ORIGINAL ARTICLE

Bali Medical Journal (*Bali Med J*) 2020, Volume 9, Number 3: 605-612
P-ISSN.2089-1180, E-ISSN.2302-2914

Published by DiscoverSys

Risk scoring in predicting preterm birth of women receiving cervical cerclage

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ABSTRACT

Background: Cervical incompetence is primarily a clinical diagnosis, which is characterized by recurrent painless dilation of cervix and spontaneous second trimester loss and preterm delivery. Despite recent advances, the indications and efficacy of cervical cerclage have been remained controversial. This study was performed with the aim of evaluating the risk factors of preterm birth among women who underwent cervical cerclage and establishing a scoring system to predict preterm labor in this group of women.

Material and Methods: This retrospective cohort study was performed on 95 women who had undergone cervical cerclage from January 2016 to January 2018 in Maternity Teaching Hospital of Sulaimaniyah, Iraq. A total of 66 women who delivered after 34 weeks were used as control group, compared to 29 cases who delivered before 34 weeks.

Results: According to the findings of the present study, there was a significant association between the preterm birth before the 34 weeks of pregnancy and the risk factors of pathological vaginal discharge, cervical length less than 25 mm prior to cerclage placement, and passive smoking. The positive predictive value was calculated using the prediction model was%99 with a risk score of 3, 47.6% with risk score 2 and 28.2% with risk score 1.

Conclusion: The prediction model can be used as a tool to identify patients at a higher risk for PTD <34 weeks and to recognize those that could benefit from cerclage and deliver after 34 weeks. It could also be a useful tool for identifying those high risk women with cerclage who require increased surveillance.

Keywords: cervical cerclage, cervical length, preterm delivery, risk score

Cite This Article: Fattah, C.N. 2020. Risk scoring in predicting preterm birth of women receiving cervical cerclage. *Bali Medical Journal* 9(3): 605-612. DOI:10.15562/bmj.v9i3.1821

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Received: 2020-05-12
Accepted: 2020-09-21
Published: 2020-12-01

INTRODUCTION

Childbirth before the week of 37th of gestation is defined as preterm birth (PTB).[1] However, the definition may vary between countries depending on viability perceptions. The World Health Organization (WHO) places 22 weeks of gestational age or 380 gram birthweight as the lowest limit, at least for the purpose of perinatal statistics.[1] Recent WHO data indicate that every year 15 million infants are born prematurely, it is about one in 10 births worldwide.[1] There are several primary risk factors: PTB-related maternal demographic specific i.e. single marital status, very high or very low maternal ages and low socio economic situation.[2,3] Black women are at higher risk of PTB about three times compared to white women. Also, the risk of very early PTB is three to four times more among them.[2] Body-mass-index (BMI) and nutritional situation are two effective factors in PTB. The risks of PTB[2,3] and low birth-weight neonates[4] are higher in underweight women. Moreover, smoking leads to increased risk of preterm delivery,[7] premature rupture of the membranes,[5] and placenta previa.[6] Having a previous history of PTB or pregnancy loss at the second trimester are the main risk factors in PTB,[2,3] so that the risk of relapse varies between 15% to over 38%.[2] This risk increases with the number of previous cases and is conversely correlated with pregnancy age of previous PTB.[8] However, women with a prior PTB history are only accounted for 10-15% of preterm delivery cases. Both spontaneous and iatrogenic PTBs are associated with increased risk of recurrence.[10]

The major cause of PTB is genital tract infection. A pathologic study consisting of over 6180 placentas provided early evidence regarding the role of intrauterine infection in preterm birth.[10] Chorioamnionitis, described as neutrophil infiltration of the fetal membranes, was present in about 5% of all placenta, but the aborted cases between the weeks of 21 and 24 were happened in 80% of the placentas of infants. The results showed a direct association between decreased gestational age and increased incidence of histologic chorioamnionitis. Only 13.8% of women experience fever during labor and most infections treated subclinically.[10]

