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Pre-induction sonographic measurement of cervical length in prolonged pregnancy: the effect of parity in the prediction of the need for Cesarean section

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KEYWORDS: cervical length; Cesarean section; induction of labor; parity; prolonged pregnancy; transvaginal sonography

ABSTRACT

Objective *To examine the effect of parity on the relationship between pre-induction cervical length and the risk of Cesarean section in women undergoing induction of labor for prolonged pregnancy.*

Methods *In 382 singleton pregnancies, induction of labor was carried out at 41 + 3 to 42 + 1 weeks of gestation. The cervical length was measured by transvaginal sonography before induction. In 71 of these cases a Cesarean section was required for either fetal distress or failure to progress and 311 women delivered vaginally. The effect of parity and pre-induction cervical length on the risk of Cesarean section was examined.*

Results *In nulliparous women the incidence of Cesarean section was significantly higher than in multiparous women (28.1% vs. 8.9%). In both nulliparae and multiparae there was a significant association between pre-induction cervical length and the rate of Cesarean section. Logistic regression analysis demonstrated that cervical length and parity provided significant independent prediction of all Cesarean sections and Cesarean sections for failure to progress. The odds of Cesarean section increased by about 10% with each increase of 1 mm in cervical length, over the mean cervical length of 20 mm for nulliparae and 18 mm for multiparae, and the odds was about 75% lower in multiparae, compared to nulliparae with the same cervical length. Receiver–operating characteristics curves (ROC) demonstrated that cervical length was better than the Bishop score in the prediction of all Cesarean sections (area under ROC = 0.72 vs. 0.68) and Cesarean sections for failure to progress (area under ROC = 0.76 vs. 0.69).*

Conclusion *In women undergoing induction of labor for prolonged pregnancy, cervical length and parity provide significant independent prediction of the likelihood of Cesarean section. Copyright © 2003 ISUOG. Published by John Wiley & Sons, Ltd.*

INTRODUCTION

In prolonged pregnancy, induction of labor, compared to expectant management, is associated with a substantial reduction in perinatal mortality[1–5]. However, approximately 20% of women having induction of labor need a Cesarean section for delivery[5,6]. The aim of this study was to examine the effect of parity and pre-induction sonographically measured cervical length in predicting the likelihood of Cesarean section in women undergoing induction of labor for prolonged pregnancy.

METHODS

Transvaginal sonographic measurement of cervical length was undertaken immediately before induction of labor for prolonged pregnancy in 192 nulliparous and 190 multiparous women with single, live fetuses in cephalic presentation. The methodology of cervical assessment and induction of labor are as previously described[7–11].

Statistical analysis

The women were divided by parity into nulliparae and multiparae. They were further subdivided into four groups according to cervical length (1–10, 11–20, 21–30 and 31–40 mm). They were also divided into four groups according to Bishop score (0–3, 4, 5–8 and 9) and four groups according to cervical length by vaginal examination (< 1, 1–2, 2–4 and > 4 cm). These groups were compared using component column

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charts. Receiver–operating characteristics (ROC) curves for sonographic cervical length and Bishop score were compared for predicting the likelihood of Cesarean section overall and Cesarean section for failure to progress. In cases complicated by both failure to progress and fetal distress we used the primary indication for which the Cesarean section was done. Logistic regression was used to investigate the independent prediction of all Cesarean sections and Cesarean sections for failure to progress by sonographic cervical length and parity. Two-sided *P* values are reported throughout.

RESULTS

Sonographic measurement of cervical length was successfully carried out in all 382 pregnancies. The median gestation at induction was 41 + 3 (range, 41 + 3 to 42 + 1) weeks and the median cervical length in multiparae was significantly shorter than in nulliparae (median 16 mm, range 1–40 mm vs. median 18 mm, range 5–39 mm, $P < 0.05$).

In the 382 women, delivery was vaginal in 311 (81.1%) and by Cesarean section in 71 (18.9%).

