

Ultrasound cervical length in predicting preterm birth: Prospective study

Achour Radhouane¹, Ben Jemaa Nadia², Ksibi Imen³, Meriem Cheour³, Bouriel Ines¹, Ayari Feirouz³, Samia Kacem³, and Neji Khaled¹

1. Emergency Department of Gynecology and Obstetrics of Maternity and neonatology Center of Tunis; Faculty of medicine of Tunis; El Manar University of Tunis-Tunisia

2. Foetopathology Department of Maternity and neonatology Center of Tunis; Faculty of medicine of Tunis; El Manar University of Tunis-Tunisia

3. Neonatology Department of Maternity and neonatology Center of Tunis; Faculty of medicine of Tunis; El Manar University of Tunis-Tunisia

RESEARCH

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Corresponding Author:

Achour Radhouane
Emergency Department of Gynecology and Obstetrics of Maternity and neonatology Center of Tunis
Faculty of medicine of Tunis
El Manar University of Tunis-Tunisia
Email: radhouane.a@live.com

ABSTRACT

Background

Preterm birth is a leading cause of perinatal morbidity and mortality and represents a major public health problem. It is associated with a 15–20 per cent mortality rate and remains responsible for 75 per cent of perinatal deaths in foetuses without anomalies.

Aims

The aim of this study was to evaluate the importance of cervical length measured in the first trimester (11–14 Weeks of amenorrhea “WA”) and the second trimester (20–24 Weeks of amenorrhea “WA”) in an asymptomatic population of singleton pregnancies to assess the risk of spontaneous preterm birth compared to the digital assessment.

Methods

We conducted a prospective, longitudinal study involving 117 asymptomatic women with singleton pregnancies between January and December 2015.

Results

In our study, the clinical examination had a low positive predictive value and a low sensibility for screening women at risk of preterm delivery. Cervical length less than 35mm between 12–14WA and 30mm between 22–24WA predicts the occurrence of preterm birth with a high sensitivity (Se), and specificity (Sp).

Conclusion

We conclude that ultrasound screening of preterm delivery is now highly recommended.

Key Words

Transvaginal sonography, risk, preterm birth

What this study adds:

1. What is known about this subject?

Digital assessment of the cervix has been commonly used to diagnose premature labour. It is subjective, and varies between examiners. The sonographic measurement of cervical length had a good estimation of the risk of preterm labour with a threshold of 35mm between 12 and 14 Week of amenorrhea (WA) and 30mm between 22 and 24 WA.

2. What new information is offered in this study?

Our study in a maternity centre in Tunisia allowed us to show the interest in the systematic measurement of the length of the cervix in the first trimester (11–14WA) and in the second trimester (20–24WA) in an asymptomatic pregnancy population to assess the risk of spontaneous preterm delivery compared to digital assessment by vaginal touch.

3. What are the implications for research, policy, or practice?

Premature birth remains the main cause of mortality and perinatal morbidity. Caused by the low positive predictive value (PPV) of digital assessment, some authors were interested in the ultrasound examination of the cervical length to identify women at risk of preterm delivery.

Background

Preterm birth is a major public health problem in terms of perinatal mortality, long term morbidity and health economics. It is associated with a 15–20 per cent mortality rate and remains responsible for 75 per cent of perinatal deaths in foetuses without anomalies.¹

The accurate diagnosis and prediction of preterm delivery remains a major problem in obstetrics.

The ultrasound measurement of cervical length is becoming an increasingly popular component of prenatal care, compared to the clinical examination. However, the role of this method as a screening tool in the prediction of preterm delivery in the first or the second trimester of pregnancy is still controversial.²⁻³

Method

We conducted this prospective, longitudinal study involving 117 asymptomatic women with singleton pregnancies between January and December 2015. Before the study began, a statement was made on the informed consent of study participants.

Indeed, women with singletons were offered an ultrasound examination at 11 to 13+6 weeks for pregnancy dating and early diagnosis of major chromosomal and other foetal abnormalities, and another scan at 20 to 24 weeks of amenorrhoea (WA) for examination of foetal anatomy and growth.

