Original Research

A Universal Transvaginal Cervical Length Screening Program for Preterm Birth Prevention

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OBJECTIVE: To evaluate a universal transvaginal ultrasonogram cervical length screening program on the incidence of a cervical length 20 mm or less and adherence to the management protocol for a cervical length less than 25 mm.

METHODS: We conducted a prospective cohort study of women with singleton gestations 18 0/7 to 23 6/7 weeks of gestation eligible for universal transvaginal ultrasonogram cervical length screening over an 18-month period. Only women receiving antenatal care at our institution were included. Women with a prior spontaneous preterm birth and without delivery data available were excluded. A transvaginal ultrasonogram cervical length of less than 25 mm was managed according to a predetermined protocol. Primary outcomes were the incidence of a cervical length 20 mm or less and adherence to the management protocol for a cervical length less than 25 mm. Secondary outcomes were the incidences of spontaneous preterm birth at less than 37, less than 34, or less than 32 weeks of gestation among women undergoing transvaginal ultrasonogram cervical length screening compared with those not screened.

RESULTS: One thousand five hundred sixty-nine of 2,171 (72.3%) eligible women underwent transvaginal ultrasonogram cervical length screening. Overall, 17 (1.1%, 95% confidence interval [CI] 0.66–1.74) women had a cervical length 20 mm or less before 24 weeks of gestation. Management protocol deviations occurred in nine women with a cervical length less than 25 mm (43%, 95% CI 24.3–63.5). There was no difference in the incidence of spontaneous preterm birth at less than 37 weeks of gestation (4.1 compared with 4.7%, adjusted odds ratio [OR] 0.91, 95% CI 0.57–1.45), less than 34 weeks of gestation (1.5 compared with 1.3%, adjusted OR 1.19, 95% CI 0.52–2.74), or less than 32 weeks of gestation (0.8 compared with 0.8%, adjusted OR 0.0.76, 95% CI 0.26–2.25) among women receiving transvaginal ultrasonogram cervical length screening compared with those not screened.

CONCLUSION: In a universal transvaginal ultrasonogram cervical length screening program, the incidence of a cervical length 20 mm or less was 1.1% in women with singleton gestations without prior spontaneous preterm birth. Protocol deviations occurred in 43% of women with a cervical length less than 25 mm. The incidence of spontaneous preterm birth was similar among women undergoing transvaginal cervical length screening compared with those not screened.

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In 2012, the incidence of preterm birth was 11.5% in the United States.[1] Approximately two-thirds of all preterm births are spontaneous, and one-third are medically indicated.[2] Vaginal progesterone has been shown to reduce the incidence of spontaneous preterm birth at less than 33–34 weeks of gestation by approximately 45% in women with short cervix with singleton pregnancies before 24 weeks of gestation.[3,4] These studies have generated controversy regarding universal transvaginal ultrasonogram cervical length screening for spontaneous preterm birth prevention in a low-risk population. Proponents of universal transvaginal ultrasonogram cervical length screening argue that it can identify women in a "preclinical phase," measurements are reproducible, an effective

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intervention exists, and there are no adverse effects from treatment.[5] Furthermore, transvaginal ultrasonogram cervical length screening and treatment with vaginal progesterone in women with short cervical length is cost-effective compared with other screening methods[6] and compared with no screening.[7] Opponents of universal transvaginal ultrasonogram cervical length screening raise concerns about the lack of universal access to transvaginal ultrasonogram, inconsistency of cervical length screening in uncontrolled environments, lack of standardized treatment protocols, and lack of cost-effectiveness if the incidence of a short cervix is less than reported in randomized controlled trials.[6–8] Given the current controversy, national organizations support, but do not mandate, universal transvaginal ultrasonogram cervical length screening.[5,9]

Our objective was to evaluate our experience with a universal transvaginal ultrasonogram cervical length screening program in a single academic tertiary care institution. Primary outcomes were the incidence of a short cervical length (cervical length 20 mm or less) and adherence to the management protocol for cervical length less than 25 mm.

MATERIALS AND METHODS

This prospective cohort study was designed to evaluate our universal transvaginal ultrasonogram cervical length screening program, assessing outcomes in women eligible for universal transvaginal ultrasonogram cervical length screening between January 1, 2012, and June 30, 2013.

