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ORIGINAL ARTICLE

The effect of maternal obesity on cervical cerclage outcomes: A retrospective cohort study

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ABSTRACT

Objective: The objective of the study was to investigate the relationship between body mass index (BMI) and gestational age at delivery in patients who underwent cervical cerclage.

Material and Methods: The population of this retrospective study comprised the patients aged 18–45 who underwent cervical cerclage procedure in Zeynep Kamil Hospital between 2014 and 2021. Maternal demographic data and clinical characteristics, including BMI at the time of the cervical cerclage, were recorded. Patients were categorized into three groups according to their BMI values: normal (BMI: <25 kg/m^2), overweight (BMI: 25–29.9 kg/m^2), and obese (BMI: ≥30 kg/m^2) groups. The primary and secondary outcomes of this study were gestational age at delivery and the percentage of deliveries that occurred <37 weeks, respectively.

Results: The study sample consisted of 151 patients with a mean age of 30.4±5.6 years. The mean gestational age at cervical cerclage was 18.0±4.0 weeks, and the median gestational age at delivery was 37.0 weeks. Gestational week at delivery was significantly lower, and significantly fewer deliveries at ≥37 weeks occurred in the obese group compared with the other two groups (p<0.001). There was a significant inverse correlation between maternal BMI and gestational age at delivery (r=−0.516, p<0.001).

Conclusion: Gestational age at delivery is inversely correlated with BMI in the pregnancies which have undergone cerclage operation. Accordingly, the risk of preterm delivery is significantly associated with BMI values of ≥30 kg/m^2 in patients with cervical cerclage. Maternal obesity is shown to decrease the success of cerclage.

Keywords: Cervical cerclage, maternal obesity, preterm birth.

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INTRODUCTION

Maternal obesity plays a significant role in antenatal and perinatal pregnancy complications.[1] It has been proposed that there is a significant relationship between higher maternal weights and shorter cervical lengths during the second trimester.[1,2] It was demonstrated in several studies that obese women carried higher preterm birth risk.[3,4] However, the relationship between obesity and the increase in the risk of spontaneous preterm birth remains controversial.[2] There are various studies in the literature reporting an increase, decrease, or no difference in the risk of preterm delivery in the patients with obesity.[3,5,6]

Cervical insufficiency is one of the most frequently encountered causes of preterm births.[1] Cervical cerclage is performed in pregnant women who are determined to have cervical incompetence as indicated by ultrasound examination and/or medical history, to prevent recurrent abortions or preterm births.[1,3] Gestational age at delivery has been regarded as the primary outcome associated with cervical insufficiency and its surgical treatment.[3,7] Although cervical cerclage has widespread use, its efficiency in obese pregnant women is still a matter of debate given the conflicting results in the literature. Some studies reported an inverse relationship between body mass index (BMI) and gestational age at delivery, contrary to other studies.[3,8–12] Therefore, the effect of obesity on preterm birth risk and the outcomes of cervical cerclage needs to be clarified. The discrepancies between the relevant studies might be due to the heterogeneity of these studies. As an example, the BMI values in these studies have been calculated at different time points ranging from the pre-pregnancy period to the time of delivery.[3,8–11] Moreover, there are only a limited number of studies available in the literature about the effect of obesity existing at the time of cerclage on the outcomes of the operation.[3,8]

In this context, the objective of this study is to investigate the effect of BMI at the time of cervical cerclage on the gestational age at delivery.

MATERIAL AND METHODS

Research Design

This study was designed as a retrospective study. The study protocol was approved by the institutional ethical committee (date: February 23, 2022 and No. 23) and it was carried out in accordance with the principles of the Declaration of Helsinki. Written informed consent was not taken from the patients due to the study's retrospective design and the anonymity of the data.