The characteristics of current pregnancy include the risk of PTB increased by 2-folds in the case of a short inter-pregnancy interval < 6 months, which is explained by lower opportunity for inflammation recovery and compensating food deficiency due to the previous pregnancy. Women who experience preterm delivery in their first childbirth are at a

higher risk.[11] Multiple gestations are associated with a considerable risk of preterm labor, so that 15 to 20% of all PTBs are attributed to 2-3% multiple birth.[3] Due to uterine over-distention, about 48% of multiple gestations leads to preterm delivery. Vaginal bleeding due to placenta previa, placental abruption or bleeding in the first two trimesters increases the risk of PTB.[11] The entrance of bacteria living in lower genital tract into decidua can cause leukocytosis and cytokine production which cause synthesis of prostaglandin in the chorion, myometrium, amnion, and decidua.[12] This can result in uterine contractions, membrane exposure, cervical dilatation, and thereby the entrance of more microbes into uterine cavity. There are evidence regarding the association of bacterial vaginosis (BV) with the higher risk of preterm birth, especially BV before the sixteenth week of pregnancy,[13] which indicates a critical period for preterm delivery later in gestation.[14] The association of untreated pyelonephritis and urinary tract infection with preterm delivery has long been recognized. Other studies have also shown the effect of pyelonephritis or asymptomatic bacteriuria on the preterm birth. All pregnant women are recommended to perform screening and treatment for bacteriuria at their first prenatal visit.[15] A more detailed risk evaluation of PTB is possible through investigating secondary risk factors based on signs, symptoms and examination during the gestation. One of the important topics in practical obstetric care is screening for primary symptoms of spontaneous preterm delivery.[16]

Ultrasound measurement of the cervical length

Transvaginal sonography (TV) is regarded as the most efficient method for assessing cervix.[17] TV provides a better reproducibility of the entire cervix, thus it is more accurate compared to transabdominal ultrasound and digital examination.[18] Abdominal ultrasound suffers from several technical problems, including bladder distension, cervix position, and myometrium contractions, which provides a fallacious cervical appearance.[17] The measurement of cervical length using transvaginal sonography is among the main predictors of PTB in all under-studied cases.[9]

Fetal Fibronectin

Fetal fibronectin (fFN) is a large glycoprotein that produced by fatal cells. It is located in the interface between the maternal decidua and fetal membranes. High concentrations of fFN could normally be found within the extracellular matrix of this layer.[17] Cervicovaginal discharge in the early stages of gestation as well as just before delivery contain fetal fibronectin.[18,19] However, its concentration is normally low within the 2nd and early 3rd trimester. It seems that there is an association between the beginning of preterm labor and disconnection of choriodecidual junction, which results in fetal fibronectin release that is detectable in cervicovaginal mucous. Fetal fibronectin can be quantitated. According to an initial clinical study by Lockwood et al., both the presence and absence of fetal fibronectin have strong predictive value in predicting the risk of preterm delivery.[18] There are supportive data about the screening for fetal fibronectin in pregnancy in women with PTB, since colytics and transmit to tertiary care should be considered.[20]

problem statement(Risk scoring):Although many individual tests have failed to be predictive of PTB on their own, there have been attempts to combine risk measures into various risk models.[21] To date, no combination of tests has proven useful to consistently screen women for potential PTB risk. Methodologically, the ideal study design for postulating and testing predictive methods for preterm birth is prospective cohort studies. Although case-control studies aimed to investigate new biomarkers may represent the frequency of a marker in pregnancy that leads to PTB, they are unable to provide an exact estimation of the negative and positive effectiveness of a given test.[22]

Cervical Cerclage

In 1742, Herman[23] used Emmet trachelorrhaphy to treat three patients and introduced cervical surgery to prevent repeated gestation loss. The use of transvaginal cerclage in cervical incompetence treatment has been documented by Shirodkar in 1803 and later by McDonald in 1805.[10] In spite of little adjustments, these methods have been used in the management of incompetent cervix.[2]

Cervical Incompetence

There is no consistent definition of cervical incompetence, but it can be specified as shortening and dilatation of the cervix before the week of 24 of delivery when no preterm labor is presented. Cervical incompetence is mostly associated with pain-free, progressive dilation of the uterine cervix in the 2nd or early 3rd trimester of pregnancy which may lead to membrane premature rupture, membrane prolapse, preterm birth, or mid-trimester pregnancy loss.[25] It is estimated that cervical incompetence happens at less than 1% of obstetric cases[26] and approximately in 8% of females who have experienced recurrent mid-trimester losses.[27] In women having preterm delivery, the length of cervix remains relatively constant till the third trimester of pregnancy.[28] Any possible

