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The Influence of Class III Obesity on Subarachnoid Depth of Turkish Parturient: A Prospective Observational Study

Türk Gebelerde Sınıf III Obezitenin Subaraknoid Derinlik Üzerine Etkisi: Prospektif Gözlemsel Çalışma

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ABSTRACT

Introduction: This observational study aimed to investigate the effects of morbid obesity on the subarachnoid depth and spinal anaesthesia technique.

Methods: Sixty American Society of Anesthesiologists Classification II women with term pregnancy who were candidates for elective caesarean section under spinal anaesthesia were enrolled in this prospective, observational study. Only patients with a Body Mass index (BMI) of <30 kg/m^2 (control group) or BMI ≥40 kg/m^2 (obesity group) were included in the study. Spinal anaesthesia was performed in the sitting position via a midline approach at either L3-4 or L4-5 level by using a 25G 90-mm Quincke spinal needle with an introducer. Demographic data of the parturient, visual characteristics of the lumbosacral region, palpation of landmarks, depth of the spine, technical characteristics of the block, time of block performance and satisfaction of patients were recorded.

Results: The spinal depth of the control and obesity groups were 51.7±4.4 and 69±10.4 mm, respectively (p<0.001). Although needle change was not necessary for any of the patients in the control group, a 120-mm long needle change was required in six patients in the obesity group (p<0.024). We found that the incidence of patients with landmarks that were difficult to palpate was higher in the obesity group, and significantly increased attempt number, skin puncture and needle pass were also required in this group.

Conclusion: Anaesthesiologists should be prepared for a longer attempt in patients with obesity but should not be discouraged as the increase in the number of attempts or prolonged initiation time of spinal anaesthesia was not associated with patient dissatisfaction or discomfort.

Keywords: Spinal anaesthesia, subarachnoid depth, obstetric anaesthesia, obesity

ÖZ

Amaç: Bu gözlemsel çalışmada, morbid obezitenin subaraknoid derinlik ve spinal anestezi tekniği üzerine etkileri araştırıldı.

Yöntemler: Prospektif gözlemsel çalışmamıza, spinal anestezi altında elektif sezaryen operasyonu planlanan 60 term gebe dahil edildi. Çalışmaya Vücut Kitle indeksi (VKİ) <30 kg/m^2 (kontrol grup) ya da VKİ ≥40 kg/m^2 (obez grup) olan ASA II hastalar alındı. Spinal anestezi; oturur pozisyonda, orta hat yaklaşımı ile L3-4 ya da L4-L5 seviyesinden 25G, 90 mm Quincke spinal iğne ile uygulandı. Gebelerin demografik verileri, lumbosakral bölgenin inspeksiyon bulguları, nirengi noktası palpasyon bulguları, spinal derinlik, blok teknik karakteristikleri, blok performans zamanları ve hasta memnuniyeti kaydedildi.

Bulgular: Kontrol grup ve obez grupta spinal derinlik sırasıyla 51,7±4,4 mm ve 69±10,4 mm (p<0,001) idi. kontrol grupta iğne değişimine ihtiyaç duyulmazken, obez grupta altı hastada 120 mm uzunluğunda iğneye geçildi (p<0,024). Obez grupta nirengi nokta palpasyonu zor, blok denenen seviye, cilt ponksiyonu ve iğne yönlendirme sayısı belirgin olarak fazla bulundu.

Sonuç: Obezitesi olan hastalarda blok uygulamalarında anestezistler fazla sayıda deneme için hazırlıklı olmalıdır; ancak bu nedenle spinal anestezi uygulamasından vazgeçmemelidirler çünkü bu durum ya da spinal anestezi başlangıç süresindeki uzama, hasta memnuniyetsizliği ve hasta rahatsızlığı ile ilişkilendirilmemiştir.

Anahtar Kelimeler: Spinal anestezi, subaraknoid derinlik, obstetrik anestezi, obezite

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Introduction

Single-shot spinal anaesthesia for caesarean section is commonly preferred as it can provide a superior quality of anaesthesia with quick onset (1). Subarachnoid depth, that is, the distance between the skin and subarachnoid puncture site, can vary between the patients depending on their body habitus (2,3). The epidural and/or subarachnoid depth are documented in several parturient populations, including Turkish patients (4-8). However, there is a trend of Body Mass index (BMI) increase over the last decades in our country, but its effects on subarachnoid depth or spinal block application ease are unknown. This observational study aims to investigate the effects of morbid obesity on the subarachnoid depth and spinal anaesthesia technique.