Population and Sample

The study population comprised all patients aged 18–45 who underwent elective or ultrasound/ physical examination indicated cervical cerclage due to cervical insufficiency in Zeynep Kamil Women and Children Research Hospital between 2014 and 2021 were included. The exclusion criteria were as follows: (a) having a positive cervicovaginal culture, (b) detection of amniotic sludge appearance on ultrasound, (c) presence of clinical and laboratory findings indicative of chorioamnionitis, (d) active vaginal bleeding (e) regular uterine contractions, (f) multiple pregnancies, and (g) presence of fetal (intrauterine growth retardation, oligohydramnios, congenital anomalies, etc.) and maternal comorbidities (polyhydramnios, intrahepatic cholestasis, severe preeclampsia, uncontrolled diabetes, abruption of placenta, placenta previa, and placenta accreta) deemed to be associated with an increased risk of preterm delivery irrespective of cervical insufficiency, and (h) induced preterm deliveries for any indication. All surgical procedures were performed by obstetricians specialized in fetal and maternal medicine.

Data Collection

The maternal demographic and clinical characteristics, including age, obstetrical history, current pregnancy findings, and comorbidities of the patients included in the study, were recorded. In addition, data such as gestational age at the time of cerclage and indication for emergency or elective cerclage were obtained from the patients' medical records. All gestational ages were confirmed by estimated dating according to first trimester ultrasounds. The cervical lengths were measured using a standard transvaginal technique.[11] The BMI values of the patients calculated at the time of admission for the cerclage procedure were obtained from the medical records. Patients were categorized into three groups according to their BMI values: normal (BMI: <25 kg/m^2), overweight (BMI: 25–29.9 kg/m^2), and obese (BMI: ≥30 kg/m^2) groups.[3,12] Cases with abortion and their gestational ages at abortion time were recorded. The gestational age and mode of delivery were noted. Births that occurred before 37 weeks of gestation were deemed preterm delivery, whereas births that occurred at or after 37 weeks of gestation were deemed full-term labor.

Cervical Cerclage Procedure

McDonald's cervical cerclage procedure was performed as a single purse-string suture using a No.4 monofilament polyester suture (Mersilene Polyester Fiber Suture; Ethicon, Somerville, NJ, USA).[8] The range for cervical cerclage time was between 12 and 26 gestational weeks.

Statistical Analysis

The primary outcome of this study was the gestational age at delivery. The statistical analysis of the research data primarily included the comparison of patients with different BMI values and different types of the cerclage procedure (prophylactic cerclage and ultrasound or physical examination indicated cerclage). Descriptive statistics were expressed as mean±standard deviation values in the case of continuous variables that were determined to conform to the normal distribution, as median along with minimum and maximum values in the case of continuous variables that were determined not to conform to the normal distribution, and as numbers and percentage values in the case of categorical variables. The Shapiro–Wilk, Kolmogorov–Smirnov, and Anderson-Darling tests were used to analyze whether the numerical variables conformed to the normal distribution.

The Pearson's Chi-squared test, Fisher's exact test, and Fisher-Freeman-Halton test were used to compare the differences between categorical variables in 2 × 2 and RXC tables.

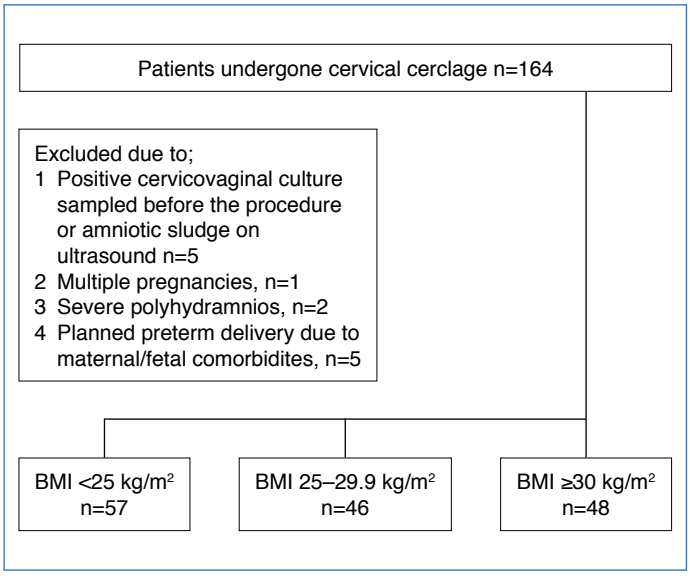

Figure 1: Flowchart of the cases.

