 DOI: 10.1111/j.1479-828X.2010.01225.x

Original Article

Transabdominal scanning of the cervix at the 20-week morphology scan: Comparison with transvaginal cervical measurements in a healthy nulliparous population

Peter R. STONE, Eliza H.Y. CHAN, Lesley M. E. MCCOWAN, Rennae S. TAYLOR and Jennifer M. MITCHELL on behalf of the SCOPE Consortium

Department of Obstetrics and Gynaecology, University of Auckland, Auckland, New Zealand

Background: Healthy, nulliparous women at low risk for preterm birth would not usually undergo transvaginal scanning at the 20-week morphology scan. The study aimed to determine whether transabdominal cervical measurement would be sufficient to exclude a short cervix in this population.

Aims: To investigate the relationship between transabdominal (TA) and transvaginal (TV) ultrasound measurements of the cervix at 20 weeks' gestation.

Methods: At 20 weeks' gestation, TA and TV cervical length was measured in 203 healthy nulliparous participants in the Screening for Pregnancy Endpoints (SCOPE) study. The TA and TV measurements were correlated and examined for variance.

Results: Paired measurements were achieved in 203 cases. The shortest cervical length on TV scanning was 22 mm, the longest was 59 mm, with TA equivalents of 21 mm and 56 mm respectively. The mean TV cervical length was 39.1 (SD 6.2) mm and mean TA 36.6 (SD 5.8) mm. The average difference between the measurements was 2.6 (SD 5.2) mm, the TA length being the shorter of the two. A TA on the 25th percentile (33 mm length) was associated with a 25th percentile TV length of 36 mm. The intraclass correlation coefficient between TV and TA measurements was 0.77, but the actual difference between the two measurements was not constant.

Conclusions: Transabdominal measurements are consistently less than TV measurements. As the measurements are correlated, TA scanning could be used to assess cervical length in most cases initially. Where the TA length is <5th percentile (27 mm), this measure could be used as an indication to perform a TV scan as this correlates with a 5th percentile TV measurement of 28 mm.

Key words: cervical length measurement, cervix uteri, premature birth, prenatal ultrasonography.

Introduction

Assessment of the cervix at the 18- to 20-week morphology scan is frequently reported in general obstetric ultrasound practice. Although the first descriptions of cervical scanning were those using a transabdominal (TA) approach,[1] transvaginal (TV) measurement of cervical length has become the preferred method and is the only ultrasound technique that has been validated in the prediction of spontaneous preterm birth.[2] The method of measuring the cervix by TV scan has been standardised as it may be subject to variation due to technical factors such as transducer pressure or position.[3] Whilst TV scanning is the method generally recommended for assessing the cervical length in women at high risk of preterm birth, some women decline a TV scan in the second trimester. At the 18- to 20-week fetal ultrasound morphology assessment, it is common practice for women thought to be at high risk of spontaneous preterm birth to have a TV cervical length measurement. However, in routine practice, TV scanning may not be part of that examination or may not be readily available. Also, as some women decline a TV scan, we were interested to investigate whether TA measurements could be used as an alternative, at least as an initial assessment of cervical length.

There have been few studies specifically comparing TV and TA measurement of the cervix in pregnancy.[4–6] To our knowledge, this study is the first to examine the relationship between TA and TV measurements in a nulliparous population. Our aim was to compare the TA and TV cervical length measurements at the 18- to 20-week morphology scan in a group of nulliparous women using high-quality modern ultrasound technology.

Correspondence: Professor Peter R. Stone, Department of Obstetrics and Gynaecology, Faculty of Medical and Health Sciences, University of Auckland, Private Bag 92019, Auckland, New Zealand. Email: p.stone@auckland.ac.nz

Received 28 March 2010; accepted 27 July 2010.

Methods

Between November 2004 and July 2007, a sub-group ($n = 203$) of healthy nulliparous participants in the SCOPE (Screening for Pregnancy Endpoints, SCOPE) study in Auckland, New Zealand had both TA and TV cervical length measurements (ACTRN12607000551493, Australian and New Zealand Clinical Trials Registry). Ethical approval for SCOPE was obtained from the local ethics committee (New Zealand AKX/02/00/364). All women provided written consent for cervical measurement. The measurements were taken at the time of their 18- to 20-week anatomy scan. A history of any prior cervical treatment was recorded as part of the large data set in the SCOPE study. All scans in this study were performed by a single experienced sonographer.