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reduction in the length of cervix (less than 0.5 mm per week) is not clinically significant.[28] Heath et al.[29] reported an average cervical length of 38 mm at 23rd week. Moreover, Iams et al.[30] documented a mean cervical length of 35 mm at 24th week and 34 mm at 28th week. If funneling is present, measurement should exclude the funnel and be taken from the funnel tip to the external os.[31] In women who deliver preterm or require cerclage, the rate of change in cervical length may be predictive of preterm birth. Although women with preterm delivery experience faster reduction in cervical length than those with normal delivery time, the difference is usually small.[32] The reduction in cervical length ranges from 0.5 mm per week to 8 mm per week.[32]

Aim of the study

The aim of this study is to evaluate the risk factors associated with preterm birth in women before receiving cervical cerclage and to develop a scoring system for predicting preterm labor in these women. This prediction model can be used as a tool to identify women who are likely to develop preterm birth and thus can be offered frequent surveillance.

PATIENT AND METHODS

Type of the study

This is a retrospective cohort study of 95 patients who received cervical cerclage between 12 to 24 weeks in 2 years' time.

This study was conducted from January 2016 to December 2018 at Sulaimaniyah maternity teaching hospital, Iraq.

Inclusion Criteria

Singleton pregnancies between 12 to 24 weeks which undergone cervical cerclage in 2016 & 2017 in Sulaimaniyah maternity teaching hospital.

Exclusion Criteria

Multiple pregnancy: Cerclage before 12 weeks or after 24 weeks of gestation: Multiple and higher order pregnancy: Pregnancy complicated by medical disease.

Sample Size Measurement

In the present study, 6 risk factors related to preterm delivery (<week 34 of delivery) were studied, including the length of cervix prior to placement of cerclage, the age of gestation at time of cervical placement of cerclage, urgency cerclage placement, exposing to passive smoking, history of recurring pathological vaginal secretions, and history of 3 or more losses including mid-trimester miscarriage and preterm birth.

Data Gathering

The data were obtained from the case sheet of the patient and phone calls.

Statistical Analysis

Data entry was performed using an excel spreadsheet and the statistical analysis was performed by SPSS program, version 21 (IBM SPSS statistics package software program for statistical analysis). The data were presented in tabular form to describe the variables of the study. The patients were divided into two groups based on the delivery time (before and after 34 weeks). Independent t-test were used to compare the mean values of quantitative variable. Chi-square tests were used to compare categorical data between the two mentioned groups of the patients. Logistic regression was performed to find Odds ratio of the factors found to be risky for preterm birth. P values of 0.05 were used as a cut off point for significance of statistical tests.

RESULTS

The study was performed in tertiary teaching hospital. Totally, 95 women with required criteria were included in the study, of which 66 cases had delivery at or over 34 weeks and 29 cases had delivery lower than 34 weeks of pregnancy. The total number of live birth (LB) and neonatal death (ND) in both term and preterm infants in Sulaimaniyah maternity teaching hospital, Iraq during 2016 and 2017 has been shown in Table 1.

In 2016, the total number of live birth were 18441, neonatal mortality rate was 1.2%, In relation to gestational age (21.97%) of them were full term and (78.03%) were preterm. Among preterm deaths, 18.9% were born ≥34 weeks, while 81.03% were born before 34 weeks. In 2017, total number of live birth was 19994, neonatal mortality rate was 1.37% in which 18.25% of them were full term and 81.75% were preterm. Among preterm deaths, 17.86% were born ≥34 weeks, while 82.14% were born before 34 weeks.

Table 2 shows the demographic characteristic of the studied groups. In this study, the patients were of comparable age; the mean age of patients who gave birth before 34 weeks was 32.1 ± 5.0 and the mean age of patient who gave birth after 34 weeks was 32.8 ± 5.6. P value=0.57 which is not significant by using Pearson chi-square test at 0.05 level of significance. 27.6% of the employed patients gave birth <34 weeks and 72.4% of them gave birth ≥ 34 weeks, while for the unemployed patients, 30.3% of them gave birth < 34 weeks and 69.7% of them ≥ 34 weeks. P value=0.79 which is not significant by using Pearson chi-squared test at 0.05 level of significance. 40.9%of the patients who

gave birth < 34 weeks and 59.1% of those who gave birth ≥ 34 weeks had history of passive smoking. 21.6% of patients who gave birth < 34 weeks and 78.4% of patients who gave birth ≥ 34 weeks did not have a history of passive smoking. p value was < 0.05 which was statistically significant.

