Sonographic measurement of cervical length in threatened preterm labor in singleton pregnancies with intact membranes

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ABSTRACT

Objectives *To predict when delivery will occur, within 48 h and 7 days of presentation and before 35 weeks' gestation in women presenting with threatened preterm labor.*

Methods *Sonographic measurement of cervical length was carried out in 510 women with singleton pregnancies presenting with threatened preterm labor and intact membranes at 24 to 33 + 6 weeks of gestation. The measurement was not taken into account in the subsequent management of the pregnancies. The outcome measures were delivery within 48 h and 7 days of presentation and delivery before 35 weeks.*

Results *The median gestation at presentation was 30 + 1 (range, 24 to 33 + 6) weeks and the median cervical length was 25 (range, 1–51) mm. Delivery within 48 h of presentation occurred in 21 (4.1%) cases, delivery within 7 days occurred in 43 (8.4%) and delivery before 35 weeks occurred in 76 (14.9%). Logistic regression analysis demonstrated that the only significant independent predictor of delivery within 48 h was cervical length (odds ratio (OR), 0.73; 95% CI, 0.65–0.81) and for delivery within 7 days the independent predictors were cervical length (OR, 0.69; 95% CI, 0.63–0.76) and vaginal bleeding (OR, 19.42; 95% CI, 3.87–97.4). In the subgroup of women who did not deliver within 7 days of presentation, the incidence of delivery before 35 weeks was 7.1% (33 of 467) and the only significant independent predictor of such delivery was cervical length (OR, 0.92; 95% CI, 0.88–0.96, P < 0.0001). There was no significant independent contribution to any of the outcome measures from ethnic group, maternal age, gestational age, body mass index, parity, cigarette smoking or use of tocolytics.*

Conclusions *In women with threatened preterm labor sonographic measurement of cervical length helps to distinguish between true and false labor and to predict early preterm delivery. Copyright © 2005 ISUOG. Published by John Wiley & Sons, Ltd.*

INTRODUCTION

In threatened preterm labor, sonographic measurement of cervical length at presentation can help to distinguish between those women who do and those who do not deliver within the subsequent 7 days. Thus, in the combined data from three sonographic studies in a total of 532 singleton pregnancies presenting with threatened labor at 24–36 weeks, delivery within 7 days occurred in 49% of those with cervical length less than 15 mm and in 1.2% of those with a cervical length of 15 mm or more[1–3]. In this study we examined 510 women presenting at 24 to 33 + 6 weeks, including the 426 presenting before 34 weeks from the combined data of the three previous studies, to investigate further the relationship between cervical length and delivery within 7 days of presentation. We also examined the relationship between cervical length and delivery within 48 h of presentation and before 35 weeks' gestation.

METHODS

This was a multicenter observational study of sonographic measurement of cervical length in 510 women with singleton pregnancies presenting to the labor ward

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ORIGINAL PAPER

with painful and regular uterine contractions at 24 to $33 + 6$ weeks of gestation[1-3]. Women with ruptured membranes and those in active labor, defined by the presence of cervical dilatation of 3 cm or more, were excluded. The study was carried out at Harold Wood and King George's Hospitals, Essex, St Mary's Hospital, Portsmouth and Homerton Hospital, London, UK; Virchow Clinic Charité Berlin, Germany; Tygerberg Hospital, Cape Town and Kalafong Hospital, Pretoria, South Africa.

The management of the women, including hospitalization and administration of tocolytics, was determined by the attending obstetricians without taking into account the ultrasound findings[1-3]. The outcome measures were delivery within 48 h and 7 days of presentation, and delivery before 35 weeks' gestation.

Statistical analysis

Univariate logistic regression analysis was used to investigate the effect on delivery within 48 h, within 7 days or before 35 weeks of: maternal age, ethnic origin, parity, gestational age at presentation, cigarette smoking, body mass index (BMI), vaginal bleeding at presentation, use of tocolytics and cervical length. Maternal age in years, gestational age in weeks, BMI in kg/m^2 and cervical length in mm were examined as continuous numerical variables. A code was given for: ethnic origin (0 for Caucasian, 1 for Afro-Caribbean and 2 for Asian); parity (0 for nulliparous and 1 for parous); cigarette smoking (0 for no and 1 for yes); vaginal bleeding (0 for no and 1 for yes); use of tocolytics (0 for no and 1 for yes). Multiple logistic regression analysis was subsequently performed to determine the significant independent contribution of those variables yielding $P < 0.05$ in the univariate analysis. The final logistic regression models were used to calculate the probability scores and derive receiver–operating characteristics (ROC) curves for the three outcome measures.