The machines used were a Voluson 730 Expert series (GE Healthcare, Milwaukee, WI, USA) TA probe RAB 4-8L, TV probe RIC 5-9H and a Philips HDI 5000 (Philips Medical Systems, The Netherlands); TA probe C5-2 curvilinear array and the TV probe C8-4v. The technique used was that modified from Berghella *et al.*,[7] and essentially as had been previously described by Sonek and Shellhaas.[1] The patient emptied her bladder prior to the TV scan. The lithotomy position was not used, but on occasion, the woman was asked to place her hands underneath the buttocks to elevate and rotate the pelvis to aid visualisation of the full extent of the cervix. The TV probe was inserted slowly until the cervix was clearly visualised in the sagittal plane. Care was taken to ensure that undue pressure was not applied to prevent distortion of the cervical canal and obscure any funnelling of the internal os. The probe was then gently withdrawn until the image became less clear and was then gradually reinserted just until the image was clear. The zoom setting was adjusted such that the image filled at least 75% of the screen, and the depth settings were always adjusted to a maximum of 6 cm. Measurement of the cervical length was taken from the internal os to the external os incorporating only that length that was bordered by endocervical mucosa. Where the cervical canal was curved and could not be measured in one plane, two measurements were made and added, the first from internal os to the point of curvature in the canal and the second from this point to the external os. The possible effect of funnelling on cervical length was managed by recording its presence where observed, but the standard measurement procedure only including endocervical bordered cervix was used in all cases. No fundal or suprapubic pressure was applied during the examinations as described by Gomez *et al.*[8] The measurement of the cervix using the TA approach was then carried out within a few minutes after the TV scan when the bladder was still nearly empty and before the commencement of the morphology scan. The cervix was visualised in the sagittal plane and care was taken to obtain the full length of the cervical canal. If the cervix was angled posteriorly, the woman was asked to raise her hips so that her pelvis was tipped and the angle of the cervix was altered to obtain better visualisation. The measurement was taken as previously described, including only endocervical bordered cervix. All measurements were taken in triplicate and the shortest measurement recorded onto the data base.

Statistical analysis

The Pearson correlation was used to examine the significant association between TV length and TA length measurement. The Paired t-test was used to examine whether there was a significant difference between TA and TV length measurements. Data were analysed using SAS® system 9.1.3 (SAS, Cary, NC, USA). The intraclass correlation coefficient was calculated and a Bland Altman scattergram was used to illustrate the agreement between the TA and TV measurements.

Results

Two hundred and three nulliparous women participated in this study. The mean gestation at delivery was 39.9 (35.6–42.8) weeks with no preterm births <35 weeks gestation. No women in this cohort had had a cone biopsy of the cervix, but eight women had had a large loop excision of the cervical transformation zone (LLETZ). The mean (SD) gestation for the anatomy scan was 19.5 (0.76) weeks.

The mean TV cervical length measurement was 39.1 mm (SD 6.2 mm) and the mean TA cervical length measurement was 36.6 mm (SD 5.8 mm). As shown in Table 1, the mean cervical length measured on TA scanning was consistently shorter than the TV length when measured in the same woman. The mean difference between the two methods of measurement was 2.6 mm and although it was found that there was a correlation between the TV and TA lengths, the differences between measurements varied nonlinearly with cervical length, the intraclass correlation coefficient being 0.77. Figure 1 is a Bland Altman scattergram of the difference between the TA and TV measurements plotted against the mean of these measurements. As shown, 95% of the data points lie within ±2 standard errors of the mean differences between the two measurements.

In Table 2, the discrepancy between TA and TV scanning was analysed by the centile of the TA measurement. The TA cervical measurement ≤25th centile appeared more likely to be discrepant than the higher centile groups. To investigate this further, we examined the nature of the discrepancy (Table 3) to determine whether it was the TA or the TV measurement that was the shorter. Table 3 shows that all TA measurements ≤25 mm were associated with a longer TV measurement. Also, in the group with TA measurements >25 mm and ≤33 mm, in 96.8% (30 cases) the TA was shorter than the TV measurements and in only one (3.2%) was the TV measurement shorter than the TA. That is, the TA scan did not appear to "over measure" the cervical length when compared with the TV approach. In two cases, it was found that the TA measurement was >49 mm, which was longer than that found on TV scanning.