The incidence of Cesarean section was lower within the first 24 h after induction than in those delivering after 24 h (11.8% or 34/289, 95% CI 8.3%–16% vs. 39.8% or 37/93, 95% CI 29.8%–50.5%; $\chi^2 = 36.5$, $P < 0.0001$). The rate of instrumental delivery was not significantly different between those delivering within the first 24 h after induction than in those delivering after 24 h (15.6% or 45/289 vs. 21.5% or 20/93).

In nulliparous women the incidence of Cesarean section was significantly higher than in multiparous women (54/192 or 28.1%, 95% CI 21.9%–35.0% vs. 17/190 or 8.9%, 95% CI 5.3%–13.9%; $\chi^2 = 23.2$, $P < 0.0001$). In nulliparae, 24/126 had Cesarean section within 24 h of induction (19%, 95% CI 12.6%–27%), including five for failure to progress and 19 for fetal distress. In those delivering after 24 h, the incidence of Cesarean section was significantly higher (30/66 or 45.5%, 95% CI 33.1%–58.2%; $\chi^2 = 14.94$, $P < 0.0001$), and the indication for Cesarean section was failure to progress in 21 and fetal distress in nine cases. In multiparae, 10/163 had Cesarean section within 24 h of induction (6.1%, 95% CI 3%–11%), including three for failure to progress and seven for fetal distress. In those delivering after 24 h, the incidence of Cesarean section was significantly higher (7/27 or 25.9%, 95% CI 11.1%–46.3%; $\chi^2 = 7.45$, $P = 0.0063$), and the indication for Cesarean section was failure to progress in five and fetal distress in two cases.

There was a significant association between pre-induction sonographic cervical length and the incidence of Cesarean section in both nulliparae and multiparae (Table 1 and Figure 1). Sonographic cervical length was a better predictor of mode of delivery than Bishop score or cervical length by vaginal examination (Tables 1–3). Similarly, in the ROC curves the area under the curve was higher for sonographic cervical length than the Bishop score both in the prediction of all Cesarean sections and in the prediction of Cesarean sections for failure to progress (0.72 vs. 0.68 and 0.76 vs. 0.68, respectively; Figure 2).

Logistic regression analysis demonstrated that both parity and cervical length are significant predictors of risk of all Cesarean sections. An increase of 1 mm in cervical length over the mean cervical length (20 mm for nulliparae and 18 mm for multiparae) was associated with a 10.2% increase in the odds of a Cesarean section. The odds of all Cesarean sections were 74% lower in multiparae, compared to nulliparae with the same cervical length (Table 4). Logistic regression analysis also showed that sonographic cervical length and parity provided

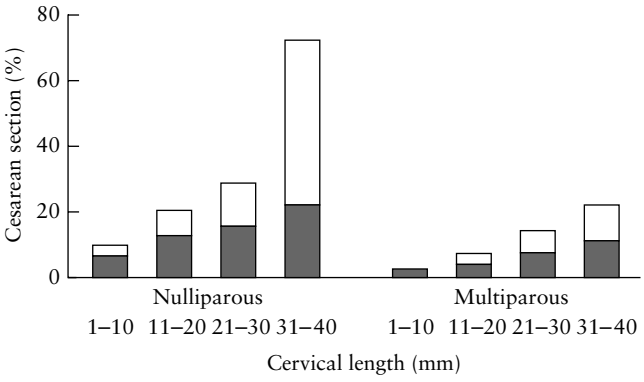

Figure 1 Association between pre-induction cervical length by scan and the percentage requiring Cesarean section for fetal distress (■) or failure to progress (□) in nulliparae and multiparae.