In the comparison of two independent groups by the type of cerclage, the independent samples t-test and the Mann–Whitney U test were used in cases where numerical variables conformed and did not conform to the normal distribution, respectively.

On the other hand, in the comparison of more than two independent BMI-based groups, the one-way analysis of variance test and the Kruskal–Wallis test were used in cases where numerical variables conformed and did not conform to the normal distribution, respectively. The differences between BMI-based groups were evaluated with the Dwass-Steel-Critchlow-Fligner test in the case of analyses where non-parametric tests were used. Spearman correlation coefficients were calculated to analyze the relationships between BMI and gestational age at delivery.

"Jamovi project (2022), Jamovi (Version 2.2.5.0) (Computer Software) (Retrieved from https://www.jamovi.org) and JASP (Version 0.16.1) (Retrieved from https://jasp-stats.org) software packages were used to conduct the statistical analyses. In all statistical analyses, the significance level (P-value) was set at 0.05.

RESULTS

A total of 164 patients underwent cerclage operations between January 2014 and December 2021. Of these patients, five were excluded due to positive cervicovaginal culture or amniotic sludge increasing the possibility of intra-amniotic infection before the operation. One twin pregnancy, two patients with severe polyhydramnios presented in late second trimester were excluded since considered as confounding factors. Five pregnant with cerclage had iatrogenic preterm delivery due to maternal or fetal obstetrical complications and excluded (Fig. 1). The study sample consisted of 151 patients with a mean age of 30.4±5.6 years. The obstetric histories and comorbidities of the patients are shown in Table 1. Of these patients, 57 (37.7%), 46 (30.5%), and 48 (31.8%) had BMI values of <25 kg/m², 25–29.9 kg/m², and ≥30 kg/m², respectively (Fig. 1). The mean gestational age at cervical cerclage was calculated as

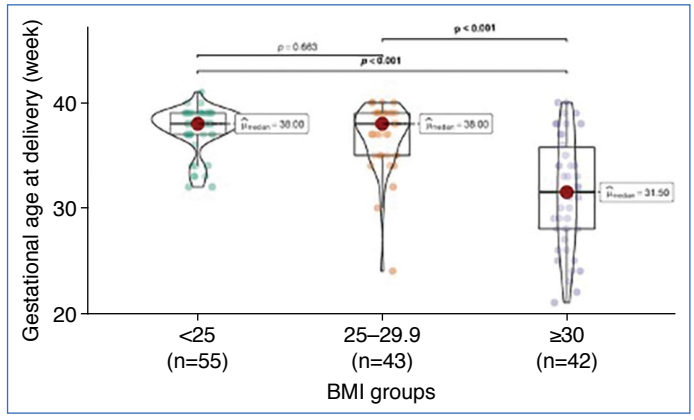

Figure 2: Graphic representation of gestational age at delivery between the body mass index groups.

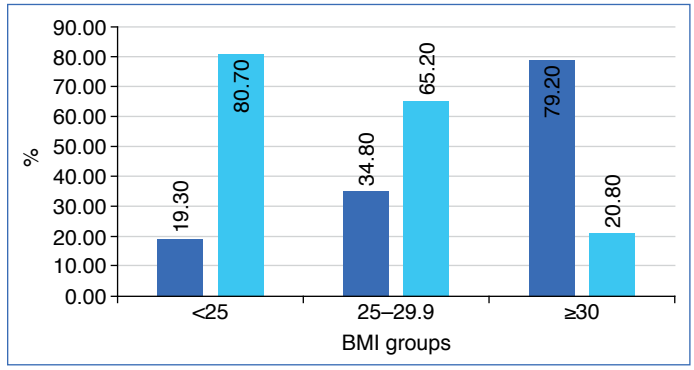

Figure 3: Proportions of the deliveries ≥37 weeks in the body mass index-based groups.

