesia. Successful placement within two tries and ten minutes was considered easy placement. SPSS version 20 was used for data analysis.

Results: A total of 150 obese females were undergoing gynecologic surgery were enrolled. The mean age of the study population was 40.5 ± 6.5 years and mean BMI was 35.9 ± 6.1 kg/m². Preoperative MRI revealed several anatomical anomalies. The most frequent finding, seen in 88 (58.7%) participants, was increased subcutaneous fat thickness. 82 (54.7%) of the patients had an increased skin-to-epidural distance. 72 patients (48.0%) had poor lumbar anatomical landmark visibility, while 48 patients (32.0%) had decreased interspinous distance.42 patients (28.0%) had degenerative spinal alterations, while 30 patients (20.0%) had facet joint hypertrophy. 18 (12.0%) individuals had scoliosis or other anatomical abnormalities**.** Difficult neuraxial anesthesia was reported in 65 (43.3%) patients, while 85 (56.7%) patients had successful placement. Difficulty was statistically correlated with increased skin-to-epidural distance, higher subcutaneous fat thickness, decreased interspinous distance, poor lumbar landmark visibility, degenerative alterations, and scoliosis/anatomical variation.

Conclusion: Our study concluded that for obese women undergoing gynecological surgery, MRI-based anatomical evaluation may be a helpful predictor of difficult neuraxial anesthesia.

Keywords: Gynecological surgery, Obese women, MRI, difficult neuraxial anesthesia

INTRODUCTION

Neuraxial anesthesia, which includes spinal and epidural anesthesia, is frequently used for a variety of surgical operations. It has a number of benefits, such as efficient analgesia after surgery, a lower need for systemic opioids, and the ability to eliminate airway instrumentation in some individuals[1]. One significant patient-related condition that can make neuraxial anesthesia more difficult is obesity. Needle insertion may be technically difficult due to increased subcutaneous adipose tissue, poorly perceptible spinous processes, limited spinal flexion, and an increased distance between the skin and epidural space[2]. It is more challenging to identify lumbar anatomical markers in obese persons. Repeated efforts and many needle insertions may make patients more uncomfortable and raise the possibility of problems. Lumbar spinal structures, interspinous spaces, subcutaneous tissue, and surrounding anatomical structures may all be clearly seen by magnetic resonance imaging. Because of these features, MRI is a potentially helpful technology for determining anatomical parameters linked to challenging neuraxial anesthesia. Previous studies have shown that aberrant spinal architecture and poor palpability of spinal landmarks are linked to technical problems during neuraxial treatments[2]. Age, sex, body mass index, spinal vertebral deformity, the anesthetist's experience, the ability to recognize spinal cord landmarks, spinal radiological features, the location of spinal anesthesia, skin distances from epidural and subarachnoid space, and the size and type of needles are all factors that have been found to influence the ease of anesthesia[3,4]. Prenatal prediction of the simplicity of providing spinal anesthetic has generally been found to increase the likelihood of success, reduce numerous punctures, and improve patient comfort and quality of life[5, 6]. Given that the best anatomical indications and the simplicity of forecasting the difficulties of the neuraxial procedures were not discussed in earlier research[7]. Thus, the purpose of this study was to assess the relationship between the technical difficulties of neuraxial anesthesia in obese women undergoing gynecological surgery and preoperative MRI findings.

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MATERIAL AND METHODS

The present prospective observational study was conducted at Gyanae / OBS Department Lady Reading Hospital Peshawar and Radiology Department Gomal medical college D I Khan from April 2023 to July 2023 to following approval from the ethical committee of the institute. A total of 150 obese (BMI of 30 kg/m² or above) women of different age groups with, planned for elective gynecological surgery with neuraxial anesthesia and Patients who

had done lumbar MRI before surgery were included in this study. Women needed general anesthesia, spinal tumor, congenital spinal deformity and were not welling to participate in the study were excluded. Data including, weight, age, medical history, previous history of difficult neuraxial anesthesia and BMI were recorded. Before surgical procedure clinical examination were assessed including lumbar spine anatomy, visible spinal abnormalities, palpability of spinous processes and back flexion. Anatomical features important to neuraxial anesthesia were assessed by reviewing preoperative lumbar MRI findings. MRI measures employing a consistent measuring methodology, carried out by a radiologist who was blind to the anesthetic results. Qualified anesthesiologists used institutional guidelines to administer neuraxial anesthesia. The procedural outcomes tracked were the number of skin punctures with needle redirections, as well as the time necessary to complete successful insertion. The planned neuraxial space was successfully identified; an alternate intervertebral level was needed; and the intended neuraxial approach failed. More than two needle attempts, more than ten minutes for effective placement, or inability to finish the desired neuraxial procedure were all considered indicators of difficult neuraxial anesthesia. Successful placement within two tries and ten minutes was considered easy placement. SPSS version 20 was used for data analysis. Mean and standard deviation was used for expression of continuous variables and frequencies and percentages were determined for categorical variables. T test was applied for finding between difficult and easy neuraxial anesthesia groups. A p-value <0.05 was considered statistically significant.