Table 1 Association between pre-induction cervical length by scan and the incidence of Cesarean section in both nulliparae (total $\chi^2 = 28.11$, $P < 0.0001$, χ^2 for linear trend = 22.0, $P < 0.0001$) and multiparae (total $\chi^2 = 8.2$, $P = 0.0425$, χ^2 for linear trend = 8.01, $P = 0.0046$)

		Cesarean section (n *(%)*)		
Group	n	*Fetal distress*	*Failure to progress*	*Total*
Nulliparae cervix 1–10 mm	29	2 (6.9)	1 (3.4)	3 (10.3)
Nulliparae cervix 11–20 mm	80	11 (13.8)	6 (7.5)	17 (21.3)
Nulliparae cervix 21–30 mm	61	10 (16.4)	8 (13.1)	18 (29.5)
Nulliparae cervix 31–40 mm	22	5 (22.7)	11 (50.0)	16 (72.7)
Multiparae cervix 1–10 mm	44	1 (2.3)	–	1 (2.3)
Multiparae cervix 11–20 mm	86	3 (3.5)	3 (3.5)	6 (7.0)
Multiparae cervix 21–30 mm	42	3 (7.1)	3 (7.1)	6 (14.2)
Multiparae cervix 31–40 mm	18	2 (11.1)	2 (11.1)	4 (22.2)

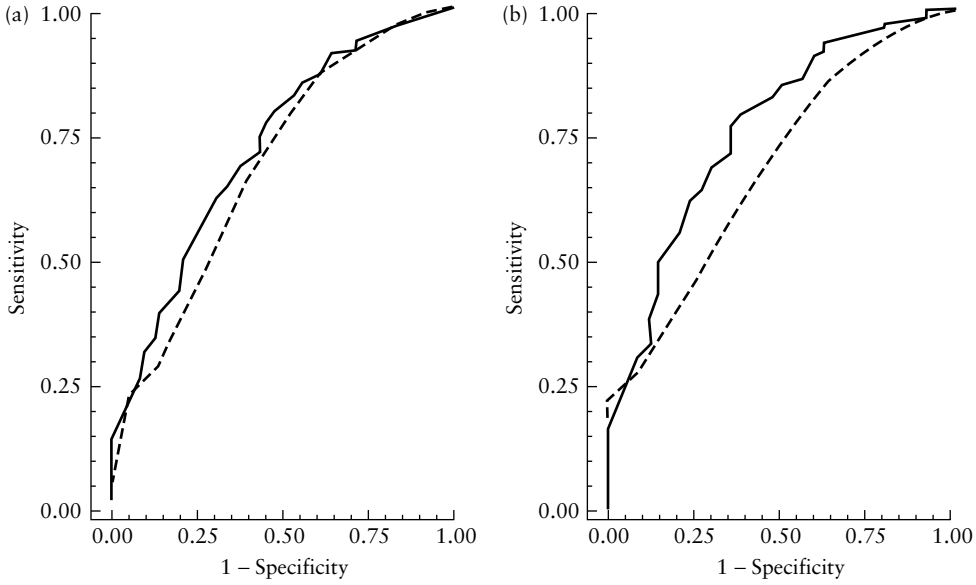

Figure 2 Receiver–operating characteristics curves for sonographically measured cervical length (——) and Bishop score (– – –) for the likelihood of a Cesarean section (a) and Cesarean section for failure to progress (b).

Table 2 Association between pre-induction Bishop score and the incidence of Cesarean section in both nulliparae (total $\chi^2 = 16.6$, $P < 0.001$, χ^2 for linear trend = 14.5, $P = 0.0001$) and multiparae (total $\chi^2 = 4.01$, $P = 0.260$, χ^2 for linear trend = 0.8, $P = 0.373$)

		Cesarean section (n *(%)*)		
Group	n	*Fetal distress*	*Failure to progress*	*Total*
Nulliparae Bishop score 9–10	4	–	–	–
Nulliparae Bishop score 5–8	56	6 (13.0)	6 (13.0)	12 (26.0)
Nulliparae Bishop score 4	35	4 (11.4)	5 (14.3)	9 (25.7)
Nulliparae Bishop score 0–3	97	18 (18.5)	15 (15.5)	33 (34.0)
Multiparae Bishop score 9–10	13	1 (4.5)	–	1 (4.5)
Multiparae Bishop score 5–8	84	3 (4.0)	2 (2.7)	5 (6.7)
Multiparae Bishop score 4	32	–	–	–
Multiparae Bishop score 0–3	61	5 (8.2)	6 (9.8)	11 (18.0)