18.0±4.0 weeks. Prolapsed membrane and funneling existed before the cerclage operation in 26 (17.2%) and 40 (26.5%) patients, respectively. Seventy-two (47.7%) of the cases were ultrasound/physical examination indicated, and 79 (52.3%) of the cases were elective cerclage.

There was no significant difference between the BMI-based groups for age, obstetric history, pregnancy-related complications, and the cervical findings before the cerclage (p>0.05) There was also no significant difference between the BMI-based groups in terms of indication of cerclage procedure, which are elective and ultrasound or physical examination indicated (p=0.195) (Table 1).

The mean gestational age at the time of procedure was significantly higher in the ultrasound/ physical examination-indicated cerclage group than in the prophylactic cerclage group (21.6±2.4 vs. 14.8±1.5 weeks, respectively; p<0.001). The mean cervical length before cerclage was 15.1±5.5 mm and 26.1±6.2 in the ultrasound/physical examination indicated and prophylactic cerclage groups, respectively. The difference between the groups in terms of cervical length was significant (p<0.001).

The comparison of the ultrasound/physical examination- indicated and prophylactic cerclage groups in terms of pregnancy outcomes revealed no significant differences between the groups. The median gestational week at delivery was 37 weeks for the entire study population (Table 2).

Table 1: Demographic and clinical characteristics of the patients grouped according to the different BMI values

		BMI groups			
	Overall (n=151)	BMI <25 kg/m² (n=57)	BMI 25–29.9 kg/m² (n=46)	BMI ≥30 kg/m² (n=48)	p
Age (year)†	30.4±5.6	30.4±5.1	29.2±5.6	31.5±6.1	0.192*
Gravidity‡	3.0 (1.0–16.0)	3.0 (1.0–8.0)	3.0 (1.0–9.0)	3.5 (1.0–16.0)	0.257**
Parity‡	1.0 (0.0–3.0)	1.0 (0.0–3.0)	1.0 (0.0–3.0)	1.0 (0.0–3.0)	0.669**
Abortion history§	92 (60.9)	33 (57.9)	27 (59.7)	32 (66.7)	0.612***
Number of previous abortions‡	1.0 (0.0–13.0)	1.0 (0.0–5.0)	1.0 (0.0–6.0)	2.0 (0.0–13.0)	0.154**
Coexisting diseases§	5 (3.3)	1 (1.8)	1 (2.2)	3 (6.3)	0.384***
Pregnancy-related complications§					
Preeclampsia	10 (6.6)	2 (3.5)	3 (6.5)	5 (10.4)	0.377***
Gestational diabetes	3 (2.0)	1 (1.8)	0 (0.0)	2 (4.2)	0.503***
Cervical findings					
Cervical length (mm)†	22.1±7.9	23.5±7.8	19.9±7.2	22.4±8.3	0.094*
Prolapsed membrane§	26 (17.2)	9 (15.8)	9 (19.6)	8 (16.7)	0.874***
Funneling§	40 (26.5)	13 (22.8)	17 (37.0)	10 (20.8)	0.152***
Cervical dilatation§	6 (4.0)	3 (5.3)	1 (2.2)	2 (4.2)	0.999***
Gestational age at cerclage (week)†	18.0±4.0	18.2±4.1	18.2±3.9	17.6±3.9	0.703*
Type of cerclage§					
Emergency	72 (47.7)	25 (43.9)	27 (58.7)	20 (41.7)	0.195***
Elective	79 (52.3)	32 (56.1)	19 (41.3)	28 (58.3)	

†: Mean±standard deviation; ‡: Median (min–max); §: n (%); BMI: Body mass index; *: One-Way ANOVA; **: Kruskal–Wallis test; ***: Pearson Chi-square/ Fisher Freeman Halton test.

