EGYPTIAN JOURNAL OF ANAESTHESIA
2021, VOL. 37, NO. 1, 373–376
https://doi.org/10.1080/11101849.2021.1966286

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The relation between body mass index and difficulty in inducing spinal anesthesia in elective cesarean section

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ABSTRACT

Introduction: Increasing numbers of people globally are affected by obesity, and the number of obese parturient women has correspondingly risen. For obese parturient women, neuraxial anesthetic procedures are generally safe. As the body mass index (BMI) increases, spinal anesthesia becomes more challenging, with a larger failure rate.

Methodology: A total of 383 parturient women were included in this research. They were assigned to three groups according to BMI: Group 1 included 157 women with a BMI of <30; group 2 included 189 women with a BMI of 30–40, and group 3 included 37 women with a BMI of >40. Participants' ages, weights, and heights were documented, and the number of attempts at inducing spinal anesthesia during labor was counted. Every new skin puncture was considered a new attempt. The success or failure of the blockade was noted.

Results: In pregnant participants, we found that BMI was a reliable predictor of difficulty with the neuraxial technique of inducing spinal anesthesia. We found a weakly positive correlation (r = 0.132) between BMI and the number of attempts to induce spinal anesthesia. This association was statistically significant (p = 0.01).

Conclusion: In pregnant patients, especially those who are obese and have a substantial amount of fatty tissue in the back, anesthesiologists should check the patient's back thoroughly during the initial patient encounter. We also advise that anesthesia induction be carried out by an experienced senior anesthesiologist.

ARTICLE HISTORY
Received 13 July 2021
Revised 31 July 2021
Accepted 5 August 2021

KEYWORDS
Spinal anesthesia; obesity; body mass index; cesarean section

1. Introduction

Increasing numbers of people throughout the world are affected by obesity, and the number of obese mothers has risen as well [1]. Normal weight is 19–25 kg/m^2, and overweight is 25–30 kg/m^2, according to the World Health Organization. Class I obesity is defined as a body mass index (BMI) of 30 to <35 kg/m^2, class II obesity is defined as a BMI of 35 to <40 kg/m^2, and class III obesity is defined as a BMI of ≥40 kg/m^2 [2]. Morbid obesity is defined as a BMI of 40–50 kg/m^2, whereas super-morbid obesity is defined as a BMI of ≥50 kg/m^2 [3].

Many factors may lead to maternal morbidity in obese parturient women: prepregnancy or gestational hypertension, prepregnancy, or gestational diabetes mellitus, cardiomyopathies, respiratory disorders such as obstructive sleep apnea, thromboembolic disorders, and infections [4,5]. In addition, the number of cesarean sections is increasing [6]. In most cases, neuraxial anesthesia techniques are safe for obese parturient women who may be at high risk for difficult airway, aspiration, and hypoxia [7].

Some anesthesiologists, however, have found that spinal anesthesia is more difficult to achieve in obese patients, and failure rates are higher [8]. Multiple needle placement attempts and restricted access may result in consequences such as pain, discomfort, a greater risk of spinal hemorrhage, postdural puncture-related headache, and damage to neural structures [9].

To reduce the number of attempts and the risk of failure, anesthetists should predict which patients are at risk for these difficulties [10]. Management by experienced anesthesiologists decreases the time required for anesthesia, increases the success rate, and reduces possible complications [11,12]. Many studies have shown that in nonobstetric patients, palpation of bony landmarks and obesity are relevant predictors of difficulties with neuraxial techniques [13,14].

The objective of this research was to determine the relationship between obesity and difficulty in spinal anesthesia induction in elective cesarean sections, as well as the value of BMI as a predictor of difficulty with spinal anesthesia induction.

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This article has been corrected with minor changes. These changes do not impact the academic content of the article.
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2. Methodology

This observational prospective study, performed in Algezeera Hospital (Giza, Egypt), from November 2020 to February 2021, included 383 pregnant women scheduled for elective cesarean section. All these women provided informed written consent to participate after the institution's Ethics Review Committee granted permission for the study.

Each woman was assigned to one of three groups. Group 1 included those with a BMI of <30; group 2 included those with a BMI of 30–40, and group 3 included those with a BMI of >40.