RESULTS

The median gestational age at presentation was $30 + 1$ (range, 24 to $33 + 6$) weeks and the median cervical length was 25 (range, 1–51) mm. Delivery within 48 h of presentation occurred in 21 (4.1%) cases, delivery within 7 days occurred in 43 (8.4%) and delivery before 35 weeks occurred in 76 (14.9%). The demographic and pregnancy characteristics of the women and the results of univariate analysis in predicting the three outcome measures are shown in Table 1. There were significant associations between delivery within 48 h and ethnic origin, BMI, cervical length and use of tocolytics, and between delivery within 7 days and ethnic origin, bleeding, cervical length and use of tocolytics. For delivery before 35 weeks there were significant associations with ethnic origin, BMI, bleeding, cervical length and use of tocolytics, while for delivery after 7 days but before 35 weeks there were significant associations with BMI, cervical length and use of tocolytics.

Logistic regression analysis demonstrated that the only significant independent predictor of delivery within 48 h

Table 1 Univariate analysis in 510 women with threatened labor at 24 to $33 + 6$ weeks in the prediction of delivery within 48 h and within 7 days of presentation and before 35 weeks' gestation

Variable	Median (range) or n (%)	Delivery within 48 h (n = 21/510 (4.1%))		Delivery within 7 days (n = 43/510 (8.4%))		Delivery before 35 weeks* (n = 33/467 (7.1%))	
		OR (95% CI)	P	OR (95% CI)	P	OR (95% CI)	P
Age (years)	26 (16–41)	1.02 (0.95–1.1)	0.545	1.03 (0.98–1.09)	0.196	0.95 (0.89–1.01)	0.127
Ethnic origin			0.001		0.001		0.724
Caucasian	396 (77.6)	1		1		1	
African	83 (16.3)	5.3 (2.13–13.2)		3.39 (1.73–6.67)		1.02 (0.38–2.76)	
Asian	31 (6.1)	1.3 (0.16–10.4)		0.47 (0.06–3.62)		0.44 (0.06–3.34)	
Body mass index	24 (14–45)	0.86 (0.75–0.98)	0.024	0.97 (0.90–1.06)	0.549	0.89 (0.80–0.98)	0.024
Parity			0.489		0.858		0.481
Nulliparous	232 (45.5)	1		1		1	
Parous	278 (54.5)	1.37 (0.56–3.37)		1.06 (0.57–1.99)		0.77 (0.38–1.57)	
Smoker			0.414		0.753		0.082
No	401 (78.6)	1		1		1	
Yes	109 (21.4)	1.5 (0.57–3.96)		1.13 (0.54–2.36)		1.96 (0.92–4.21)	
Bleeding			0.077		< 0.0001		0.199
No	468 (91.8)	1		1		1	
Yes	42 (8.2)	2.79 (0.89–8.72)		4.83 (2.23–10.5)		2.08 (0.68–6.34)	
Gestational age (weeks)	30.2 (24–33.9)	1.007 (0.87–1.17)	0.929	1.00 (0.89–1.11)	1.000	0.92 (0.82–1.03)	0.153
Cervical length (mm)	25 (1–51)	0.73 (0.65–0.81)	< 0.0001	0.714 (0.66–0.78)	< 0.0001	0.92 (0.88–0.96)	< 0.0001
Use of tocolytics			0.030		< 0.0001		0.007
No	245 (48.0)	1		1		1	
Yes	265 (52.0)	3.08 (1.11–8.54)		4.51 (2.05–9.93)		2.95 (1.34–6.49)	

*Delivery before 35 weeks in the subgroup that did not deliver within 7 days of presentation.

