Transperineal ultrasound measurement of cervical length to predict preterm delivery in women with threatened preterm labour

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Objective: This study evaluated the predictive value of cervical length as measured by transperineal ultrasound for preterm delivery and the cut-off value in patients with threatened preterm labour.

Methods: Medical records of women admitted to Kwong Wah Hospital between 1 January 2019 and 31 December 2021 for threatened preterm labour at a gestational age between 24+0 and 33+6 weeks were reviewed retrospectively. Patient demographics, cervical length as measured by transperineal ultrasound on admission, and delivery outcomes were collected and analysed.

Results: Of 60 women admitted for threatened preterm labour, 21 (35.0%) delivered before 37 weeks. Ten (16.7%) women delivered within 7 days of admission. Cervical length as measured by transperineal ultrasound on admission was positively correlated with the admission-to-delivery interval (r=0.61, p<0.001). Using the cut-off value of 2.5 cm to predict delivery within 7 days of admission was the most sensitive (90.0%) and specific (86.0%). In univariate analysis, risk factors for preterm delivery were previous preterm delivery, maternal age, history of antepartum haemorrhage, and cervical length. In multivariate analysis, only cervical length remained significantly associated with preterm delivery.

Conclusion: Transperineal ultrasound is a non-invasive alternative to transvaginal ultrasound for measuring cervical length to predict preterm delivery in patients with threatened preterm labour. A cut-off value of 2.5 cm has high sensitivity and specificity.

Keywords: Cervical length measurement; Obstetric labor, premature; Ultrasonography

Introduction

Threatened preterm labour is diagnosed when a pregnant woman presents with regular uterine contractions before 37 weeks without cervical effacement or dilatation. It may or may not progress into preterm labour. Preterm birth is defined as delivery before 37 completed weeks (259 days)[1]. Identifying the risk of preterm labour is important as preterm birth is associated with significant neonatal morbidities and mortality, especially in extremely preterm infants (<28 weeks)[2-4]. It is important to identify those at risk of preterm labour and birth, so measures can be taken to reduce the risk of morbidities and mortality. For example, use of antenatal corticosteroids to reduce the risk of respiratory distress syndrome and neonatal death[5], and use of tocolysis and magnesium sulphate for neuroprotection[6].

The NICE (National Institute for Health and Care Excellence) guideline on preterm labour and birth suggests measuring cervical length by transvaginal ultrasound to determine the likelihood of birth within 48 hours. The ACOG (American Congress of Obstetricians and Gynecologists) finds that cervical length, as measured by transvaginal ultrasound, has good negative predictive value for preterm labour[6,7].

Ultrasound measurement of cervical length can be through the transabdominal, transperineal, or transvaginal route[8]. The transvaginal route is the gold standard, but it is invasive and may not be readily accepted by patients[9]. The transabdominal route causes the least discomfort, but it tends to overestimate cervical length, leading to underdiagnosis of short cervix in up to 50% of cases[10]. The transperineal route is reasonably accurate, with correlation coefficients ranging from 0.77 to 0.97. It is a sensible alternative in cases of premature preterm rupture of membranes (PPROM) or the patient is reluctant to undergo a vaginal examination[9], but its application is limited by the need for an experienced sonographer[9,11-13].

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In our unit, cervical length is routinely measured by transperineal ultrasound. This study evaluated the predictive value of cervical length as measured by transperineal ultrasound for preterm delivery and the cut-off value. The findings could help clinicians counsel patients admitted for threatened preterm labour about their risk of preterm delivery.

Materials and methods

This is a retrospective observational study. Medical records of women admitted to Kwong Wah Hospital between 1 January 2019 and 31 December 2021 for threatened preterm labour at a gestational age between 24+0 and 33+6 weeks were reviewed. Women with active preterm labour on admission (defined as cervical dilatation or cervical effacement with an unmeasurable cervical length), PPROM, multiple pregnancy, cervical incompetence, or who did not undergo a transperineal ultrasound were excluded.