Inclusion criteria were full-term pregnancy and being scheduled for an elective cesarean section. Also, all participants were in class II of the American Society of Anesthesiologists (ASA) Physical Status Classification and were between 18 and 40 years of age. Women aged of <18 or of >40 years, those with ASA III–VI, those undergoing emergency cesarean section, and those with any contraindication to spinal anesthesia were excluded from the study. Patients in whom induction of spinal anesthesia failed were also excluded.

After establishment of standard monitoring and administration of preload medication according to our protocol, 2–2.5 mL of hyperbaric bupivacaine 0.5% was injected with a 25 G spinal needle by a senior obstetric anesthesiologist (minimum of 5 years of experience in obstetric anesthesia, to exclude lack of experience as a factor) while women were in the sitting position. At our institution, we alter the needle angle through a single skin puncture to execute successive passes rather than attempting neuraxial treatments in several interspinous regions or generating second skin punctures.

Patients were then positioned supine with left-sided uterine displacement on a horizontal operating table.

Participants' ages, weights, and heights were documented, and the number of attempts to induce spinal anesthesia were counted. Each fresh skin puncture, whether at the same or a different level of the spine, was deemed a new attempt. An extra attempt was not counted if the needle was already placed and redirected without causing another skin puncture. The attempt was considered a failure if more local anesthetics, a second neuraxial block, or general anesthesia was required.

2.1. Statistical analysis

The Statistical Package for the Social Sciences, version 26 (IBM Corporation, Armonk, NY, USA), was used to examine the data. Data were calculated as medians and ranges and as means and standard deviations. The Kolmogorov–Smirnov test was used to determine the normality of the data. The groups were compared with the Kruskal–Wallis test, followed by a post hoc test for pairwise comparison between groups. Continuous data were compared with the Spearman correlation. All tests were two-tailed, and a p value of 0.05 was considered significant.

3. Results

The mean ages were 31 in group 3, 30.1 in group 2, and 26.5 in group 1. The difference in ages among all the groups was statistically significant ($p < 0.001$). The women in group 1 were significantly younger than those in groups 2 and 3 ($p < 0.001$), but the mean ages of groups 2 and 3 did not differ significantly ($p = 1.000$).

There was no statistical significance between the numbers of women in whom the midline or paramedian approach was used. The paramedian approach was used in 47.8% of the women in group 1, 59.8% of those in group 2, and 70.3% of those in group 3; it was used was 214 (55.9%) of all the women in the study. No case of failure of spinal anesthesia was reported in any group (Table 1).

Data with different letters are significantly different; those with the same letter are not significantly different. Group 1 was significantly younger than groups 2 and 3 ($p < 0.001$); groups 2 and 3 did not differ significantly in age ($p = 1.000$).

The median of the number of attempts was 1 in each group, which was statistically significant ($p = 0.027$); the mean numbers of attempts were 1.1 in groups 1 and 2 and 1.3 in group 3. The difference between groups 1 and 3 was significant ($p = 0.023$), as was the difference between groups 2 and 3 ($p = 0.044$). The difference between groups 1 and 2 was not statistically significant ($p = 1.000$; Table 2).

We found a weak positive correlation ($r = 0.132$) between BMI and the number of attempts. This correlation was statistically significant ($p = 0.01$; Table 3).

Table 1. Sociodemographic characteristics of the participants.

Characteristic	Total (n = 383)	Group 1 (n = 157)	Group 2 (n = 189)	Group 3 (n = 37)	p value
Age, mean±SDa	28.8 ± 5.6	26.5 ± 5.3	30.2 ± 5.2	31.0 ± 5.5	
Age, median (range)	29.0 (17.0–43.0)	26.0 (17.0–42.0)[a]	30.0 (17.0–43.0)[b]	30.0 (19.0–42.0)[b]	<0.001
No. of women undergoing paramedian approach	214 (55.9%)	75 (47.8%)	113 (59.8%)	26 (70.3%)	0.15
Weight	82.7(15.3)	69.6(6.6)	87.7(8.7)	112.3(11.6)	<0.001
BMI	32.1(5.6)	27.1 [2]	33.9(2.5)	44.1 [3]	<0.001
No. of failures to induce spinal anesthesia	0 (0)	0 (0)	0 (0)	0 (0)	

aSD: standard deviation.

Table 2. The number of attempts to induce spinal anesthesia in the three groups.