Table 3 shows the Relation between parity and history of previous evacuation of retained product of conception (RPOC) with birth < 34 Weeks and ≥ 34 Weeks (38.5%) of nulliparous patients delivered < 34 Weeks and (61.5%) of them delivered ≥ 34 Weeks. While the rest of the patient (27.3%) whose their parity were between (1-3) delivered < 34 Weeks and (70.4%) of them delivered ≥ 34 Weeks. (27.3%) of patients whose their parity were ≥ 4 children delivered < 34 Weeks and (72.7%) of them delivered ≥ 34 Weeks. P value=0.79 which is statistically not significant. Also (24.4%) of patients who delivered < 34 Weeks and (75.6%) of patients who delivered ≥ 34 Weeks have history of evacuation of RPOC. And the rest of patients who delivered before or after 34 weeks had no history of evacuation of retained product P value=0.22 which is not statistically significant.

Table 1 Total number of live birth (LB) and neonatal death (ND) in both term and preterm infants

Neonatal outcome	2013	2014
Total number of live birth	18441	19994
Total number of neonatal death	223(1.20%) of LB	274(1.37%) of LB
Total number of term death	49(21.97%) of ND	50(18.25%) of ND
Total number of preterm death	174(78.03%) of ND	224 (81.75%) of ND
≥ 34 week	33(18.97%) of PTB	40(17.86%) of PTB
Before 34 week	141(81.03%) of PTB	184(82.14%)of PTB

Table 2 Demographic characteristic of the studied group

		Weeks of pregnancy			
Variable		**< 34 Weeks**	**≥ 34 Weeks**	**Total**	**P value**
Maternal Age (Years) Mean ± SD		32.1 ± 5.0	32.8 ± 5.6		0.57
Occupation	Employed	8 (27.6%)	21 (72.4%)	29 (100%)	0.79
	Unemployed	20 (30.3%)	46 (69.7%)	66 (100%)	
Passive smoking	Yes	18 (40.9%)	26 (59.1%)	44 (100%)	< 0.05
	No	11 (21.6%)	40 (78.4%)	51 (100%)	
		Weeks of pregnancy			
Variable		**< 34 Weeks**	**≥ 34 Weeks**	**Total**	**P value**
Maternal Age (Years) Mean ± SD		32.1 ± 5.0	32.8 ± 5.6		0.57
Occupation	Employed	8 (27.6%)	21 (72.4%)	29 (100%)	0.79
	Unemployed	20 (30.3%)	46 (69.7%)	66 (100%)	
Passive smoking	Yes	18 (40.9%)	26 (59.1%)	44 (100%)	< 0.05
	No	11 (21.6%)	40 (78.4%)	51 (100%)	

Table 3 Relationship between parity and history of previous evacuation of retained product of conception (RPOC) with birth < 34 weeks and ≥ 34 weeks

		Weeks of pregnancy			
Variable		**< 34 Weeks**	**≥ 34 Weeks**	**Total**	**P value**
Parity	Nulliparous	5 (38.5%)	8 (61.5%)	13 (100%)	0.79
	1 - 3 children	21 (29.6%)	50 (70.4%)	71 (100%)	
	≥ 4 children	3 (27.3%)	8 (72.7%)	11 (100%)	
Evacuation of RPOC	Yes	11 (24.4%)	34 (75.6%)	45 (100%)	0.22
	No	18 (36%)	32 (64%)	50 (100%)	

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Table 4 Distribution of various problems specific to current pregnancy, mode of delivery (MOD), pregnancy outcome between studied groups

Variable		Weeks of pregnancy		Total	P value
		< 34 Weeks	≥ 34 Weeks		
GD	Yes	1 (20%)	4 (80%)	5 (100%)	0.6
	No	28 (31.1%)	62 (68.9%)	90(100%)	
HT	Yes	3(60%)	2(40%)	5 (100%)	0.14
	No	26 (28.9%)	64 (71.1%)	90(100%)	
Mode of delivery(MOD)	NVD	18 (36%)	32 (64%)	50(100%)	0.22
	CS	11 (24.4%)	34 (75.6%)	45(100%)	
Pregnancy outcome	Alive birth	22 (25.3%)	65 (74.7%)	87(100%)	0.001
	Neonatal mortality	7(87.5%)	1 (12.5%)	8(100%)	

