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Cervical length and funneling at 23 weeks of gestation in the prediction of spontaneous early preterm delivery

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ABSTRACT

Objectives *To establish the relationship of cervical length at 23 weeks of gestation to the risk of spontaneous delivery before 33 weeks and to determine the possible additional risk if funneling is present.*

Methods *During a 36-month period, 6819 women with singleton pregnancies underwent transvaginal sonographic cervical assessment at 22–24 weeks as a screening test for preterm delivery. The distribution of cervical length and the prevalence of funneling, defined as dilatation of the internal os of ≥ 5 mm in width, were established. Women who underwent cervical cerclage, iatrogenic preterm delivery or were lost to follow-up were excluded from further analysis. In the remaining 6334 pregnancies, logistic regression was used to examine the contribution of cervical length and funneling to the risk of spontaneous preterm delivery before 33 weeks.*

Results *The median cervical length was 36 mm and in 1.6% of cases the length was ≤ 15 mm. There was a significant inverse association between cervical length and percentage rate of spontaneous delivery before 33 weeks. Funneling of the internal os was present in about 4% of pregnancies and the prevalence decreased with increasing cervical length from 98% when the length was ≤ 15 mm to about 25% for lengths of 16–30 mm and less than 1% at lengths of > 30 mm. The rate of preterm delivery was 6.9% in those with funneling compared to 0.7% in those without funneling ($\chi^2 = 86.7$; $P < 0.0001$). However, logistic regression analysis demonstrated that funneling did not provide a significant additional contribution to cervical length in the prediction of spontaneous delivery before 33 weeks (odds ratio for short cervix = 24.9, Z = 4.43, $P < 0.0001$; odds ratio for funneling = 1.8, Z = 0.84, $P = 0.40$).*

Conclusion *In the prediction of preterm delivery, funneling does not provide any significant contribution in addition to cervical length.*

INTRODUCTION

Sonographic measurement of cervical length at 22–24 weeks of gestation provides useful prediction of the risk of subsequent spontaneous delivery before 33 weeks[1–3]. Another sonographic finding in pregnancies at risk of preterm delivery is 'funneling' or dilatation of the internal os[4–7] and several authors have suggested that funneling is an early sign of cervical 'incompetence'[8–11]. However, it is uncertain if short cervical length and funneling contribute independently in the prediction of preterm delivery. The aim of this study was to establish the relationship of cervical length at 23 weeks to the risk of spontaneous delivery before 33 weeks and to determine the possible additional risk if funneling is present.

MATERIALS AND METHODS

At King's College Hospital, London, women attending for routine antenatal care are offered an ultrasound scan at 11–14 weeks of gestation and another at 23 weeks. The latter includes examination of the fetus and the option of having a transvaginal scan to measure cervical length as a screening test for spontaneous preterm delivery. Women with a short cervix (≤ 15 mm) are given the option of participating in an ongoing multicenter randomized trial of cervical cerclage. This study has approval from the hospital ethics committee and written informed consent is obtained from all women.

The women are asked to empty their bladder and are placed in the dorsal lithotomy position. Transvaginal sonography with a 5-MHz transducer (Aloka 1700, Aloka Co., Ltd, Tokyo, Japan) is carried out by sonographers who have received The Fetal Medicine Foundation Certificate of Competence in Cervical Assessment (http://www.fetalmedicine.com). The probe is placed in the anterior fornix of the vagina and care is taken to avoid exerting undue pressure on the cervix, which may artificially lengthen the cervix. A sagittal view of the cervix is obtained and the sonolucent endocervical mucosa is used as a guide to the true position of the internal os, thereby avoiding confusion with the lower segment of the uterus[12].

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The calipers are used to measure the linear distance between the triangular area of echodensity at the external os and the V-shaped notch at the internal os. Each examination is performed over a period of about 3 min in order to note any dynamic changes in the cervix. Funneling is defined as dilatation of the internal os of ≥ 5 mm in width persisting throughout the 3-min period of the ultrasound examination (Figure 1).

Patient characteristics and ultrasound findings are recorded in a computer database. Gestational age is determined from the menstrual history and confirmed from the measurement of fetal crown–rump length at the first-trimester scan. Data on pregnancy outcome were obtained from the computerized system in the delivery ward, and for those that delivered at home or in other hospitals, from the general practitioner or from the patients themselves.