Number of attempts	Total (n = 383)	Group 1 (n = 157)	Group 2 (n = 189)	Group 3 (n = 37)	*p* value
Median (range)	1.0 (1.0–4.0)	1.0 (1.0–4.0)[a]	1.0 (1.0–3.0)[a]	1.0 (1.0–3.0)[b]	0.027
Mean ± SDa	1.1 ± 0.4	1.1 ± 0.4	1.1 ± 0.4	1.3 ± 0.6	

aSD: standard deviation.

Table 3. Correlation between body mass index and number of attempts to induce spinal anesthesia.

	Body mass index	
	Correlation coefficient (*r*)	*p* value
Number of attempts	0.132	0.010

Variables with different letters (a,b) are significantly different; those with the same letter are not significantly different. Groups 1[(a)] and 3[(b)] were significantly different ($p = 0.023$), as were groups 2[(a)] and 3[(a)] ($p = 0.044$). Groups 1 and 2 did not differ significantly ($p = 1.000$)

4. Discussion

The purpose of this study was to see how BMI affected difficulties with the induction of spinal anesthesia during elective cesarean procedures. Our results indicated that BMI is a reliable predictor of difficulties with neuraxial technique in pregnant women. No failure to induce spinal anesthesia occurred in our study because all the procedures were carried by experienced obstetric anesthesiologists.

In 2006, in a prospective study involving 101 women undergoing cesarean sections with epidural anesthesia, an epidural catheter had already been placed to provide analgesia for normal vaginal deliveries, which had been originally planned. Weight and BMI were major risk factors for epidural anesthetic failure in 20 cases [15].

In 2011, Rodrigues and Brandão studied 315 pregnant women with BMIs of ≥30 kg/m^2 who received spinal anesthesia for cesarean deliveries. They found that in patients with higher BMIs, more technical difficulties occurred; those patients also had a higher incidence of hypotension and hemorrhage and longer surgery time than did those with lower BMIs [16].

In 2014, Ružman et al. [8] investigated the variables related to problematic neuraxial blockade in 316 patients. They discovered that in patients with a greater BMI and weight, physicians typically had greater difficulty palpating the interspinous region, which hampered needle placement. Although their results are similar to ours study, they did not specify the reasons for or types of surgery, and they didn't include obstetric procedures among the types of surgery.

In 2004, to identify the variables that may increase vulnerability to needle placement difficulties during needle insertion for spinal anesthesia, Atallah et al. examined 300 patients undergoing urological operations. The most important factors influencing the difficulty included obvious spinal deformity and the inability of anesthesiologists, both senior and junior, to easily palpate bony spinal landmarks [17].

Another observational study, conducted in 2009, involved 1477 women undergoing cesarean deliveries. The investigators compared the prevalence of obesity among the women, the relationship between BMI and rate of cesarean sections, and the association with different postoperative complications. They found that obese patients had greater difficulties with neuraxial anesthesia than did other patients [18].

In 2009, Ellinas et al. studied the effects of obesity and other factors on difficulty with neuraxial anesthesia techniques in 427 parturient women. They counted how many needle passes were needed and how long the induction of neuraxial anesthesia took. They found that the inability of the practitioner to palpate the patient's bony landmarks and the patient's inability to bend her back were important predictors of difficulties. Obesity, conversely, was discovered to be a significant predictor of both the inability to palpate landmarks and the inability to bend the back [14].

In 2016, Kula et al. studied 2485 patients laboring under epidural anesthesia to compare the relationship between BMI and the difficulty and rate of failure to induce epidural anesthesia. They found that patients with a BMI of more than 30 kg/m^2 were at higher risk for failure to induce anesthesia and for trouble in inducing epidural anesthesia [19].

The goals of our study were to define such difficulties and to determine how BMI played a role in such difficulties.

Because BMI alone does not explain many aspects that may cause difficulties in anesthesia induction, such as adipose tissue distribution, we studied BMI and body weight together. In cases of obesity, BMI can influence the anesthesiologist's prediction of difficulty. We found that BMI and, to a greater extent, body weight are significantly affect the difficulty of neuraxial technique.

For an obese pregnant patient who has a substantial amount of fatty tissue in the back, we recommend that anesthesiologists thoroughly evaluate the patient's back during the initial assessment. We also recommend that the induction of anesthesia be carried by a skilled senior anesthesiologist.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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