Maternal characteristics and risk factors for preterm delivery were collected, including age, parity, ethnicity, body mass index (BMI), gestational age, antenatal risk factors for preterm birth such as a history of preterm delivery, short inter-pregnancy interval (<18 months), use of assisted reproductive technology, culture-proven bacteriuria, bacterial vaginosis, smoking, drinking alcohol, using drugs, and fetal abnormalities[14], as were the cervical lengths measured by transperineal ultrasound.

Transperineal ultrasound was performed by trained doctors (at least a second-year resident with a year's labour ward ultrasound experience) on admission using a MySono U6 (Samsung Medison). The patient lay in the supine position while the transducer was placed on the perineum and rotated until the complete cervical canal and the internal and external ora were identified (Figure 1). The callipers were placed at the external and internal ora[8]. The shortest distance was recorded when more than one measurement was made. All patients admitted for threatened preterm labour were given antenatal corticosteroids and tocolytics if no contraindications, regardless of cervical length.

Data analysis was performed using SPSS (Windows version 27, IBM, Armonk [NY], United States). The association between cervical length and delivery interval in threatened preterm labour was assessed using the Pearson correlation coefficient and receiver operating characteristic curve analysis together with logistic regression analysis. A value of $p<0.05$ was considered statistically significant. Univariate analysis was first performed for all potential
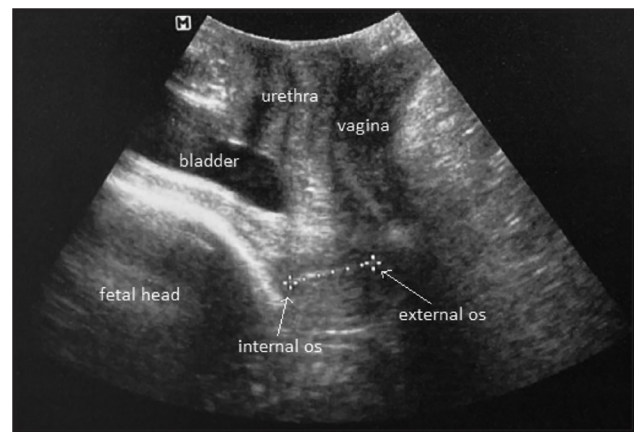

Figure 1. Transperineal ultrasound image for measuring cervical length.

risk factors for preterm delivery. Those with $p<0.2$ were included in the multivariate analysis.

Results

Of 103 women admitted for threatened preterm labour, 43 were excluded owing to multiple pregnancy (n=9), PPROM (n=12), active preterm labour (n=4), and no transperineal ultrasound performed (n=18). The remaining 60 women with a mean age of 32 years and a mean gestational age on admission of 31 weeks were included for analysis. Regarding risk factors for preterm birth[14], 40.0% of women were of advanced maternal age (≥35 years); 23.7% had low BMI (<18.5); 1.7% had high BMI (≥30); 13.3% had a history of antepartum haemorrhage; 10.0% had culture-proven bacteriuria, but none had culture-proven bacterial vaginosis; 12.9% of multiparous women had a history of preterm birth; 6.5% of multiparous women had a short inter-pregnancy interval (<18 months). None was smoker, alcohol drinker, or drug user. No fetus had anomalies. 30.0% of women did not have any risk factors for preterm birth (Table 1).

Of the 60 women, 12 (20.0%) delivered at early preterm (<34 weeks) and nine (15.0%) delivered at late preterm (34 to 36+6 weeks). Ten (16.7%) women delivered within 7 days of admission. Cervical length as measured by transperineal ultrasound on admission was positively correlated with the admission-to-delivery interval (r=0.61, $p<0.001$, Figure 2).