Statistical analysis

A computer search was performed to identify all singleton pregnancies that had undergone cervical assessment at 23 weeks and the prevalence of funneling according to cervical length was determined. Regression analysis was used to calculate the relationship between cervical length and the risk of spontaneous delivery before 33 weeks. This model was then applied to the subgroup of women with funneling to estimate the expected number of preterm deliveries. A χ^2-test was used to determine the significance of the difference between the observed and expected number of preterm deliveries. Furthermore, multiple logistic regression was used to determine the possible significance of funneling, independent of cervical length, in the prediction of spontaneous delivery before 33 weeks.

RESULTS

During a 36-month period (January 1997 to January 2000) 6819 women with singleton pregnancies underwent cervical assessment at 22–24 weeks (median, 23 weeks) as a screening test for preterm delivery. The women included 3482 (51.1%) Caucasians, 2791 (40.9%) of Afro-Caribbean origin and 546 (8.0%) of other ethnic groups. The median maternal age was 30 years (range, 16–46 years) and 1330 (19.5%) were aged 35 years or more, 955 (14%) were cigarette smokers and the body mass index was < 19.8 in 550 (8.1%), 19.8–26 in 3861 (56.6%) and > 26 in 2408 (35.3%). In terms of obstetric history, 2246 (32.9%) patients had had no previous pregnancies, 1371 (20.1%) had only had one or more miscarriage and/or termination of pregnancy before 16 weeks of gestation, 2746 (40.3%) had had one or more term deliveries, with or without previous fetal losses before 16 weeks, 230 (3.4%) had had at least one previous spontaneous preterm delivery and 131 (1.9%) had had at least one previous miscarriage or termination at 16–23 weeks.

Cervical length was normally distributed and the median, fifth and first centiles were 36 mm, 22 mm and 11 mm, respectively. The mean was 36 mm and the standard deviation was 9 mm (Figure 2). Funneling of the cervical canal at the level of the internal os was present in 294 (4.3%) cases; funneling was observed in 100% (all 20) of cases with a cervical length of 1–5 mm, in 98% (40 of 41) of those at 6–10 mm, 98% (49 of 50) at 11–15 mm, 51.3% (81 of 158) at 16–20 mm, 12.3% (51 of 415) at 21–25 mm, 2.5% (26 of 1025) at 26–30 mm and 0.5% (27 of 5110) of cases with cervical length of ≥ 31 mm.

Of the 6819 pregnancies, 374 (5.5%) were lost to follow-up, 58 (0.9%) had iatrogenic preterm delivery before 33 weeks and these pregnancies were excluded from further analysis. In addition, 53 of the 111 women with cervical length of ≤ 15 mm had elective placement of a cervical suture and these were also excluded. In the remaining 6334 pregnancies, 59 (0.9%) resulted in spontaneous delivery before 33 weeks. The rate of preterm delivery was 6.9% (16 of 231) in those with funneling compared to 0.7% (43 of 6103) in those without funneling ($\chi^2 = 86.7$; $P < 0.0001$). In the total group there was a significant inverse association between cervical length