Each transabdominal ultrasonography was followed by transvaginal ultrasonography then by clinical examination. The cervical length was measured in the sagittal plane, visualising the internal and external os and the endocervical canal as landmarks. When the cervical canal was curved, it was measured in multiple linear segments. Each examination was performed over a period of about 3 months and the shortest of three measurements was recorded.

Participant characteristics, including details of maternal age, surgical history and obstetric history were obtained from a

questionnaire completed by the patients at the first ultrasound scan and entered into a computer data base. Patients with major foetal abnormalities, painful regular uterine contractions or history of ruptured membranes or cervical cerclage in situ or uterine malformations were excluded from this study.

Statistical analysis

A receiver operating characteristic (ROC) curve was constructed for cervical lengths to test its effectiveness in predicting premature delivery. The areas under the ROC curves were calculated and the sensitivity, specificity and positive predictive value for the CL were calculated for predicting preterm delivery. Student's-test was used to determine the differences in the cervical lengths at the first and second scan. A Pearson correlation test was used to test the independence between CL and the gestational week at preterm delivery. A P - Value inferior than 0.05 was considered significant. Analyses were performed using commercial software (SPSS 11.5).

Results

One hundred and seventeen singletons pregnancies met the inclusion criteria during the study period. The mean age was 28 years (18–41years). 76 per cent of women were gravida 1. Only 20 women (17.1 per cent) had in her history a uterine revision.

In the first trimester, a cervical length inferior to 35mm was significantly correlated to the preterm delivery ($p < 0.001$) (Table 1) with an OR equal to 3.915.

The cutoff of 35mm was drawn from a ROC curve, giving the best possible sensibility (Se) and specificity (Sp) (ROC Curve 1).

The mean cervical length of women having a threat preterm delivery between 12 and 14 weeks of amenorrhoea (WA) was equal to 32.3mm while it was equal to 40.7mm for those delivering at term. An opening of the internal os of the cervix superior to 4mm is significantly correlated with the occurrence of preterm labour with an OR equal to 4.196 (ROC Curve 2) (Table 2 and Figure 1).

As in the first trimester, and from the analysis of a ROC curve (ROC Curve 3), a threshold of cervical length (CL) to 30mm was chosen for the best rates of sensitivity and specificity (Table 3). Indeed, a CL measured between 22 and 24WA inferior to 30mm was significantly correlated to the preterm birth with an OR=5.531. In addition, an opening of the internal os of the cervix superior to 7mm was

significantly correlated to a preterm delivery with an OR equal to 8.842. This cutoff drawn from a ROC curve (ROC Curve 4) was associated to a highly sensibility (82.5 per cent) and specificity (78.7 per cent). Its negative predictive value was 90.5 per cent and positive predictive value (PPV) 67.5 per cent.

The mean cervical length between 22 and 24WA for patients who presented a threat of preterm delivery was 26.1mm with an opening of the internal os of 9mm. However, it reached 38.7mm for women delivering at term with an internal os of 2.3mm (Figures 2 and 3).

In addition, between 22 and 24WA, an intra-cervical protrusion of membranes was observed in 24 women, among them, 17 have delivered prematurely and only 3 have submitted a late abortion. Protrusion of membranes thus had an excellent PPV equal to 100 per cent (Table 4).

Digital assessment of the cervix has been done systematically for all women during the first and the second trimester. Indeed, the cervix was estimated shortened and modified in the 1st trimester in 9 per cent of patients who delivered prematurely (Se=9 per cent, positive predictive value PPV=50 per cent, negative predictive value NPV=37 per cent) (Table 5) and in 11.2 per cent in the 2nd trimester (Se=21.2 per cent) (Table 6).

Therefore we can conclude that digital assessment of the internal os of the cervix was not very sensitive for predicting preterm birth neither in the first trimester (Se=6.4 per cent) (Table 7) nor in the second (Se=37.5 per cent) (Table 8).

Discussion

Digital assessment of the cervix has been commonly used to diagnose premature labour. It is subjective, and varies between examiners; and underestimates true anatomic length by approximately 14mm, whereas ultrasonography measured cervical length accurately.⁴⁻⁶

In our study, digital assessment had a low sensibility in predicting threatened preterm labour in the first trimester as in the second trimester.