Table 1 Summary of transabdominal and transvaginal cervical length measurements

		Centile						Centile				
	Minimum	1st	5th	10th	25th	Median	Mean (SD)	75th	90th	95th	99th	Maximum
Transabdominal (mm)	21	25	27	29	33	37	36.6 (5.8)	40	44	47	49	56
Transvaginal (mm)	22	25	28	31	36	39	39.1 (6.2)	43	47	50	56	59
Transabdominal–Transvaginal (mm)	−23	−17	−13	−10	−5	−2	−2.6 (5.2)	0	3	4	9	12

Paired *t*-test on transabdominal and transvaginal length ($P < 0.0001$) indicating transabdominal is significantly different from transvaginal length, on average 2.6 mm.

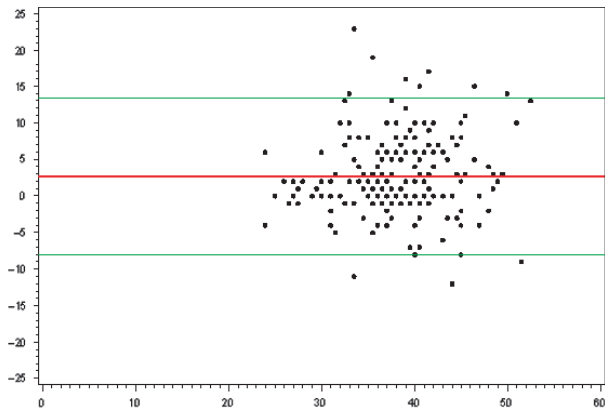

Figure 1 Bland Altman plot showing agreement between transabdominal (TA) and transvaginal (TV) cervical length measurements. The difference between measurements is plotted on the *y* axis, the mean of the TA and TV measurements is plotted on the *x* axis. The fine horizontal lines define ±2 standard errors of the mean difference.

Discussion

Visualisation of the cervix, transabdominally, is usually possible during the 18- to 20-week morphology scan. Women at low risk for preterm birth would generally not expect to have a TV scan at the time of that scan.

Transvaginal cervical length measurement has been recommended as a clinical tool to identify women at high risk of spontaneous premature birth.[2] The standard measurement of the cervix is limited by variability in the technique and there is a definite learning process even for sonographers trained in TV scanning[9] with a suggested 50 supervised cases being necessary before consistency in measurement is achieved.[2]

Transvaginal scanning would appear to have several advantages over TA scanning, including the close proximity of the cervix to a higher frequency transducer than is generally used for TA scans. Bladder filling may be a confounding factor in influencing the appearance and length of the cervix on TA scans.[10] Other limitations of TA scanning include uterine contractions and the fetal presenting part obscuring the cervix, particularly with advancing gestation.[11,12]

Whilst the cervix is visible on virtually all TV scans, there are a number of circumstances where TV scanning is not possible, in particular where maternal consent is not given.

Andersen found that severe constipation precluded a TV scan due to pain and discomfort and difficulties with the positioning of transducer.[4] Nevertheless, he found that in nearly half (46%) of the cases with an empty bladder, a measurement on TA was achieved, and with a partially full bladder, which avoided cervical distortion, imaging was satisfactory in 86% of cases. This study also showed differences between parity, but did not consider the absolute difference of 4 mm between TV and TA to be clinically important. Andersen did note that the mean TA measurements overall were greater than those obtained on TV scans (mean TA 43.7 mm, SD 13.8 vs TV 41.6 mm, SD 10.2), but the differences were small and similar to the findings in our study. The effect of parity was not examined in the current study as all women were nulliparous, but some authors have noted the multiparous cervix to be longer than the nulliparous one,[13] though this may be a 3rd trimester finding.[14]

Table 2 Consistency between transabdominal and transvaginal cervical length measurements

Transabdominal length (mm)	Total (N = 203)	Transabdominal = Transvaginal (N = 98)	Transabdominal ≠ Transvaginal (N = 105)
≤25	5 (2)	2 (40)	3 (60)
>25 to ≤33	52 (26)	21 (40)	31 (60)
>33 to ≤37	57 (28)	27 (47)	30 (53)
>37 to ≤40	47 (23)	22 (47)	25 (53)
>40 to ≤49	40 (20)	26 (65)	14 (35)
>49	2 (1)	0 (0)	2 (100)

Results are expressed as N (%).