Methods

After obtaining Ethics Committee approval (2015-7/6) and written informed consent from parturients, 60 American Society of Anesthesiologists Classification II women with term pregnancy who were candidates for elective caesarean section under spinal anaesthesia were enrolled to this prospective, observational study. Only patients with a BMI of <30 kg/m^2 (control group) or ≥40 kg/m^2 (obesity group) were included with an allocation ratio of 1:1. Patients in whom single-shot spinal anaesthesia would not be feasible (expectation of long surgery and contraindication to neuraxial blockade), patients with a skeletal anomaly that may result in spine assessment difficulty and patients who are unable to cooperate were excluded from the study.

Spinal anaesthesia was performed in the sitting position via a midline approach at either L3-4 or L4-5 level by using a 25G 90-mm Quincke spinal needle (Braun®, Melsungen, Germany) via an introducer using 12-14 mg of 0.5% hyperbaric bupivacaine and 20 µg of fentanyl. The needle was changed to a longer one [25G 120-mm Quincke spinal needle (Braun®)] if needed (insufficient needle length despite full insertion). Patients were placed head down and in a 15° left lateral tilt position after the block was performed. Loss of sensation to cold (ice cube) was used to assess the sensory block, and patients were turned supine after achieving the T4 sensory block level, and surgery was started. Systolic arterial pressure and heart rate were recorded every 3 min for the first 15 min and every 5 min thereafter. Hypotension was defined as a 30% drop in systolic arterial pressure or a systolic arterial pressure less than 100 mmHg. When encountered, hypotension was treated by increasing intravenous fluid infusion rate and giving 5 mg ephedrine bolus.

Parturients' demographic data, gravity, parity and weight gain during pregnancy were recorded. Iliac crest and spinous processes were palpated and graded as easy, palpable and non-palpable. The lumbosacral region was visually graded after sitting position as convex, straight and concave. Sitting was achieved with the patient positioned at the edge of the operating table with 90° knee flexion. The feet were supported with a stool, and arms were placed on their thighs. The maximum flexion of the spine was obtained by instructing them to arch like a 'mad cat'. Each introducer insertion to the skin was marked and recorded as skin puncture. Spinal needle insertion and advancement beyond the tip of the spinous process were defined as a single 'pass', and each redirection was counted as further pass attempts.

Time to subarachnoid space puncture time [skin-cerebrospinal fluid (CSF) time: the time between introducer insertion and CSF free flow], time to loss of cold sensation at T4 dermatome (CSF-T4 time: the time between observation of CSF and detection of loss of cold sensation at T4), hysterotomy time (T4-hysterotomy time: the time between loss of cold sensation at T4 dermatome and incision of the uterus), delivery time (hysterotomy-delivery time: the time between incision of uterus and delivery of the baby), number of punctured levels and presence of paraesthesia or blood-tinged puncture were also recorded. Additionally, ephedrine, crystalloid and colloid consumption, the further need for analgesia during the operation, nausea, vomiting, patient satisfaction as a binary outcome and the willingness to use the same anaesthesia method for future caesarean section were noted.

Statistical Analysis

A preliminary study of pregnant patients with BMI ≤30 kg/m^2 revealed a subarachnoid depth of 55±12 mm. To detect a minimum of 10-mm depth difference with an alpha error of 0.05 and a beta of 0.2, each group required 30 patients. As the rate-limiting enrolment was in the obesity group, we decided to enrol the first eligible consenting control patient after enrolling one patient from the obesity group.

Quantitative data were given as mean ± standard deviation or median (25^{th}-75^{th} percentile). The qualitative data were presented as the number of cases and percentages. Student's t-test analysed quantitative data with normal distribution and the Mann-Whitney U test for data that are not normally distributed. The chi-square or Fisher's exact tests analysed the qualitative data. A p-value of <0.05 was considered statistically significant.