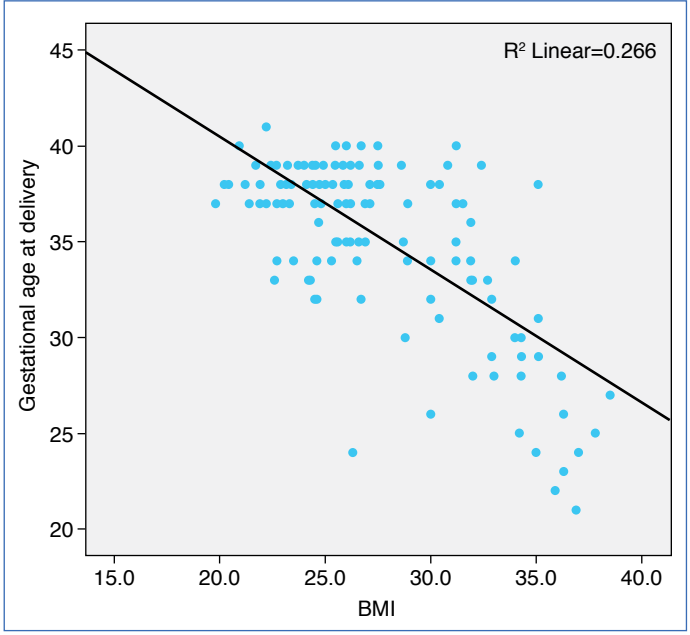

Figure 4: Correlation analysis of body mass index and gestational age at delivery.

As shown in Table 3; 11 (7.3%) abortions occurred in all patients in the study and there was no significant difference in the rate of abortion between the groups (p=0.208).

Subgroup analysis of the gestational week at delivery revealed that the median gestational week at delivery in women with BMI <25 kg/m² and between 25 and 29.9 kg/m² was 38 weeks. However, the median gestational week at delivery in women with a BMI ≥30 kg/m² was 31.5 weeks and significantly lower than in the other two groups (p<0.001) (Fig. 2). In parallel, there were significantly fewer deliveries that occurred at ≥37 weeks in women with BMI values of ≥30 kg/m² compared with the other two groups (p<0.001 for both cases) (Fig. 3). Subgroup analysis of ultrasound/physical examination indicated and prophylactic cerclage groups shows that the patients with BMI ≥30 kg/m² had significantly lower gestational age at delivery than the other two groups irrespective of the indication of cerclage procedure. There was a significant correlation between BMI and gestational age at delivery in the negative direction in the total study group (r=–0.516, p<0.001) (Fig. 4). However, further analysis revealed significant inverse correlation between BMI and gestational age at delivery only in pregnant women with BMI ≥30 kg/m² (r=–0.685, p<0.001), but not in those with BMI <25 kg/m² (r=–0.096, p=0.485) and 25–29.9 kg/m² (r=–0.175, p=0.261).

Table 2: Comparison of the cervical findings and pregnancy outcomes according to the cerclage procedure

	Type of cerclage		
	US/PE indicated (n=72)	Elective (n=79)	p
Cervical findings			
Gestational age at cerclage (week)†	21.6±2.4	14.8±1.5	**<0.001***
Cervical length (mm)†	15.1±5.5	26.1±6.2	**<0.001***
Prolapsed membrane§	26 (36.1)	0 (0.0)	–
Funneling§	40 (55.6)	0 (0.0)	–
Cervical dilatation§	6 (8.3)	0 (0.0)	–
Abortion§	2 (2.8)	9 (11.4)	0.085**
Gestational age at abortion (week)‡	19.5 (19.0–20.0)	17.0 (16.0–20.0)	0.089***
Gestational age at delivery (week)‡	37.0 (24.0–40.0)	38.0 (21.0–41.0)	0.315***
Delivery ≥37 weeks§	46 (63.9)	49 (62.0)	0.946**
Mode of delivery (n=140)§			
Spontaneous labor	46 (65.7)	35 (50.0)	0.087**
Cesarean section	24 (34.3)	35 (50.0)	

†: Mean±standard deviation; ‡: Median (min–max); §: n (%); *: Independent samples t-test; **: Pearson Chi-square/fisher exact test; ***: Mann–Whitney U test.