Table 3 Analysis of discrepancies between transabdominal and transvaginal cervical measurements by transabdominal length groupings

		Transabdominal length		
Length (mm)	Centile	Total, N = 105	<Transvaginal length, N = 85	>Transvaginal length, N = 20
≤25	≤1st	3 (2)	3 (100)	0 (0)
>25 to ≤33	>1st ≤25th	31 (30)	30 (97)	1 (3)
>33 to ≤37	>25th ≤50th	30 (29)	27 (90)	3 (10)
>37 to ≤40	>50th ≤75th	25 (24)	18 (72)	7 (28)
>40 to ≤49	>75th ≤99th	14 (13)	7 (50)	7 (50)
>49	>99th	2 (2)	0 (0)	2 (100)

Results are expressed as N (%).

This study was an unblinded, prospective investigation of consecutive women scanned by a single sonographer as part of a large prediction study of obstetric outcomes, including preeclampsia, small for gestational age and preterm birth. However, the sonographer was aware that the results would not influence clinical practice. Formal measurement of residual bladder volume was not done as in most cases, the amount of urine remaining in the bladder at the time of scanning was minimal. Also, it has been shown that residual urine to a bladder depth of 5 cm does not artifactually lengthen TA cervical measurement.[6]

In our study, we have found that TA cervical length measurements were consistently shorter than those measured transvaginally. This would suggest that where a TA measurement of >25 mm is obtained, there would be little to be gained by TV scanning at least in a low-risk population. In only two cases, the TA length measured >49 mm, but that length of cervix would not be expected to be associated with high risk of preterm birth and the discrepancy found would be clinically safe. The study by To *et al.*,[5] also found that TA measurements were shorter than those found on TV scanning.

Our study population was at low risk for spontaneous preterm birth with no women giving birth at <35 weeks' gestation. All women were nulliparous and no women had had a cone biopsy of the cervix. Our sonographer was not aware of the clinical or demographic details of the participants.

In a study of 192 patients at high risk for preterm birth, Saul *et al.*, commented that TA cervical visualisation was principally a matter of sonographer training and experience and that the high rates of successful measurement were attributed to better equipment since earlier studies in addition to staff training.[6]

There is a continuum of cervical length and the risk of spontaneous preterm birth (PTB) is inversely related to cervical length.[15] Above a certain length, the risk is low; conversely, a short cervix found on scanning would place the women in a high-risk group. Therefore, during a 19- to 20-week morphology scan especially in a cohort at high risk of spontaneous PTB, TA measurement of cervical length maybe an adequate first assessment especially where the cervix is found to be least 25 mm long (the published 10th percentile)[15] or 29 mm, the 10th percentile (by TA scan) in this study of nulliparous women. Furthermore, in our study, when we examined the nature of the discrepancies between TA and TV scans, in the case of the short cervices, the TA measurements were consistently less than those on TV providing reassurance that in a low-risk nulliparous population, a TA scan would provide a safe estimate of the cervical length.

Transabdominal scanning of the cervix may have a role in basic screening for risk of preterm birth in the general population. In routine office practice, TV scanning of the cervix as part of a morphology scan may not be practical or cost effective given the prevalence of spontaneous PTB in the normal population. In low-risk singleton pregnancy, the sensitivity of TV cervical length for predicting preterm birth is around 30–40%.[15] In many developed countries, a large proportion of women booking in pregnancy are nulliparous,[16] and do not bring obstetric risk factors for preterm birth into the pregnancy. In many settings, it would not be feasible to perform TV scanning on all such women and the TA scan may provide an initial screen. However, should the cervix appear short on TA scanning or not be visible throughout its length and measure to be short, a TV scan could be offered and scheduled.