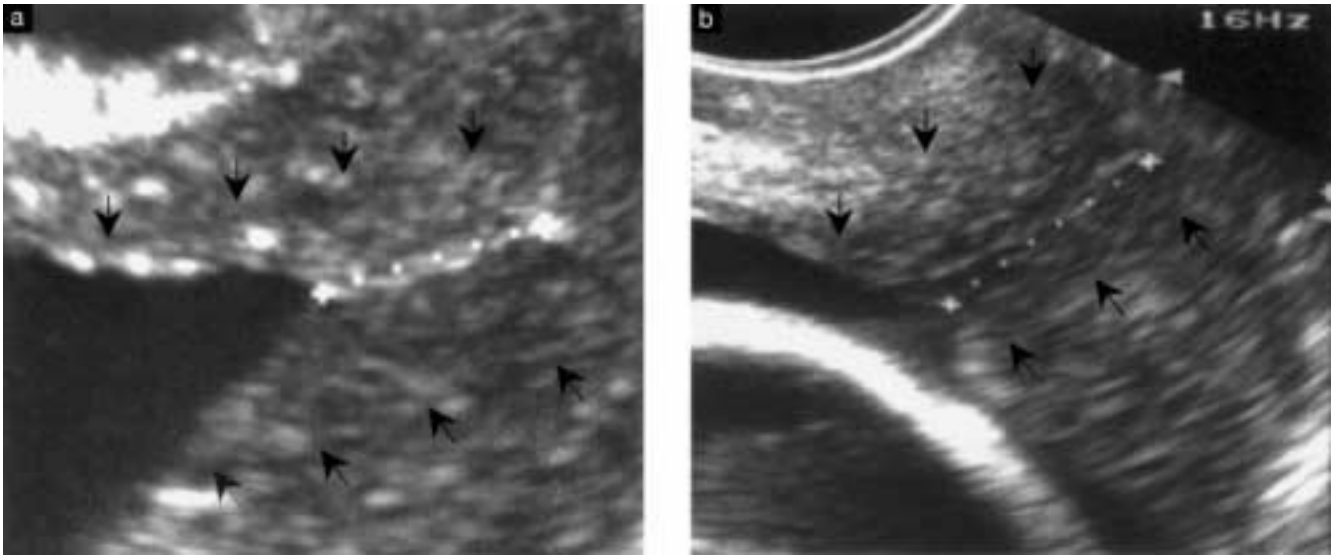

Figure 1 Transvaginal ultrasound images of the cervix. In both cases the closed cervical canal length is 16 mm. In (a) there is funneling of the cervical canal and the mucosa can be seen to extend beyond the residual closed canal (arrows). In (b) the cervical length is short but without funneling.

and percentage rate of preterm delivery before 33 weeks (rate = 10^(2.04225 – 0.07045 × cervical length + 0.00001185 × cervical length^2); $r = 0.99$; $P = 0.0073$; Figure 3). The estimated number of spontaneous early preterm deliveries was 59.6, which was similar to the observed number of 59. Logistic regression analysis demonstrated that funneling did not provide a significant additional contribution to cervical length in the prediction of spontaneous delivery before 33 weeks (odds ratio for short cervix = 24.9, $Z = 4.43$, $P < 0.0001$; odds ratio for funneling = 1.8, $Z = 0.84$, $P = 0.40$). The observed number of preterm deliveries in the patients with funneling ($n = 16$) was not significantly different from the expected number calculated on the basis of cervical length ($n = 20.7$; $\chi^2 = 0.41$, $P = 0.52$).

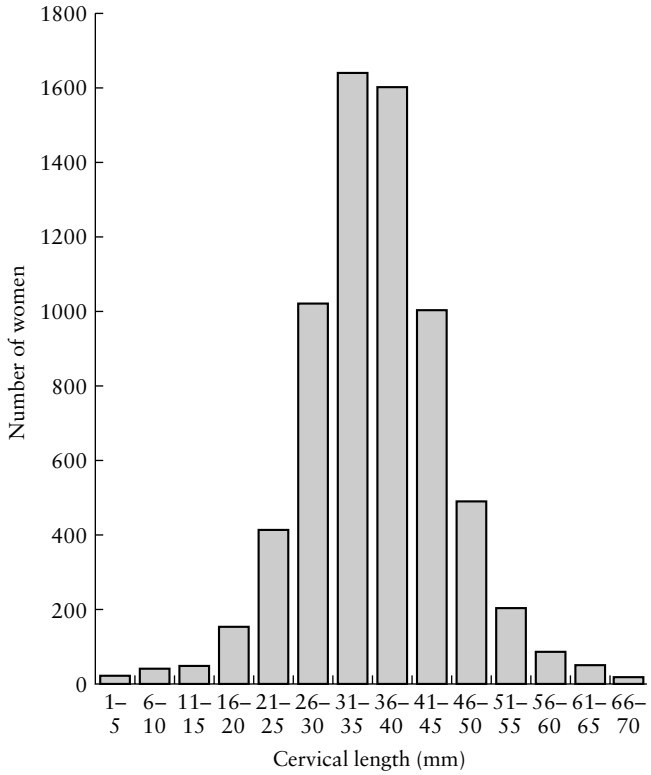

Figure 2 Distribution of cervical length at 23 weeks of gestation.