Ultrasound monitoring during pregnancy demonstrate that cervical length is normally distributed and remains relatively constant in pregnancy until the third trimester.⁷⁻⁸ If there is any statically significant reduction in length, it is not clinically significant (inferior to 0.5mm /week).⁷⁻⁹ Health et al.¹⁰ found a mean length of 38mm at 23 weeks when Owen et al.¹¹ found a mean length of 35mm at 24 weeks. If

funneling is present, measurement should exclude the funnel and be taken from the funnel tip to the external os.¹²

the threshold of the cervical length for predicting the subsequent occurrence of threatened preterm birth are determined from the ROC curve of the different populations studied, which gives the best statistical values. It varies in the literature from 15 to 35mm.¹³⁻¹⁶

In our series, the sonographic measurement of cervical length had a good estimation of the risk of preterm labour with a threshold of 35mm between 12–14 WA and 30mm between 22–24 WA.

For the opening of the internal os of cervix, its measurement by ultrasound appears to have an important contribution in predicting the subsequent occurrence of preterm delivery.¹⁴⁻¹⁷

In our series, the threshold of the internal os was determined from the analysis of ROC curves to 4mm between 12–14WA and 7mm between 22–24WA. These thresholds gave a sensitivity of 71.4 per cent and 82.5 per cent; a specificity of 62.7 per cent and 78.7 per cent; a PPV of 51.7 per cent and 67.4 per cent and NPV of 79.7 per cent and 90.5 per cent; respectively in the 1st and 2nd quarter. Our results are consistent with the majority of those in the literature.

The presence of a sacculation or protrusion of membranes was demonstrated by most authors as a very strong element to predict the occurrence of a preterm birth. This data was validated in our study by high sensitivity (66 per cent) and a high VPP (100 per cent) during the 2nd quarter. Guzman,¹⁸⁻¹⁹ assessed the possibility to track the sacculation membranes in pregnant women at risk by a fundal pressure during the ultrasound examination of 150 pregnant women with no particular history between 16 and 24 WA. After evaluation of the cervix and internal orifice, pressure is applied to the uterus.

This pressure caused no change in the internal os of cervix of 150 patients among them, 141 were delivered at term, 2 had a late abortion at 22 and 23 weeks and 7 gave birth prematurely (4, 7 per cent) giving therefore to this pressure a sensitivity equal to 83.3 per cent, specificity=97.2 per cent, PPV=88.2 per cent and a NPV=95.8 per cent.

The protrusion of the membranes then represents a sonographic sign of increased severity and is almost associated with shortened cervical length and opened internal os.

Conclusion

Premature birth remains the main cause of mortality and perinatal morbidity.

Caused by the low positive predictive value of digital assessment, some authors were interested in the ultrasound examination of the cervical length to identify women at risk of preterm delivery.

In our study, the clinical examination had a low positive predictive value and a low sensibility for screening women at risk of preterm delivery.

Ultrasound examination has emerged in the last decade to identify women at risk of preterm delivery. According to our study, cervical length less than 35mm between 12–14 WA and 30mm between 22–24WA predicts the occurrence of preterm birth with a high sensitivity, and specificity, which reinforces the recommendations already described in the literature.

These results allowed us to review our situation in Tunisia where often the measurement of the length of the cervix is done only at the advanced stage with clinical symptomatology.

Therefore, we can conclude that systematic ultrasound screening of preterm delivery is now highly recommended.

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PEER REVIEW

Not commissioned. Externally peer reviewed.

CONFLICTS OF INTEREST

We declare that we have no conflict of interest.

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ETHICS COMMITTEE APPROVAL

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Table 1: Cervical length measured by ultrasound between in the 1st trimester

Preterm birth	Yes	NO	Total	
*CL < 35mm	26	22	48	VPP=54.2 %
CL ≥ 35mm	16	53	69	VPN=76.8%
Total	42	75	117	-
	*Se=61.9 %	*Sp=70.7 %	-	-

CL: Cervical length

Se: Sensitivity

Sp: Specificity

ROC Curve 1: Sensitivity and specificity depending on the cervical length between 12-14 WA