Table 5 Distribution of various problems specific to current pregnancy, mode of delivery (MOD) and pregnancy outcome among the studied groups. than 34 weeks in women with cervical cerclage

Variable		Weeks of pregnancy		Total	P value
		< 34 Weeks	≥ 34 Weeks		
Cerclage Type	Elective	27 (29.67%)	64 (70.32%)	91 (100%)	0.39
	Emergency	2(50%)	2(50%)	4 (100%)	
Cervical Cerclage Time/ Weeks of pregnancy	12^{th}-14^{th}	28 (31.4%)	61(68.5%)	89(100%)	0.51
	15^{th}-17^{th}	0 (0.00%)	3 (100%)	3(100%)	
	18^{th}-21^{st}	1(33.33%)	2(66.6%)	3(100%)	
Vaginal Pathological discharge	Yes	15 (48.4%)	16 (51.6%)	31 (100%)	0.01
	No	14 (21.9%)	50 (78.1%)	64 (100%)	
Cervical length (mm)	<25 mm	15(62.5%)	9 (37.5%)	24 (100%)	< 0.001
	≥ 25 mm	11(17.18%)	53(82.8%)	64(100%)	
				Total * 88 case	
Previous loss	None	2(50%)	2 (50%)	4 (100%)	0.16
	1 - 2 Loss	12 (22.6%)	41 (77.4%)	53 (100%)	
	≥ 3 loss	15 (39.5%)	23 (60.5%)	38 (100%)	

* Note:cervical length of 88 cases were available.

Table 6 Multivariate analyses of risk factors associated with preterm birth less

Risk factor score	Sensitivity%	Specificity%	PPV%	NPV%	Accuracy%
1	42.3%	54.8%	28.2	69.4%	51.1%
2	38.5%	82.3%	47.6	76.1%	69.3%
3	15.4%	99%	99%	73.8	75.0%

Table 7 Predictive model for preterm births with less than 34 weeks

Variable	OR	95% CI	P value
Passive smoking	2.52	1.03 – 6.18	0.044
Pathological vaginal discharge	3.35	1.33 – 8.41	0.01
Cervical length (< 25mm)	8.03	2.81 – 22.97	< 0.001

OR=odds ratio
CI=coefficient interval

Distribution of various problems specific to the current pregnancy, mode of delivery (MOD) and pregnancy outcome among the studied groups are shown in Table 4. This table clarifies the relationship between gestational diabetes and hypertension disorder during pregnancy and mode of delivery in previous pregnancies in patients who gave birth < 34 weeks and those gave birth ≥ 34 weeks, which is not significant (P value was > 0.05). P value for pregnancy outcome were significant.

The analysis of the studied risk factors and the relationship of them with preterm birth neonates (<34 weeks) in women underwent cervical cerclage are presented in Table 5. According to the results, there is a non-significant relationship between cerclage timing and cerclage type. However, a significant association was found between the length of cervix at time of cerclage placement and pathological vaginal secretion. A P-value of 0.16 was obtained for prediction of preterm delivery in women before the week 34 of delivery.

Table 6 shows the multivariate analyses of the 3 risk factors of preterm delivery before 34 weeks in women undergone cervical cerclage.

The developed model for prediction of preterm births before 34 weeks is shown in Table 7. The predictive value of the model is 99% for the three risk factors and 47.6% when there are two risk factors but only 28.2% when there is a single risk factor. From 29 cases who gave birth before 34 weeks in our study, 1 patient gave birth <26 weeks.

DISCUSSION

Neonatal mortality and morbidity in preterm infants are directly proportional to gestational age at birth. Each addition gestational week has substantial effect on survival rate as well as good antenatal care. Identifying the model to predict patients with cervical incompetence at risk for preterm delivery before 34 weeks is important for counselling prior to performing cerclage procedures and in identifying the group who require increased surveillance. The quality and availability of intensive neonatal care have a great role in the survival of preterm infants.[33] Table 1 shows the total number of live births and neonatal deaths in Sulaimaniyah, Iraq maternity teaching hospital of Sulaimaniyah, Iraq in 2016 & 2017. Term neonatal deaths accounts for about 1/4 of all neonatal deaths, while 3/4 of the deaths occur among preterm infants. Regarding preterm neonatal deaths, there is a significant relationship between gestational age at birth, about three quarters of preterm neonatal deaths occur in neonates born before 34 weeks. Among the studied groups, there is also a significant relationship between gestational age and neonatal mortality. P-value is 0.001, which is highly significant.