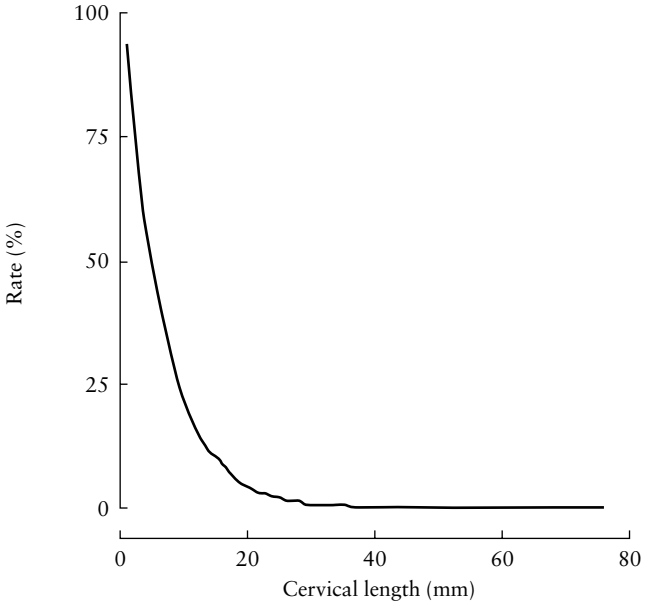

Figure 3 Association between cervical length and percentage rate of spontaneous delivery before 33 weeks of gestation.

DISCUSSION

We found that the median cervical length at 22–24 weeks was 36 mm and in 1.6% of cases the length was ≤ 15 mm. The study confirms the inverse association between cervical length and risk of spontaneous delivery before 33 weeks[1,2]. Funneling, defined as dilatation of the internal os of ≥ 5 mm, was present in about 4% of pregnancies and the prevalence decreased with increasing cervical length from 98% when the length was ≤ 15 mm to about 25% for 16–30 mm and less than 1% at > 30 mm. Consequently, in women with funneling the risk of preterm delivery (about 7%) was considerably higher than in those without funneling (0.7%). However, when cervical length was taken into account funneling did not provide any significant additional contribution in the prediction of spontaneous delivery before 33 weeks.

Several studies in patients symptomatic for preterm labor have shown a relationship between cervical funneling and the risk of subsequent preterm delivery[4,5,7,11]. There are also two observational studies in which dilatation of the internal os was an incidental finding during antenatal sonographic examination for multiple indications including a history suggestive of an increased risk of preterm birth, and they reported that funneling was associated with an increased risk of preterm delivery[6,13]. Berghella *et al.*[13] identified 43 women at 16–28 weeks of gestation as having funneling, which was defined by the presence of any opening of the internal os. The prevalence of this sonographic finding in their overall antenatal population was not reported. They found that cervical length, funnel length and the relative percentage of the cervix that was funneled were all related to the risk of preterm delivery, but the relationship between the three parameters was not defined and it is not possible to discern whether any one factor provided independent contribution to the risk of preterm delivery. Riley *et al.*[6] reported a 30% incidence of preterm delivery in a group of 31 patients who at 16–30 weeks of gestation were found to have a cervical length of < 30 mm and funneling of the internal os, defined as bulging of the membranes into the endocervical canal. The authors did not provide any data on the contribution of cervical length or funneling in predicting the risk of preterm delivery.

There is only one previous cervical screening study reporting on funneling and its association with preterm delivery. In the study involving 2915 women at 24 weeks, funneling, defined as protrusion of the amniotic membrane to ≥ 3 mm into the internal os as measured along the lateral border of the funnel, was present in 6.3% of the population[2]. No data were provided on the possible association between cervical length and the prevalence of funneling. The sensitivity of funneling in the prediction of delivery before 35 weeks was 25%, which was similar to that of a cervical length of ≤ 20 mm. Although there was a substantial variation in the reported incidence of funneling between participating centers (0–12.7%), funneling

apparently remained a significant predictor of preterm delivery after controlling for study center and cervical length.

Preterm labor is defined by the presence of regular uterine contractions and progressive dilation of the cervix. Ultrasound examination in asymptomatic women at 23 weeks of gestation identified a group with a cervical length of ≤ 15 mm and these women had a very high chance of spontaneous delivery before 33 weeks. Almost all women with such a short cervix have funneling of the internal os. Funneling did not provide any significant contribution in addition to cervical length in the prediction of preterm delivery. Dilatation of the internal os, observed sonographically as funneling, is no more than a simple reflection of the process of producing cervical shortening that will eventually result in preterm delivery. Women with a long cervix and funneling are not at increased risk of preterm delivery.

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