RESULTS

A total of 150 obese females were undergoing gynecologic surgery were enrolled. The mean age of the study population was 40.5 ± 6.5 years and mean BMI was 35.9 ± 6.1 kg/m². The most prevalent age group was 36–45 years 62(41.3%) followed by age group 46-55 years 50(33.3%) and 25-35 years 38 (25.3%). In terms of obesity severe obesity (BMI ≥40 kg/m²) was noted in 35(23.3%),55 (36.7%) individuals had a BMI of 30–34.9 kg/m² and 60 individuals (40.0%) had a BMI of 35–39.9 kg/m². the most common procedure done was Hysterectomy 65 (43.3%) and myomectomy35 (23.3%). majority of the individuals were in ASA physical status II (58.7%), followed by ASA I (30.0%) and ASA III (11.3%) as shown in Table 1. Preoperative MRI revealed several anatomical anomalies. The most frequent finding, seen in 88 (58.7%) participants, was increased subcutaneous fat thickness. 82 (54.7%) of the patients had an increased skin-to-epidural distance. 72 patients (48.0%) had poor lumbar anatomical landmark visibility, while 48 patients (32.0%) had decreased interspinous distance.42 patients (28.0%) had degenerative spinal alterations, while 30 patients (20.0%) had facet joint hypertrophy. 18 (12.0%) individuals had scoliosis or other anatomical abnormalities as shown in table 2. Difficult neuraxial anesthesia was reported in 65 (43.3%) patients, while 85 (56.7%) patients had successful placement as presented in table 3. Difficulty was statistically correlated with increased skin-to-epidural distance, higher subcutaneous fat thickness, decreased interspinous distance, poor lumbar landmark visibility, degenerative alterations, and scoliosis/anatomical variation. The hypertrophy of the facet joints was not statistically significant (table 4).

Table 1: Demographic and clinical features of the study participants

Features	Frequency /percentage
Mean age in years	40.5 ± 6.5
Mean BMI	35.9 ± 6.1 kg/m².
Age 25–35 years	38(25.3%)
Age 36–45 years	62(41.3%)
Age 46–55 years	50(33.3%)
BMI 30–34.9 kg/m²	55(36.7%)
BMI 35–39.9 kg/m²	60(40.0%)
BMI ≥40 kg/m²	35(23.3%)
ASA I	45(30.0%)
ASA II	88(58.7%)
ASA III	17(11.3%)
Hysterectomy	65(43.3%)
Myomectomy	35(23.3%)
Ovarian surgery	25(16.7%)
Other gynecological procedures	25(16.7%)

Table 2: Distribution of MRI-based anatomical findings (n=150)

MRI parameter	Frequency/ Percentage
Increased subcutaneous fat thickness	88(58.7%)
Increased skin-to-epidural distance	82(54.7%)
Reduced interspinous distance	48(32.0%)
Poor visibility of lumbar landmarks	72(48.0%)
Degenerative spinal changes	42(28.0%)
Facet joint hypertrophy	30(20.0%)
Scoliosis or anatomical variation	18(12.0%)

Table 3: Frequency of difficult and easy neuraxial anesthesia

Procedural outcome	Frequency/percentage
Easy neuraxial anesthesia	85(56.7%)
Difficult neuraxial anesthesia	65(43.3%)
Total	150(100%)

Table 4: Association between MRI findings and difficult neuraxial anesthesia

MRI parameter	Difficult (n=65)	Easy (n=85)	p-value
Increased skin-to-epidural distance	48 (73.8%)	34 (40.0%)	<0.001
Increased subcutaneous fat thickness	47 (72.3%)	41 (48.2%)	0.003
Reduced interspinous distance	30 (46.2%)	18 (21.2%)	0.001
Poor visibility of lumbar landmarks	46 (70.8%)	26 (30.6%)	<0.001
Degenerative spinal changes	25 (38.5%)	17 (20.0%)	0.012
Facet joint hypertrophy	17 (26.2%)	13 (15.3%)	0.094
Scoliosis or anatomical variation	12 (18.5%)	6 (7.1%)	0.035