On January 1, 2012, our institution implemented universal transvaginal ultrasonogram cervical length screening as the standard of care for singleton gestations without a prior spontaneous preterm birth ("low-risk") scheduled for an ultrasonogram between 18 0/7 and 23 6/7 weeks of gestation.[10] Women with spontaneous preterm birth were excluded from this one-time cervical length screening regimen because, in our institution, these women undergo serial transvaginal ultrasonogram cervical length screening from 16 to 24 weeks of gestation with the option of an ultrasonogram-indicated cerclage for a short transvaginal ultrasonogram cervical length before 24 0/7 weeks of gestation. Cervical length measurements were performed in a uniform fashion with transvaginal ultrasonogram without prior transabdominal cervical length screening, and results were interpreted according to a standardized clinical algorithm (Fig. 1). Women were permitted to opt out of transvaginal ultrasonogram cervical length screening if desired. Additionally, some women were inadvertently not offered transvaginal ultrasonogram cervical length screening during the early stages of program inception or were not offered cervical length screening as a result of a language barrier.[10] The technical aspects of our universal transvaginal ultrasonogram cervical length screening program have been previously described.[10] Women with a transvaginal ultrasonogram cervical length 20 mm or less were first prescribed 90 mg vaginal progesterone gel. If approval for the vaginal gel could not be obtained from the patient's insurance company, she was prescribed 200 mg micronized progesterone gel capsules.[10] In our institution, we do not hospitalize women diagnosed with short cervical length nor do we prescribe bed rest or offer cerclage (absent a history of prior preterm birth).

A database was created specifically for study data collection. All variables were directly entered by two of the authors (K.M.O. and R.C.B.); patient medical records were reviewed at two different time points by one of the authors (K.M.O.) to ensure accuracy. A separate query was performed on our ultrasound software database by one of the authors (V.B.) to ensure accuracy of the number of women with a cervical length 20 mm or less. Only women receiving antenatal care at our institution with delivery data available were included in the analysis. Women undergoing termination of pregnancy for fetal anomalies and those with intrauterine fetal demise were excluded. Outcome data were extracted from the antenatal and delivery records. Women delivering at outside institutions were excluded unless delivery information was recorded at the postpartum visit. If women delivered at an outside institution but were last seen for a prenatal visit at 37 weeks of gestation or greater, the gestational age recorded at the last prenatal visit was used as the gestational age at delivery in the analysis.

Primary outcomes were the incidence of a cervical length 20 mm or less before 24 weeks of gestation and adherence to the predetermined protocol for the management of a cervical length less than 25 mm (Fig. 1). Women with a cervical length between 21 and 24.9 mm were asked to return for one follow-up cervical length before 24 weeks of gestation; if the cervical length was 20 mm or less on follow-up ultrasonogram, vaginal progesterone was prescribed. If the cervical length was unchanged, no further follow-up was recommended (Fig. 1). We performed descriptive statistics on all women with a transvaginal ultrasonogram cervical length 20 mm or less. Deviations from the predetermined clinical management algorithm were recorded for each woman with a cervical length less than 25 mm. Secondary outcomes were the