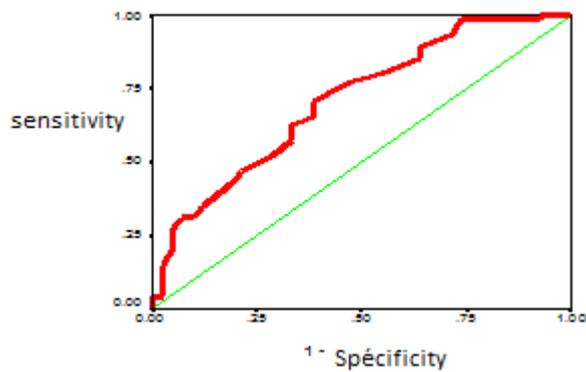


Table 2: Ultrasound evaluation of the internal os (IO) of cervix in the first trimester

Preterm birth	Yes	No	Total	
CL < 30mm	27	13	40	VPP=67.5 %
CL ≥ 30mm	13	62	75	VPN=82.6%
Total	40	75	115	-
	Se=67.5%	Sp=82.7 %	-	-

ROC Curve 2: Sensibility and specificity depending on the opening of the internal os in between 12 and 14 WA

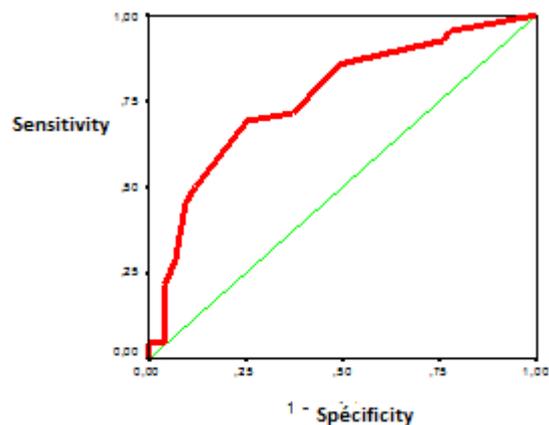
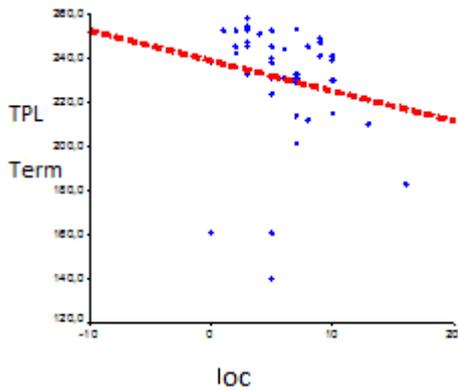


Figure 1: Distribution of the term of the threat premature labour (TPL) according to the diametre of the internal os of cervix (IOC) between 12-14 SA



ROC Curve 3: Sensibility and specificity depending on the cervical length between 22-24 WA

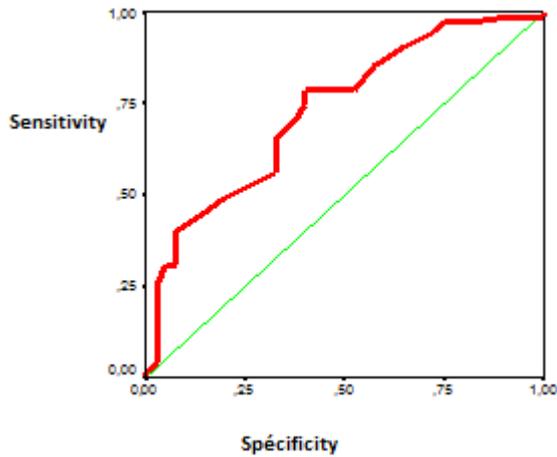


Table 3: The internal os measured by ultrasound between 22 and 24 WA

Preterm birth	Yes	No	Total	
* IO < 4mm	12	47	59	* PPV=51.7 %
IO ³ 4mm	30	28	58	* NPV=79.7%
Total	42	75	117	-
	* Se=71.4 %	* Sp=62.7 %	-	-

IO: Internal os

PPV: Positive predictive value

NPV: Negative predictive value

Se: Sensitivity

Sp: Specificity

ROC Curve 4: Sensibility and specificity depending on the opening of the internal os in between 22 and 24 WA