Results

All enrolled patients were included in the analysis. None of the patients required general anaesthesia or additional analgesic medication. Spinal depth of the control and obesity groups were 51.7±4.4 and 69±10.4 mm, respectively [mean difference of 17.3 mm with 95% confidence interval (CI): 13.1-21.4; p<0.001]. Although a needle change was not necessary for any of the patients in the control group, six patients in the obesity group required a 120-mm long needle (p<0.024).

Table 1 presents the demographic (age, height, weight and BMI) and pregnancy-related data. Table 2 demonstrates the landmark

Table 1. Demographic data

	Control group (n=30)	Obesity group (n=30)	p
Age (years)	29.8±6.1	33.8±5.9	0.012
Height (m)	1.63±0.1	1.60±0.1	0.176
Weight (kg)	77±6.9	116±12.7	<0.001
BMI	29±0.5	45.4±4.6	<0.01
Gravida	2 (1-3)	2 (1-4)	0.355
Para	0.5 (0-1)	1 (0-2)	0.166
Weight gain during pregnancy (kg)	13.5 (8.8–18)	10.5 (7.8-15.8)	0.406

BMI: Body Mass index

visualisation and palpation. Technical characteristics of spinal block and time of block performance are given in Tables 3 and 4, respectively.

Physical characteristics of the patients' back were further evaluated to reveal if any assessment could predict an increased number of needle pass with forward logistic regression. The dependent parameter was categorised as needle pass with a cut-off value of five passes, and the independent predictors were palpation of spinous processes and visualisation of the lumbosacral region. The only significant parameter was non-palpable spinous processes with an odds ratio (OR) of 3.55 (95% CI: 1.5-8.2, beta=1.27, p=0.003). Similarly, the non-palpable spinous process was associated with increased subarachnoid space identification when the skin-CSF time was categorised as >3 or ≤3 min (OR: 2.85, 95% CI: 1.3-6.2, beta =1.04, p=0.009). Intraoperative crystalloid consumption was similar between the control and obesity groups (1623±407 vs 1867±556 mL, respectively, p=0.058). The numbers of patients requiring ephedrine were 3 (10%) and 4 (13.3%) in the control and obesity groups, respectively (p=1). Complications such as intraoperative nausea, vomiting, itching and patient satisfaction, as well as the willingness to request spinal anaesthesia for future caesarean section, are presented in Table 5.

Table 2. Physical examination findings

		Control group (n=30)	Obesity group (n=30)	p
Palpation of iliac crest	Easy	18 (60%)	2 (6.7%)	<0.001
	Palpable	11 (36.7%)	12 (40%)	
	Non-palpable	1 (3.3%)	16 (53.3%)	
Palpation of spinous processes	Easy	15 (50%)	2 (6.7%)	<0.001
	Palpable	14 (46.7%)	9 (30%)	
	Non-palpable	1 (3.3%)	19 (63.3%)	
Lumbosacral region view	Convex	13 (43.3%)	5 (16.7%)	0.035
	Straight	14 (46.7%)	16 (53.3%)	
	Concave	3 (10%)	9 (30%)	

Table 3. Block characteristics

	Control group (n=30)	Obesity group (n=30)	p
Number of levels attempted	1 (1-1)	1 (1-1)	0.044
Number of skin puncture	1 (1-1)	2 (1-2)	0.001
Number of pass	1 (1-2.25)	5 (1.75-8)	0.001
Paraesthesia	1 (3.3%)	8 (26.7%)	0.0257
Blood-tinged puncture	0	5 (16.7%)	0.052

Table 4. Times

	Control group (n=30)	Obesity group (n=30)	p
Skin-CSF time (min)	1.5 (1-3)	4.5 (1.38-9.63)	0.005
CSF-T4 time (min)	4 (3-5.25)	4 (3-5)	0.982
T4-hysterotomy time (min)	12 (10.38-14)	12.75 (10.88-16)	0.219
Hysterotomy-delivery time (s)	60 (37.5-60)	67.5 (40-120)	0.142

CSF: cerebrospinal fluid

Discussion

The ease of landmark identification is crucial in performing spinal anaesthesia, and subarachnoid depth determines proper needle length. Pregnancy and body habitus can influence both the technique and equipment needed for spinal anaesthesia. In this prospective observational study, we found that in pregnant patients with BMI ≥40 kg/m^2 (class III parturients with obesity), subarachnoid depth was significantly increased (mean difference of 17.3 mm with 95% CI: 13.1-21.4) compared with those with BMI <30 kg/m^2. Furthermore, this depth change was translated to a change in equipment as evidenced by a significantly increased need for longer needles in the obesity group.