Table 3 Association between pre-induction cervical length by vaginal examination and the incidence of Cesarean section in both nulliparae (total $\chi^2 = 8.47$, $P = 0.0145$, χ^2 for linear trend = 8.41, $P = 0.0037$) and multiparae (total $\chi^2 = 1.65$, $P = 0.648$, χ^2 for linear trend = 1.64, $P = 0.199$)

		Cesarean section (n *(%)*)		
Group	n	*Fetal distress*	*Failure to progress*	*Total*
Nulliparae cervix < 1 cm	52	12 (23.1)	9 (17.3)	21 (40.4)
Nulliparae cervix 1–2 cm	111	14 (12.6)	16 (14.4)	30 (27)
Nulliparae cervix 2–4 cm	29	2 (6.9)	1 (3.4)	3 (10.3)
Nulliparae cervix > 4 cm	–	–	–	–
Multiparae cervix < 1 cm	30	2 (6.7)	2 (6.7)	4 (13.4)
Multiparae cervix 1–2 cm	119	5 (4.2)	6 (5.0)	11 (9.2)
Multiparae cervix 2–4 cm	38	2 (5.3)	–	2 (5.3)
Multiparae cervix > 4 cm	3	–	–	–

significant independent contribution in the prediction of a Cesarean section for failure to progress. An increase of 1 mm in cervical length over the mean cervical length (20 mm for nulliparae and 18 mm for multiparae) was associated with a 13% increase in the odds of Cesarean section for failure to progress. The odds of Cesarean section for failure to progress were 75% lower in multiparae, compared to nulliparae with the same cervical length (Table 4).

DISCUSSION

The finding of this study that in singleton pregnancies undergoing induction of labor for prolonged pregnancy

Table 4 Results of logistic regression analysis in the prediction of all Cesarean sections and Cesarean section for failure to progress, according to cervical length and parity

Variable	*Odds ratio*	*95% CI*	P
All Cesarean sections			
Parity			< 0.0001
Nulliparae	1.00		
Multiparae	0.26	0.14–0.48	
Cervical length	1.10	1.07–1.14	< 0.0001
Cesarean sections for failure to progress			
Parity			0.002
Nulliparae	1.00		
Multiparae	0.25	0.11–0.60	
Cervical length	1.13	1.08–1.19	< 0.0001

the Cesarean section rate is about 20% is compatible with that of previous reports[5,6]. In addition, we found that the rate of Cesarean section is dependent on parity, being about 10% for multiparous women and 30% for nulliparae.

We found that pre-induction cervical length and parity provided significant independent prediction of all Cesarean sections and Cesarean sections for failure to progress. The odds of Cesarean section increased by about 10% with each increase of 1 mm in cervical length, over the mean cervical length of 20 mm for nulliparae and 18 mm for multiparae. We also found that cervical length was better than the Bishop score in the prediction of Cesarean section.

Two previous studies on the value of pre-induction sonographic cervical length have also reported that this measurement provides a significant contribution in the prediction of mode of delivery. Ware and Raynor[12] examined 77 women before induction and found that cervical length and parity provided significant independent contributions in the prediction of the mode of delivery. Gabriel *et al.*[13,14] studied 179 women undergoing induction of labor and found that cervical length is better than the Bishop score in the prediction of the risk of Cesarean section.

Prolonged labor is associated with a higher rate of medical intervention, maternal exhaustion and longer hospitalization with consequent increased morbidity and financial cost[15–18]. We found that the rate of Cesarean section was more than three times higher in those delivering after 24 h, rather than within 24 h, of induction. Furthermore, the induction-to-delivery interval[11] and the rate of Cesarean section are higher in nulliparae than multiparae and increase with cervical length. Thus, multiparous women requiring induction for prolonged pregnancy can be reassured that if their cervical length is ≤ 20 mm they have a 95% chance of vaginal delivery. Conversely, nulliparous women with cervical length of > 30 mm should be informed that following induction of labor they have a greater than 70% chance of requiring a Cesarean section either for fetal distress or failure to progress.

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