DISCUSSION

The goal of the current study was to assess how preoperative magnetic resonance imaging (MRI) can predict difficult neuraxial anesthesia in obese patients having gynecological surgery. The intended research had 150 patients in all. Assessing the connection between obesity-related alterations, MRI-based anatomical data, and the technical challenges of neuraxial anesthesia was the primary goal. In our study, 65 patients (43.3%) had difficult neuraxial anesthesia, while 85 patients (56.7%) had simple neuraxial insertion. The results imply that anatomical alterations associated with obesity, such as elevated subcutaneous fat thickness, higher skin-to-epidural distance, decreased interspinous distance, and impaired lumbar landmark visibility, may make procedures more challenging. These anatomical considerations are crucial because proper needle trajectory and precise lumbar interspace identification are necessary for effective neuraxial anesthesia. According to Sprung et al.'s analysis of 595 neuraxial blocks, aberrant spinal anatomy or body habitus also led to procedural difficulties, although the quality of spinal markers was the best indicator of technical difficulty[8]. 43.3% of patients experienced difficult neuraxial anesthesia. Increased posterior adipose tissue, poor palpability of anatomical landmarks, or deeper epidural spaces in obese people may all contribute to this comparatively high percentage. In contrast, Ellinas et al. discovered that the capacity to palpate spinal landmarks while achieving appropriate back flexion were key indicators of neuraxial technique difficulties in a prospective observational research involving 427 pregnant women. It's interesting to note that in their investigation, BMI did not independently predict procedural complexity[1].The research population, surgical environment, procedural terminology, and operator characteristics might all be factors in the discrepancy. Their results highlight the value of anatomical evaluation as opposed to depending just on BMI. In this study, 88 individuals (58.7%) had increased subcutaneous fat thickness. The challenging neuraxial group experienced it far more frequently than the group with no difficulty (72.3% compared 48.2%; p=0.003).

Although it's independent prognostic effect may overlap with skin-to-epidural distance as well as other anatomical characteristics, this shows that subcutaneous fat thickness may add to procedural complexity. Ellinas et al. also found that obesity affected back flexibility and the palpability of spinal landmarks, but that BMI was not a reliable indicator of procedural difficulties[1]. In our study, 32.0% of patients had reduced interspinous distance, which was substantially linked to problematic neuraxial anesthesia (46.2% versus 21.2%; p=0.001). Procedural complexity was also substantially correlated with poor lumbar landmark vision (70.8% compared 30.6%). In our study, challenging neuraxial anesthesia was independently linked to a BMI of 40 kg/m² or above. Severe obesity may make posterior soft tissues thicker, make anatomical landmarks more difficult to see, and increase the depth needed to put a needle. Nevertheless, prior research has not consistently shown a connection between BMI & neuraxial difficulties. Ellinas et al. discovered that while landmark palpability along with back flexion were major predictors of neuraxial method difficulties, Obesity was not an independent predictor[1]. In a similar vein, Sprung et al. found that the quality of spinal landmarks was a stronger predictor than body habitus[8]. Previous studies assessing imaging-assisted neuraxial anesthesia provide indirect support for our findings. A thorough evaluation encompassing 9 randomized controlled trials including 866 obese people was carried out by Khoo et al. in 2024. Although there was no proof that pre-procedural ultrasound improved first-pass success, their results showed that it decreased the number of needle passes or insertion tries in obese individuals[9]. Similarly, Sidiropoulou et al. (2021) found that pre-procedural lumbar ultrasonography decreased needle redirections and increased first-attempt success in a comprehensive review & meta-analysis of 32 trials with 3,439 patients. Individuals with obesity and challenging spinal architecture benefited the most[10]. The results of these investigations support the more general idea that pre-procedural imaging might enhance anatomical evaluation and help with neuraxial operation planning, even though they mostly examined ultrasound rather than MRI. This idea is further upon in our work by assessing anatomical measures obtained from MRI as possible indicators of challenging neuraxial anesthesia. MRI offers comprehensive anatomical information regarding the lumbar spinal column, interspinous spaces, adjacent soft tissues, or epidural area, in contrast to traditional clinical evaluation.

Due to enlarged subcutaneous adipose tissue & poorly defined anatomical landmarks, traditional palpation may be less accurate in obese people. Therefore, an MRI-based evaluation may offer extra information that isn't always available via a physical examination alone. Our results imply that impaired vision of the epidural area, decreased interspinous distance, and increased skin-to-epidural distance may be helpful markers of procedural difficulties.

CONCLUSION

Our study concluded that for obese women undergoing gynecological surgery, MRI-based anatomical evaluation may be a helpful predictor of difficult neuraxial anesthesia. Procedural complexity was linked to increased skin-to-epidural distance, decreased interspinous distance, and poor epidural-space visibility.

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