Obesity, which is associated with difficulty in identifying anatomical landmarks, is steadily increasing in our population (9). In fact, we could only locate two Turkish studies in which subarachnoid depth was measured (3,8). Sahin et al. (3) classified patients with obesity as BMI >30 kg/m^2 and reported a needle depth of 65±8 mm in 25 patients, but the number of patients with class III obesity was not specified. Basaran et al. (8) focused on pre-eclamptic patients who had a BMI of 33.2±6.7 kg/m^2 compared with normotensive parturients with 30.4±5.9 kg/m^2. They concluded that preeclampsia associated with significant oedema which increased skin to subarachnoid distance.

Difficulty in locating landmarks in patients with obesity may depend on tissue oedema, weight gain during pregnancy and limited back flexion (10,11). We found that the incidence of patients with landmarks that were difficult to palpate was higher in the obesity group, which is similar to the study of Ellinas et al. (11) This was translated as a significantly increased attempt number, skin puncture and needle pass in the obesity group. Sprung et al. (12) and Ellinas et al. (11,13) also reported similar results as in our study. Further analysis of the data revealed that the difficulty in palpating the spinous processes was the most strongly related landmark parameter in predicting more than five needle passes after controlling for BMI. Of note, we cannot comment on patients with BMI between 30 and 39.9 kg/m^2 as we did not have patients in a continuous BMI range. We found that the time needed for CSF puncture in the obesity group was increased three times, which is not surprising as the landmark is less prominent. Similarly, the spinous process palpation was also a significant predictor of prolonged CSF puncture. In this study, obesity did not influence time from anaesthesia induction to surgical readiness, hysterotomy or delivery.

Furthermore, paraesthesia was also more frequent in the obesity group. This is in contrast to Sahin et al. (3) who reported similar paraesthesia in all groups but used pre-insertion ultrasound guidance in two of their four groups.

Table 5. Perioperative findings and patient satisfaction

	Control group (n=30)	Obesity group (n=30)	p
Intraoperative nausea	8 (26.7%)	12 (40%)	0.273
Intraoperative vomiting	2 (6.7%)	2 (6.7%)	1
Intraoperative itching	1 (3.3%)	4 (13.3%)	0.353
Satisfaction	29 (96.7%)	30 (100%)	1
Willingness to request spinal anaesthesia in the future	29 (96.7%)	29 (96.7%)	1

The limitations of this study include the lack of complications such as postoperative back pain, local pain at the puncture site, sensory disturbance after surgery and postspinal puncture headache. However, our study was focused on spinal anaesthesia initiation rather than its sequelae. We also know that the use of ultrasound is very helpful to identify the anatomical structures of the central lumbar region while performing neuraxial blocks and that it enhances the success rate of difficult blocks (3,14). However, it is not possible to use ultrasound in every spinal block performed because of both the availability of equipment and personal experience in its use in obstetric anaesthesia.

In conclusion, we found that in parturients with BMI ≥40 kg/m^2, spinal depth was increased, necessitating a longer needle compared with that in parturients with BMI <30 kg/m^2. Anaesthesiologists should be prepared for a longer attempt in patients with obesity but should not be discouraged as the increase in the number of attempts or prolonged initiation time of spinal anaesthesia were not associated with patient dissatisfaction or discomfort.

Ethics

Ethics Committee Approval: This study was approved by the ethics committee of Acıbadem University (2015-7/6).

Informed Consent: Written informed consent from parturients.

Peer-review: Internally peer-reviewed.

Authorship Contributions: Surgical and Medical Practices - Ö.A.G., T.Ö.S., M.O.S.; Concept- Ö.A.G., T.Ö.S., M.O.S.; Design - Ö.A.G., T.Ö.S., M.O.S.; Data Collection or Processing - Ö.A.G., T.Ö.S., M.O.S.; Analysis or Interpretation - Ö.A.G., Z.G., T.Ö.S., M.O.S.; Literature Search - Ö.A.G., H.U., Z.G., T.Ö.S., M.O.S.; Writing - Ö.A.G., T.Ö.S., M.O.S.

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