In receiver operating characteristic curve analysis, using the cut-off value of 2.5 cm to predict delivery within 7 days of admission was the most sensitive (90.0%) and

Table 1. Maternal characteristics

| Characteristics	No. (%) of patients (n=60)
Maternal age, y	
<18	2 (3.3)
18-34	34 (56.7)
≥35	24 (40.0)
Ethnicity	
Chinese	58 (96.7)
Non-Chinese	2 (3.3)
Gestation on admission, wk	
24-27+6	9 (15.0)
28-31+6	32 (53.3)
32-33+6	19 (31.7)
Parity	
Primigravida	29 (48.3)
Multigravida	31 (51.7)
History of preterm birth (n=31)	
Yes	4 (12.9)
No	27 (87.1)
Body mass index, kg/m^2 (n=59)	
<18.5	14 (23.7)
18.5-24.9	38 (64.4)
25-29.9	6 (10.2)
≥30	1 (1.7)
Inter-pregnancy interval, months (n=31)	
<18	2 (6.5)
≥18	29 (93.5)
History of antepartum haemorrhage	
Yes	8 (13.3)
No	52 (86.7)
Culture-proven bacteriuria	
Yes	6 (10.0)
No	54 (90.0)
Bacterial vaginosis	0
Smoker/alcohol drinker/drug abuser	0
Fetal anomalies	0
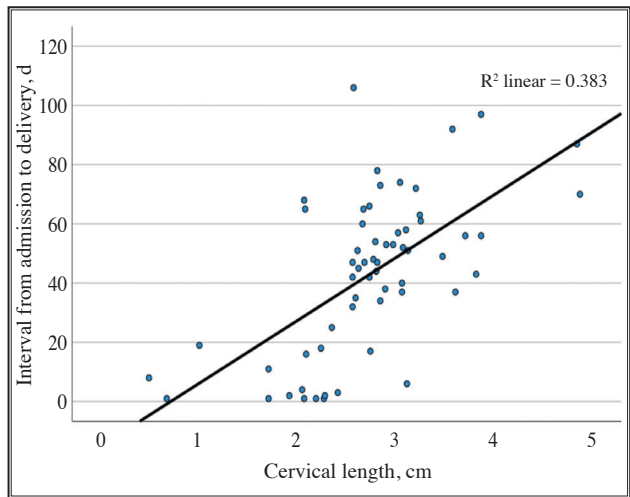
Figure 2. Cervical length is positively correlated with the interval from admission to delivery (r=0.61, p<0.001).
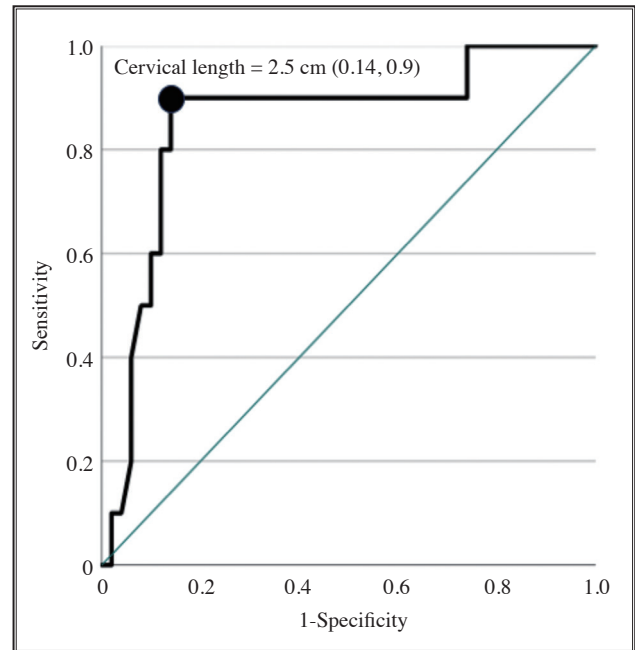

Figure 3. Receiver operating characteristic curve showing a cervical length cut-off value of 2.5 cm for predicting delivery within 7 days of admission.

specific (86.0%), with a positive predictive value of 62.5% and a negative predictive value of 97.7% (Figure 3).