was cervical length (odds ratio (OR) 0.73; 95% CI, 0.65–0.81, $P < 0.0001$; Figure 1, Tables 1 and 2) and for delivery within 7 days the independent predictors were cervical length (OR, 0.69; 95% CI, 0.63–0.76, $P < 0.0001$; Figure 1, Tables 1 and 2) and vaginal bleeding (OR, 19.42; 95% CI, 3.87–97.4, $P < 0.0001$). For delivery within 48 h the likelihood of delivery (%) = (odds/1 + odds) × 100, where odds = expY and Y = $\log_e$ (odds) = $1.238 - 0.320 \times$ cervical length (in mm), while for delivery within 7 days Y = $\log_e$(odds) = $2.848 - 0.366 \times$ cervical length (in mm) $+ 2.967 \times$ bleeding (1 for yes and 0 for no). However, in the prediction model for delivery within 7 days provided by cervical length there was no significant improvement from the inclusion of vaginal bleeding. Thus, for a sensitivity of 100%, the false-positive rate with cervical length alone was 42.2% and for cervical length and vaginal bleeding it was 42.8%. For a false-positive rate of 8.0%, the sensitivity with both models was 93.0%.

Delivery before 35 weeks occurred in 76 (14.9%) cases, and multiple regression analysis demonstrated that the significant independent predictors of such delivery were cervical length (OR, 0.84; 95% CI, 0.81–0.87, $P < 0.0001$; Figure 1, Table 2) and vaginal bleeding (OR, 5.64; 95% CI, 2.20–14.42, $P < 0.0001$). The likelihood of delivery (%) = (odds/1 + odds) × 100, where odds = expY and Y = $\log_e$ (odds) = 1.554 −

$0.175 \times$ cervical length (in mm) $+ 1.729 \times$ bleeding (1 for yes and 0 for no). However, in the prediction model for delivery before 35 weeks provided by cervical length, there was no significant improvement from the inclusion of vaginal bleeding. Thus, for a sensitivity of 76% the screen-positive rate with cervical length alone was 25.1% and for the model including cervical length and vaginal bleeding for a sensitivity of 74% it was 25.5%. For a screen-positive rate of 3.1%, the sensitivity with cervical length only was 19.7%, while with cervical length and bleeding it was 18.4%.

In the subgroup of women who did not deliver within 7 days of presentation, the incidence of delivery before 35 weeks was 7.1% (33 of 467) and the only significant independent predictor of such delivery was cervical length (OR, 0.92; 95% CI, 0.88–0.96, $P < 0.0001$) (Table 1). The likelihood of delivery (%) = (odds/1 + odds) × 100, where, odds = expY and Y = $\log_e$ (odds) = $-0.686 - 0.080 \times$ cervical length (in mm).

The ROC curves comparing the performance of cervical length at presentation in women with threatened preterm
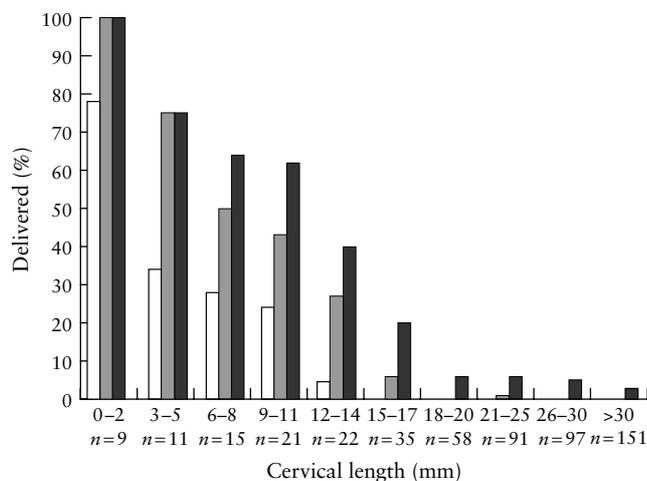

Figure 1 Rate of delivery within 48 h (□) and 7 days (▨) of presentation and before 35 weeks' gestation (■) according to cervical length at presentation.
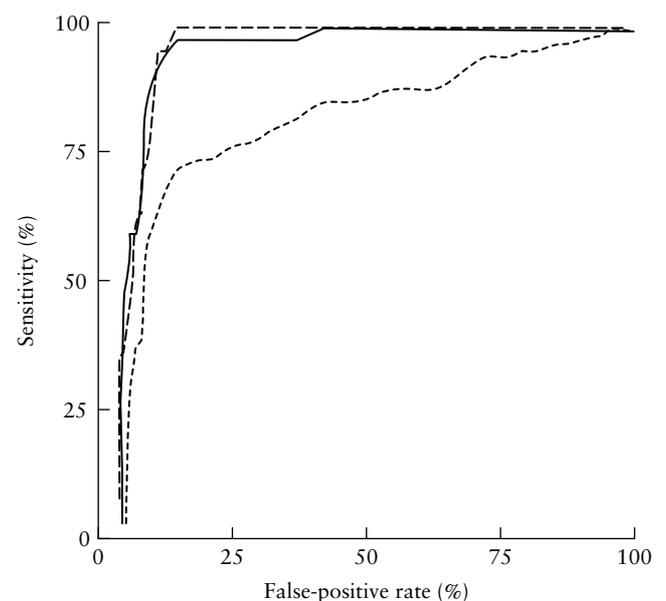