Table 3: Comparison of the pregnancy outcomes between BMI groups following the cerclage procedures

		BMI groups			
	Overall	BMI <25 kg/m²	BMI 25–29.9 kg/m²	BMI ≥30 kg/m²	p
Overall	151 (100.0)	57 (37.7)	46 (30.5)	48 (31.8)	
Abortion§	11 (7.3)	2 (3.5)	3 (6.5)	6 (12.5)	0.208**
Gestational age at delivery (week)‡	37.0 (21.0–41.0)	38.0 (32.0–41.0)	38.0 (24.0–40.0)	31.5 (21.0–40.0)	**<0.001***
Delivery ≥37 weeks§	86 (57.0)	46 (80.7)	30 (65.2)	10 (20.8)	**<0.001****
US/PE indicated cerclage§	72 (100.0)	25 (34.7)	27 (37.5)	20 (27.8)	
Abortion§	2 (2.8)	1 (4.0)	1 (3.7)	0 (0.0)	0.672***
Gestational age at cerclage (week)‡	22.0 (15.0–25.0)	22.0(19.0–25.0)	22.0(15.0–25.0)	22.0(18.0–25.0)	0.114*
Gestational age at delivery (week)‡	37.0 (24.0–40.0)	38.0 (32.0–40.0)	37.0 (24.0–40.0)	32.5 (24.0–39.0)	**<0.001***
Delivery ≥37 weeks§	38 (52.8)	17 (68.0)	15 (55.6)	6 (30.0)	**<0.001****
Elective cerclage§	79 (100.0)	32 (40.5)	19 (24.1)	28 (35.4)	
Abortion§	9 (11.4)	1 (3.1)	2 (10.5)	6 (21.4)	0.083***
Gestational age at cerclage (week)‡	14.0 (13.0–20.0)	14.5(13.0–19.0)	14.0 (13.0–16.0)	14.0 (13.0–20.0)	0.656*
Gestational age at delivery (week)‡	38.0 (21.0–41.0)	38.0 (32.0–41.0)	39.0(32.0–40.0)	29.5(21.0–40.0)	**<0.001***
Delivery ≥37 weeks§	48 (60.8)	29 (90.6)	15 (78.9)	4 (14.3)	**<0.001****

‡: Median (min–max); §: n (%); *: Independent samples t-test; **: Pearson Chi-square/fisher exact test; ***: Mann–Whitney U test; BMI: Body mass index.

DISCUSSION

The findings of this study indicated that as the pregnant women's BMI calculated at the time of cerclage increased, the gestational age at delivery decreased. Accordingly, there was a significant inverse correlation between BMI and gestational age at delivery in obese patients who underwent cerclage procedure. In addition, it was determined that the risk of preterm delivery after cerclage was significantly associated with BMI value in the group with BMI ≥30 kg/m².

There are only a limited number of studies available in the literature on the effect of obesity measured at the time of cerclage on the outcomes of cervical cerclage.[1] In one of these studies, Poggi et al.[9] reported that deliveries before 35 weeks were more frequent and the mean gestational age at delivery was significantly lower after cerclage operation in obese women. In another study, Yüksel Şimşek et al.[13] found that higher BMI was significantly associated with earlier gestational age at delivery following prophylactic cerclage procedures. In another study, it was reported that BMI is an independent risk factor for delivery at <28 weeks in patients who underwent ultrasound-indicated cerclage procedures.[14] In contrast, Yalvac et al.[8] and Farinelli et al.[10] concluded that BMI does not significantly affect pregnancy outcomes. However, it should be kept in mind that there is considerable methodological heterogeneity in these studies.[1] Different diagnostic tools were used in different studies to determine cervical insufficiency, including medical history, ultrasound, or physical examination. In several studies, patients who underwent ultrasound/ physical examination indicated and prophylactic cerclage procedures were not evaluated separately.[13] In comparison, in this study, a significant inverse correlation was found between BMI value and gestational age in the group of pregnant women with BMI higher than 30 kg/m^2. This result may be regarded as additional evidence supporting the hypothesis that obesity affects pregnancy outcomes following the cerclage procedure. In summary, further prospective large-scale studies with standardized inclusion criteria are needed to clarify the conflicting outcomes available in the literature.