In univariate analysis, risk factors for preterm delivery were previous preterm delivery, maternal age, history of antepartum haemorrhage, and cervical length. In multivariate analysis, only cervical length remained significantly associated with preterm delivery (Table 2).

Discussion

In the present study, cervical length as measured by transperineal ultrasound was a predictor for preterm delivery; the cut-off value of 2.5 cm had 90% sensitivity and 86% specificity. This concurs with NICE's and ACOG's suggestion on measuring cervical length via ultrasound to predict preterm delivery[6,7], and with a study reporting 84.6% sensitivity, 78.1% specificity, 75.9%

Table 2. Multivariate analysis for risk factors for preterm delivery

Variable	Odds ratio (95% confidence interval)	p Value
Previous preterm birth	26.8 (0.7-1003.3)	0.075
Cervical length	0.1 (0.1-0.3)	0.003
History of antepartum haemorrhage	7.5 (0.1-135.7)	0.171
Maternal age	1.2 (0.9-1.5)	0.244

positive predictive value, and 86.2% negative predictive value for the cut-off value of 2.5 cm[12].

In a meta-analysis, a cut-off value of 2.5 cm, as measured by transvaginal ultrasound, for predicting preterm birth within 7 days has a pooled sensitivity of 78.3% and a pooled specificity of 70.8%[15]. Independent predictors for delivery within 7 days are cervical length (odds ratio [OR]=0.69, 95% confidence interval [CI]=0.63-0.76) and vaginal bleeding (OR=19.42, 95% CI=3.87-97.4)[16]. Our findings based on transperineal ultrasound concur that cervical length is an independent predictor for preterm birth.

Nonetheless, different cut-off values should be used at different gestational ages, as the cervix naturally shortens as the gestation advances[17]. The false positive rate is higher if the cut-off value of 2.5 cm is used after 32 weeks of gestation; therefore, a cut-off value of 1.5 cm should be used after 32 weeks to improve sensitivity and positive predictive value.[17] Our sample was too small to stratify according to gestational age.

In the present study, only 10 (16.7%) women delivered within 7 days of admission although 21 (35.0%) women delivered preterm (before 36+6 weeks). We used delivery within 7 days of admission as an endpoint because antenatal corticosteroids are most effective if given within 7 days of delivery[18]. Not all women admitted for threatened preterm labour will deliver preterm[16]. Our protocol may need to be updated considering that most women with cervical length >2.5 cm did not deliver within 7 days of admission. Further studies with a larger sample are warranted to support such change.

The study has limitations. The sample is small; a larger sample may determine cut-off values of cervical length at different gestational ages. Transperineal ultrasound is operator-dependent and has a learning curve; therefore, there could have been inter-observer variations. We could not obtain clear images via transperineal ultrasound in some cases, possibly owing to pubic symphysis shadowing or bowel shadowing. Elevating the patient's hips can improve image resolution in 50% of cases[9].

Transperineal ultrasound may be an alternative to transvaginal or abdominal ultrasound for measuring cervical length in patients with threatened preterm labour. It can be used in patients with PPROM to reduce the risk of infection[19].

Conclusion

Cervical length, as measured by transperineal ultrasound, can predict preterm delivery in patients with threatened preterm labour. It is a non-invasive alternative to transvaginal ultrasound. A cut-off value of 2.5 cm has high sensitivity and specificity for predicting preterm delivery.

Contributors

All authors designed the study, acquired the data, analysed the data, drafted the manuscript, and critically revised the manuscript for important intellectual content. All authors had full access to the data, contributed to the study, approved the final version for publication, and take responsibility for its accuracy and integrity.

Conflicts of interest

All authors have disclosed no conflicts of interest.

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Data availability

All data generated or analysed during the present study are available from the corresponding author upon reasonable request.

Ethics approval

The study was approved by the Kowloon Central / Kowloon East Cluster Research Ethics Committee (reference: KC/KE-23-0065/ER-2). The patients were treated in accordance with the tenets of the Declaration of Helsinki. The patients provided written informed consent for all treatments and procedures and for publication.

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