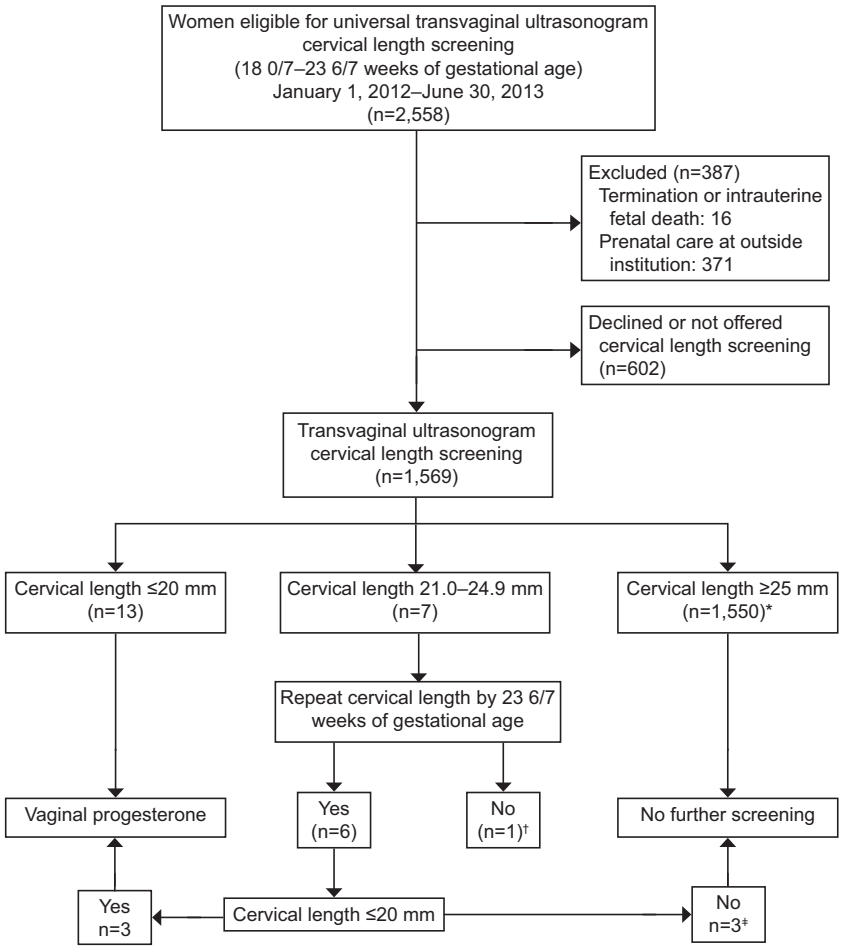

Fig. 1. Clinical management algorithm for universal cervical length screening program with data over an 18-month period. *One woman with an initial transvaginal ultrasonogram-assessed cervical length of 26 mm underwent repeat transvaginal ultrasonogram cervical length assessment, with length=11 mm. †One woman never returned for scheduled repeat transvaginal ultrasonogram cervical length assessment. ‡One woman with a repeat transvaginal ultrasonogram-assessed cervical length of 23 mm received vaginal progesterone. Deviations from the Thomas Jefferson University management protocol are shown in the Appendix, available online at http://links.lww.com/AOG/A545. Figure modified from Orzechowski KM, Nicholas SS, Baxter JK, Weiner S, Berghella V. Implementation of a universal cervical length screening program for prevention of preterm birth. Am J Perinatol 2014 Apr 4 [Epub ahead of print].

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incidences of spontaneous preterm birth at less than 37, less than 34, or less than 32 weeks of gestation among women undergoing transvaginal ultrasonogram cervical length screening compared with those not screened (eg, opted out of or were not offered transvaginal ultrasonogram cervical length screening for reasons such as a language barrier).[10] Independent samples *t* test, nonparametric tests, χ^2 test, and logistic regression were performed using SPSS 21.0. Expedited approval was obtained for this study from the Thomas Jefferson University institutional review board. Individual informed consent was not required by the institutional review board because universal transvaginal ultrasonogram cervical length screening was implemented as the standard of clinical care in our institution.

RESULTS

Over 18 months, 2,558 women were eligible for universal transvaginal ultrasonogram cervical length screening. Of these, 387 women were excluded from analysis; 371 women who did not receive antenatal care at our institution or delivered at an outside institution without available delivery data, and 16 women underwent termination for fetal anomalies or induction for intrauterine fetal demise. Therefore, a total of 2,171 eligible women had delivery data available, of whom 1,569 (72.3%) underwent universal transvaginal ultrasonogram cervical length screening. Six hundred two women did not undergo cervical length screening; 384 (17.7%) declined transvaginal ultrasonogram, and 218 (10%) were not offered screening (Fig. 1).[10] Demographic characteristics are shown in Table 1.

Among those screened, a total of 13 (0.8%, 95% confidence interval [CI] 0.47–1.43) women had a cervical length 20 mm or less diagnosed on initial ultrasonogram. Seven additional women had a transvaginal ultrasonogram cervical length between 21 and 24.9 mm, and of these, three (43%) had a transvaginal ultrasonogram cervical length 20 mm or less on follow-up ultrasonogram before 24 0/7 weeks of gestation. One woman had a cervical length 20 mm or less on repeat transvaginal ultrasonogram after an

Table 1. Demographic Data for Women Undergoing Universal Cervical Length Screening Compared With Women Not Screened

Demographic	Cervical Length Screening (n=1,569 [72.3%])	No Cervical Length Screening (n=602 [27.7%])	*P*
Maternal age (y)	27.7±5.8	28.0±5.8	.32
Nulliparous	793 (51)	204 (34)	<.001
Gestational age (wk)	20.3±1.2	20.3±1.2	.63
Ethnicity			<.001
Caucasian	426 (27.2)	144 (23.9)	
Black	783 (49.9)	248 (41.2)	
Asian	208 (13.3)	166 (27.6)	
Hispanic	106 (6.8)	26 (4.3)	
Other or unknown	46 (2.9)	18 (3.0)	
BMI (kg/m^2)	27.4±7.9	27.1±7.0	.41
Tobacco use	1,409 (10.2)	539 (10.5)	.85
Prior dilation and curettage	528 (33.7)	185 (30.7)	.20
Prior cervical excision procedure	84 (5.4)	8 (1.3)	<.001