Figure 2 Receiver–operating characteristics curves comparing the performance of cervical length at presentation in women with threatened preterm labor in the prediction of delivery within 48 h (– – – – –) and within 7 days (———) of presentation and before 35 weeks' gestation (- - - -).

Table 2 Rate of delivery and 95% CI within 48 h and within 7 days of presentation and before 35 weeks' gestation according to cervical length at presentation

	Delivery within 48 h		Delivery within 7 days		Delivery before 35 weeks	
Cervical length	Rate (%)	95% CI	Rate (%)	95% CI	Rate (%)	95% CI
≤ 5 mm	9/20 (45.0)	23.2–66.8	16/20 (80.0)	62.5–97.5	17/20 (85.0)	69.4–100
6–10 mm	8/28 (28.6)	11.8–45.3	12/28 (42.9)	24.5–61.2	16/28 (57.1)	38.8–75.4
11–15 mm	4/47 (8.5)	0.5–16.5	14/47 (29.8)	16.7–42.8	21/47 (44.7)	30.5–58.9
16–20 mm	0/76 (−)		0/76 (−)		5/76 (6.6)	1.0–12.2
> 20 mm	0/339 (−)		1/339 (0.3%)	0–0.8	17/339 (5.0)	2.7–7.3

labor in the prediction of delivery within 48 h, within 7 days and before 35 weeks are shown in Figure 2. The areas under the curves were 97% for delivery within 48 h, 96% for delivery within 7 days and 84% for delivery before 35 weeks.

DISCUSSION

In pregnancies presenting with threatened preterm labor the outcome measures of relevance to immediate clinical management are delivery within the subsequent 48 h and delivery within 7 days. The clinical dilemma revolves around the issue of whether the patient is truly in labor and therefore in need of, firstly, hospitalization in a unit with facilities for neonatal intensive care, and, secondly, administration of tocolytics with the potentially achievable objective of short-term prolongation of pregnancy for the effective administration of corticosteroids to improve fetal lung maturity. Randomized studies have shown that the maximum effectiveness of steroids requires that delivery is delayed by at least 48 h[4], and that tocolytics can prolong pregnancy by about 7 days[5]. The third outcome measure was delivery before 35 weeks because such an event is associated with a high risk of perinatal mortality and morbidity.

The findings of the study demonstrate that all three outcome measures are significantly associated with cervical length at presentation. We found that delivery within 48 h or 7 days of presentation occurred in only 4.1% and 8.4% of cases, respectively. In the group of women presenting with a cervical length of 15 mm or more none delivered within 48 h and only 0.7% delivered within 7 days. On the basis of these results it could be argued that in such women there may be no justification for routine hospitalization and the administration of tocolytics and steroids, because of the associated economic cost and maternal and fetal risks, respectively. From the research point of view it would be necessary to determine if sonographic measurement of cervical length should be performed not only at presentation but also at various time intervals after this event.

In the group of women who did not deliver within 7 days of presentation, the incidence of delivery before 35 weeks was 7.1%, which is not substantially different from what would be expected in a population with no episodes of threatened preterm labor. In such women the finding of a significant association between cervical length and risk for subsequent preterm delivery is similar to the results of screening studies of cervical length in asymptomatic pregnancies at 22–24 weeks[6]. Randomized studies have reported that in women considered to be at high risk of preterm delivery because of a previous history of such delivery, the risk is substantially reduced by the prophylactic administration of progesterone[7,8]. The extent to which progesterone is also effective in reducing the risk of preterm delivery in both symptomatic and asymptomatic women with the sonographic finding of a short cervix remains to be determined.

ACKNOWLEDGMENT

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