In summary, we have shown that in nulliparous women scanned at 18–20 weeks' gestation, it is possible to obtain a satisfactory TA image of the cervix suitable for measurement. The TA measurements were consistently shorter than the TV ones with a mean difference of 2.6 mm. The measurements obtained are in agreement with published standards. Transabdominal scanning of the cervix at 18–20 weeks' gestation may be able to be used as a screen for the risk of preterm birth, but large studies will be necessary to confirm this.

Funding

New Zealand Screening for Pregnancy Endpoints (SCOPE) Study: New Enterprise Research Fund, Foundation for Research Science and Technology; Health Research Council; Evelyn Bond Fund, Auckland District Health Board Charitable Trust.

References

1 Sonek J, Shellhaas C. Cervical sonography: a review. *Ultrasound Obstet Gynecol* 1998; **11**: 71–78.

2 Berghella V. Novel developments on cervical length screening and progesterone for preventing preterm birth. *Br J Obstet Gynaecol* 2009; **116**: 182–187.
3 Meijer-Hoogeveen M, Stoutenbeek P, Visser GHA. Methods of sonographic cervical length measurement in pregnancy: a review of the literature. *J Matern Fetal Neonatal Med* 2006; **19**: 755–762.
4 Andersen HF. Transvaginal and transabdominal ultrasonography of the uterine cervix during pregnancy. *J Clin Ultrasound* 1991; **19**: 77–83.
5 To MS, Skentou C, Cicero S, Nicolaides KH. Cervical assessment at the routine 23-weeks' scan: problems with transabdominal sonography. *Ultrasound Obstet Gynecol* 2000; **15**: 292–296.
6 Saul LL, Kurtzman JT, Hagemann C, Ghamsary M, Wing DA. Is transabdominal sonography of the cervix after voiding a reliable method of cervical length assessment? *J Ultrasound Med* 2008; **27**: 1305–1311.
7 Berghella V, Bega G, Tolosa JE, Berghella M. Ultrasound assessment of the cervix. *Clin Obstet Gynecol* 2003; **46**: 947–962.
8 Gomez R, Galasso M, Romero R *et al.* Ultrasonographic examination of the uterine cervix is better than cervical digital examination as a predictor of the likelihood of premature delivery in patients with preterm labor and intact membranes. *Am J Obstet Gynecol* 1994; **171**: 956–964.
9 Vayssiere C, Moriniere C, Camus E *et al.* Measuring cervical length with ultrasound: evaluation of the procedures and duration of a learning method. *Ultrasound Obstet Gynecol* 2002; **20**: 575–579.
10 Mason GC, Maresh MJA. Alterations in bladder volume and the ultrasound appearance of the cervix. *Br J Obstet Gynaecol* 1990; **97**: 457–458.
11 Karis JP, Hertzberg BS, Bowie JD. Sonographic diagnosis of premature cervical dilatation. Potential pitfall due to lower uterine segment contractions. *J Ultrasound Med* 1991; **10**: 83–87.
12 Brown JE, Thieme GA, Shah DM, Fleischer AC, Boehm FH. Transabdominal and transvaginal endosonography: evaluation of the cervix and lower uterine segment in pregnancy. *Am J Obstet Gynecol* 1986; **155**: 721–726.
13 Cook CM, Ellwood DA. A longitudinal study of the cervix in pregnancy using transvaginal ultrasound. *Br J Obstet Gynaecol* 1996; **103**: 16–18.
14 Rovas L, Sladkevicius P, Strobel E, Valentin L. Reference data representative of normal findings at two-dimensional and three-dimensional gray-scale ultrasound examination of the cervix from 17 to 41 weeks' gestation. *Ultrasound Obstet Gynecol* 2006; **27**: 392–402.
15 Iams JD, Goldenberg RL, Meis PJ *et al.* and the National Institute of Child Health and Human Development Maternal Fetal Medicine Unit Network. The length of the cervix and the risk of spontaneous premature delivery. *N Engl J Med* 1996; **334**: 567–572.
16 National Women's Hospital Annual Clinical 2007 Report: Auckland District Health Board, 2007. Available from URL: http://www.adhb.govt.nz/nwhealthinfo/GynaecologyServices/gynae%20written%20info/NW%20Annual%20Clinical%20Report%202007.pdf.