BMI, body mass index.
Data are mean±standard deviation or n (%) unless otherwise specified.

initial cervical length of 26 mm, which would have otherwise been undetected if the predetermined management protocol had been followed; this woman was included in the calculation of the incidence of cervical length 20 mm or less (see the Appendix, available online at http://links.lww.com/AOG/A545). Of the 17 (1.1%, 95% CI 0.66–1.74) women with cervical length 20 mm or less, 13 (76.5%) received vaginal progesterone, two declined progesterone, one delivered before progesterone could be initiated, and one was hospitalized with advanced cervical dilation and progesterone was not prescribed. In total, deviations from the predetermined clinical management protocol occurred in nine women with a cervical length less than 25 mm (43%, 95% CI 24.3–63.5) and in six women with a cervical length 20 mm or less before 24 weeks of gestation (35%, 95% CI 17.17–58.84) (Appendix, http://links.lww.com/AOG/A545).

The overall incidence of spontaneous preterm birth at less than 37 weeks of gestation was 4.3%. There was no difference in the incidence of spontaneous preterm birth at less than 37, less than 34, and less than 32 weeks of gestation among women who received transvaginal ultrasonogram cervical length screening compared with those who were not screened (Table 2). Women undergoing transvaginal ultrasonogram cervical length screening were more likely to be nulliparous, to have had a prior cervical conization, and to be of non-Asian ethnicity (Table 1). The unadjusted odds ratio (OR) for spontaneous preterm birth at less than 37 weeks of gestation among those undergoing transvaginal ultrasonogram cervical length screening compared with those who were not screened was 0.89 (95% CI 0.56–1.40). Logistic regression was performed to adjust for the effects of nulliparity, prior conization, and race with an adjusted OR for spontaneous preterm birth at less than 37 weeks of gestation of 0.91 (95% CI 0.57–1.45) (Table 2). Adjusted ORs remained insignificant for spontaneous preterm birth at less than 34 and less

Table 2. Outcome Data

Outcome	Cervical Length Screening (n=1,569 [72.3%])	No Cervical Length Screening (n=602 [27.7%])	Adjusted OR* (95% CI)
Spontaneous preterm birth (wk of gestation)			
Less than 37	65 (4.1)	28 (4.7)	0.91 (0.57–1.45)
Less than 34	24 (1.5)	8 (1.3)	1.19 (0.52–2.74)
Less than 32	12 (0.8)	5 (0.8)	0.76 (0.26–2.25)

OR, odds ratio; CI, confidence interval.
Data are n (%) unless otherwise specified.
* Adjusted for race, prior conization, and nulliparity in logistic regression.

Table 3. Outcome Data for Nulliparous Women Only

Outcome	Transvaginal Ultrasonogram Cervical Length Screening (n=793 [80%])	No Transvaginal Ultrasonogram Cervical Length Screening (n=204 [20%])	Adjusted OR* (95% CI)
Spontaneous preterm birth (wk of gestation)			
Less than 37	40 (5.0)	8 (3.9)	1.43 (0.64–3.11)
Less than 34	11 (1.4)	4 (2.0)	0.71 (0.22–2.30)
Less than 32	7 (0.9)	3 (1.5)	0.59 (0.12–2.35)

OR, odds ratio; CI, confidence interval.
Data are n (%) unless otherwise specified.
* Adjusted for race, prior conization, and nulliparity in logistic regression.

than 32 weeks of gestation (Table 2). Similarly, there was no difference in the rates spontaneous preterm birth at less than 37, less than 34, and less than 32 weeks of gestation among nulliparous women who underwent transvaginal ultrasonogram cervical length screening compared with those not screened (Table 3). The incidences of spontaneous preterm birth at less than 37, less than 34, and less than 32 weeks of gestation by cervical length category before 24 0/7 weeks of gestation are shown in Table 4.