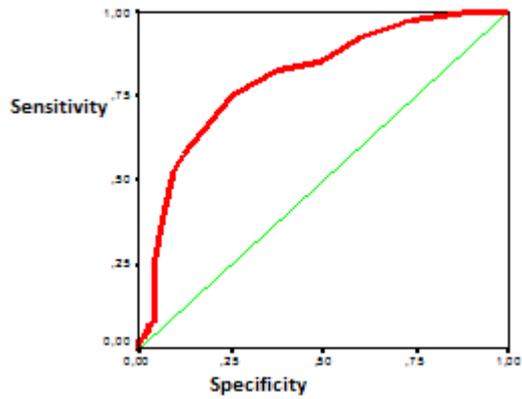


Figure 2: Distribution of the term of the threat premature labour (TPL) according to the cervical length (CL) between 22-24 WA

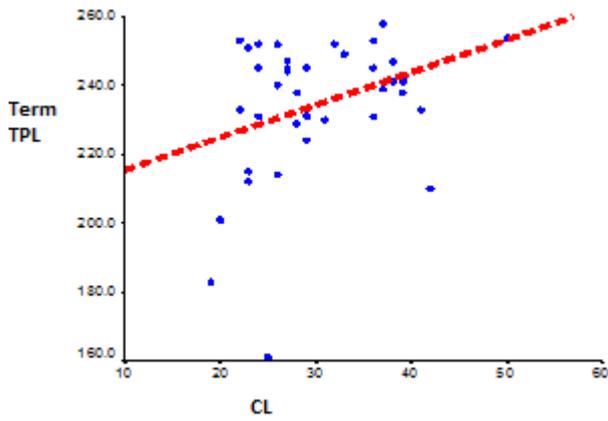


Figure 3: Distribution of the term of the threat premature labour (TPL) according to the diameter of the internal os of cervix (IOC) between 22-24 WA

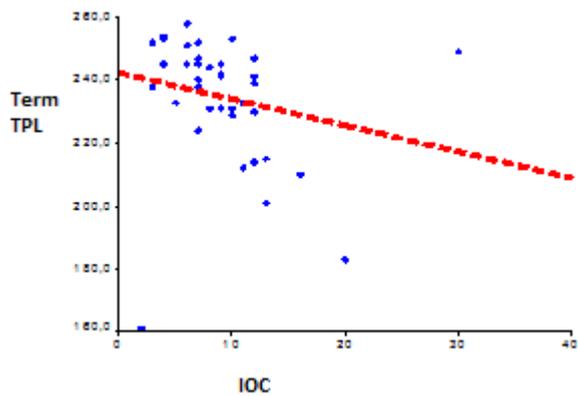


Table 4: Evaluation of the protrusion of membranes by ultrasound scan between 22 and 24 WA

Threatened of preterm birth	Yes	No	Total	
Protrusion +	24	0	24	VPP=100%
Protrusion -	16	75	91	VPN=82.4%
Total	40	75	115	-
	Se=60%	Sp=100%	-	-

Table 5: Evaluation of CL by clinical examination in the first trimester

Prematurity	Yes	No	Total	
Shortened CL	3	3	6	VPP=50%
Long CL	30	81	111	VPN=73%
Total	33	84	117	-
	Se=9%	Sp=96.4%	-	-

Table 6: Evaluation of CL by clinical examination in the second trimester

Prematurity	Yes	No	Total	
Shortened CL	7	6	13	VPP=53.8%
Long CL	26	76	102	VPN=75%
Total	33	82	115	-
	Se=21.2%	Sp=92.5%	-	-

Table 7: Evaluation of the cervical internal os by clinical examination in the first trimester

Prematurity	Yes	No	Total	
Opened internal os	2	2	4	VPP=50%
Normal internal os	31	82	113	VPN=72.5%
Total	33	84	117	-
	Se=6.4%	Sp=97.6%	-	-

Table 8: Evaluation of cervical internal os by clinical examination in the second trimester

Prematurity	Yes	No	Total	
Opened internal os	9	1	10	VPP=90%
Normal internal os	24	81	105	VPN=79%
Total	33	82	115	-
	Se=37.5%	Sp=98.8%	-	-