It is seen that the BMI values taken into account in these studies have been calculated at different time points such as the pre-pregnancy period,[11,12] the time of cerclage procedure.[3,8–10] or the time of the delivery.[7] In this study, the BMI values calculated at the time of the cerclage procedure were taken into account. The reason for not taking the BMI at the delivery time into account was that the effect of weight gain in pregnancy would differ according to the gestational age at delivery. The possibility that the range of gestational age at the time of cerclage (18±4 weeks) may act as a confounding factor for BMI measurements was ruled out since there was no significant difference between the BMI-based groups in gestational age at the time of cerclage. The findings of this study should not be generalized and used only to evaluate the clinical significance of obesity measured at one specific time during the pregnancy period, which is the time of the cerclage procedure. However, these findings could be worth sharing with the patients who currently have BMI values ≥30 kg/m^2 at the time of cerclage while informed consent is being taken before the operation.

Although the negative effect of obesity on the gestational age at delivery in pregnant women who underwent McDonald's cerclage procedure was demonstrated in this study, further comparisons, including other procedures such as Shirodkar's cerclage procedure, could not be made since they were beyond the scope of this study. Thus, further large-scale studies should be conducted to establish which procedure is more efficient in treating cervical insufficiency in obese pregnant women.

In this study, the effect of the indication of cerclage procedure on gestational age at delivery has also been investigated. There were no significant differences between elective and ultrasound/physical examination indicated cerclage in terms of gestational age at delivery, and the rate of the deliveries occurred ≥37 weeks. These findings are similar to the findings reported in several other studies.[13,15,16] Further prospective randomized studies are needed to compare the success of different cerclage indications (elective, ultrasound indicated, and physical examination indicated) in each BMI group. Hypothetically, elective cerclage may have better results in cervical incompetent obese pregnant women compared to ultrasound indicated or emergent cerclage to prevent rapid cervical dilatation due to a greater mechanical load on the cervix in the second trimester.

There were some limitations of this study. First, it was designed as a retrospective study. Second, the sample size was relatively small. Third, physical examination-indicated emergency cerclage cases and ultrasound-indicated cases were evaluated in a single group to overcome possible interobserver differences due to the retrospective design of the study. The strength of the study was to have been conducted in a single tertiary center. All patients were examined and operated in the same manner. A single technique (Mc Donald's) was performed. This fact eliminates the variability of operation indications and techniques as confounding factors.

CONCLUSION

Obesity seems to adversely affect the success of ultrasound/examination-indicated emergency cerclage and elective cervical cerclage procedures since higher BMI values were found to be inversely correlated with duration of pregnancy. This inverse relationship is even more evident in women with BMI values higher than 30 kg/m^2 at the time of the cerclage procedure.

Statement

Ethics Committee Approval: The Zeynep Kamil Maternity and Children's Training and Research Hospital Clinical Research Ethics Committee granted approval for this study (date: 23.02.2022, number: 23).

Informed Consent: Written informed consent was obtained from patients who participated in this study.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept – LU; Design – LU, ÇÖ; Supervision – LU; Resource – ÇÖ; Materials – ÇÖ, AÖ; Data Collection and/or Processing – ÇÖ, ÖGE; Analysis and/or Interpretation – ÖGE, ÇÖ; Literature Search – ÇÖ, AÖ; Writing – ÇÖ, AÖ; Critical Reviews – LU, OD.

Conflict of Interest: The authors have no conflict of interest to declare.

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