DISCUSSION

The incidence of cervical length 20 mm or less in our cohort was less than that of randomized controlled trials evaluating vaginal progesterone for a short cervical length.[3,4] Both trials included women with prior spontaneous preterm birth (13% and 15%, respectively), which may account for their higher incidence of a short cervical length (1.7%[4] to 2.3%[3] compared with 1.1% in our study). Furthermore, a short cervical length was defined as cervical length 10–20 mm and cervical length less than 15 mm on initial transvaginal ultrasonogram cervical length, respectively.[3,4] Using these definitions, our incidences were 0.64% (95% CI 0.33–1.19) for cervical length 10–20 mm and 0.45% (95% CI 0.20–0.94) for cervical length less than 15 mm on initial transvaginal ultrasonogram cervical length, both statistically significantly lower than in the randomized trials.[3,4] This may have implications for cost-effectiveness, because studies have demonstrated cost-effectiveness of universal cervical length screening using a presumed probability of cervical length 15 mm or less of 1.19%[7] and 1.5%.[6] Additionally, our incidence was also statistically lower than that reported by Facco et al[11] in women with singleton gestations without prior spontaneous preterm birth (1.1% [95% CI 0.66–1.74] compared with 3.1%). The higher incidence of a short cervix in the Facco study could be related to use of older data (1992–1994) or the fact that transvaginal ultrasonogram cervical length was measured at a slightly greater gestational age (22–24 weeks).

The incidences of spontaneous preterm birth at less than 37, less than 34, and less than 32 weeks of gestation were similar among women undergoing universal transvaginal ultrasonogram cervical length screening compared with those not screened (Table 2). It is possible that other unidentified differences may exist between the groups, because not all risk factors for spontaneous preterm birth were evaluated. Furthermore, our study is underpowered to detect a difference in spontaneous preterm birth among the groups. Rates of spontaneous preterm birth at less than 37 weeks of gestation were 4.1% among those screened and 4.7% in the unscreened group. A post hoc power analysis indicates 18,341 women would be needed in each group to achieve 80% power to reject the null hypothesis that there is no difference in preterm birth rates. Similarly, in a randomized controlled

Table 4. Incidence of Spontaneous Preterm Birth by Transvaginal Ultrasonogram Cervical Length

Final Transvaginal Ultrasonogram Cervical Length at Less Than 24 wk of Gestation (mm)	n (%)	Spontaneous Preterm Birth at Less Than 37 wk of Gestation	Spontaneous Preterm Birth at Less Than 34 wk of Gestation	Spontaneous Preterm Birth at Less Than 32 wk of Gestation
20 or less	17 (1.1)	11 (64.7)	9 (52.9)	8 (47.1)
21–24.9	4 (0.25)	1 (25)	1 (25)	0 (0)
25 or greater	1,548 (98.7)	53 (3.4)	14 (0.9)	4 (0.3)

Data are n (%) unless otherwise specified.

trial, 72,800 women would need to be randomized to transvaginal ultrasonogram cervical length screening compared with no cervical length screening to detect a difference in preterm birth between the groups.

Although a standardized management protocol was established before implementation of universal transvaginal ultrasonogram cervical length screening, protocol deviations occurred in 43% of women with a transvaginal ultrasonogram cervical length less than 25 mm. The most common violation was insertion of an Arabin-like pessary in six women with cervical length 20 mm or less, largely because after implementation of cervical length screening, a randomized controlled trial was published demonstrating reduction in spontaneous preterm birth at less than 34 weeks of gestation in women with short cervix treated with a pessary.[12] Protocol deviations can significantly increase costs associated with cervical length screening. Another limitation of our study is that our results may not be generalizable to other populations.

One of the study strengths is the prospective collection of data and use of a standardized management protocol. Additionally, our data illustrate the actual use and potential barriers to universal transvaginal ultrasonogram cervical length screening. In our cohort, 72.3% of eligible women underwent transvaginal ultrasonogram cervical length screening compared with 82.3% in the Fonseca trial,[4] suggesting that there is a certain burden associated with it.[10] This has implications for the use of transvaginal ultrasonogram cervical length screening as a universal screening method, because decreased screening rates may result in lower detection rates of a cervical length 20 mm or less.

The low incidence of a cervical length 20 mm or less in our cohort raises questions regarding whether universal transvaginal ultrasonogram cervical length screening in low-risk asymptomatic women is beneficial. Further study of universal transvaginal ultrasonogram cervical length screening with larger sample sizes is needed. Additionally, other protocols for cervical length screening and treatment such as progesterone for a cervical length greater than 20 mm, pessary insertion for a cervical length less than 25 mm, or others should be studied to evaluate whether screening is beneficial and, if so, which method is most effective and cost-effective. Currently, neither the Society for Maternal-Fetal Medicine nor the American College of Obstetricians and Gynecologists mandate universal transvaginal ultrasonogram cervical length screening, but both state it may be considered in women with singleton gestations without prior spontaneous preterm birth.[5,9]

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