Preterm delivery was more likely in teenage mothers, and this finding is in agreement with the findings of the study by Ali- S Khashar et al.[34] We have discovered that maternal age has no significant risk in this study and all cases were above (18) years. Passive smoking has a significant risk on birth before 34 weeks of pregnancy (P value less than 0.05). These results are in line with the findings of Khader et al. (2011) who reported a significant association between exposure to passive smoking and higher risk of preterm birth.[35] A similar association was also found between passive smoking history and preterm delivery.[36] Contrarily, Andriani et al. could not find a significant association between passive smoking history and preterm delivery in their national prospective longitudinal cohort study.[37] Given the large population of women exposed to passive smoking,[38] such an association between passive maternal smoking and preterm delivery, no matter how small it is, could produce a considerable public health burden.[39]

There is no significant difference regarding history of previous evacuation of RPOC among the studied groups in this study and this was in agreement with the study performed by Madore C et al.,[40] does not demonstrate that cervical dilation during dilatation and curretage predisposes to cervical insufficiency as previously described. Pathological vaginal discharge was present in 32.6% of the studied population. The rate of preterm birth before the week 34 in women with a history of abnormal vaginal discharge was 48.2%, while this rate was 21.9% in those with no history of it. This is in line with the results of the study by Cram et al. who found a significant association between pathological vaginal discharge during gestation and premature birth.[41]

There is high a discrepancy between sample size for emergency and elective cerclage cases. (91case elective, 4 cases emergency) this is adversely affect outcome may lead to false positive or false negative cases. 29.67% of elective cases delivered before 34 weeks and 64 (70.32%) delivered ≥ 34 weeks. For emergency cases, although the percentage of women giving birth before 34 weeks was higher in comparison with the elective cases, it was not statistically significant. The same result was found in the study performed by Cockwell KA, et al., who mentioned that there was no significant difference between the emergency cerclage group and elective cerclage group regarding mean gestational age of delivery, delivery beyond 34 weeks and overall pregnancy outcome.[42] In an Indian study, Khan et al. evaluated the outcomes of elective, urgent, and emergency cerclage and argued that patients with cervical incompetence could benefit from emergency cerclage and the outcomes get better when elective cerclage is done before the onset of

preterm labor process (elective group) and at early stages of cervical alterations (urgent group), rather cerclage placement when incompetence process has already started (Emergency group).[43] Considering the gestational age of the studied population at the time of cerclage placement, three gestational age groups were defined: 12-14 years, 15-17 years, and 18-21 years. There was no significant association between different gestational age groups with delivery before 34 weeks. This was in agreement with the study by Gupta et al. (2013,India) who reported that there was no difference in age groups below 21 week but there is significant relation when cervical cerclage done between 21-26 weeks.[44] The current result is in line with the study by Berghella V et al.[45] who reported a reverse association between the preterm delivery frequency and cervix length as measured by ultrasonography in pregnancy. Women with cervical lengths over than 25 mm had significantly lower risk of preterm birth than those with <25 mm cervical lengths.

CONCLUSION

The results of the present study showed 3 effective risk factors in preterm childbirth before 34 weeks of gestation in women undergoing cervical cerclage. These factors are the history of pathological vaginal discharge during pregnancy, cervical length less than 25 mm before the cerclage placement, and passive smoking. In addition to accurate care for genital tract infection, pregnant women should be informed properly about the negative effects of nicotine exposure on preterm delivery. Women with 3 risk factors were most likely to develop preterm birth. The prediction model designed in our study can be used as a tool for counselling these patients before receiving cervical cerclage in order to identify those women who require frequent surveillance after cerclage placement who may deliver before 34 weeks.

CONFLICT OF INTEREST

The authors have stated explicitly that there are no conflicts of interest in connection with this article.

FUNDING

These authors have no support or funding to report.

ETHICAL CONSIDERATIONS

Approval for this study has been obtained from clinical directorate of Sulaimaniyah maternity hospital, where all the data were collected and consents were taken from all patients participating in this study.

ACKNOWLEDGMENTS

I would like to express Special thanks for all women who are involved in this study and everyone who helps me in conducting this study.

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