ORIGINAL RESEARCH

Assessment of Cervical Volume at 19–22 Weeks for Predicting a Prolonged Pregnancy

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Abstract

Objective: To determine whether the transvaginal ultrasonographic measurement of the cervical volume at 19–22 weeks could predict a post-term pregnancy.

Materials and methods: This work involves a retrospective case–control study comprising 44 women who delivered beyond 41 weeks and 87 women who delivered at term (37–40 + 6 weeks), matched by age and parity. All of them had undergone cervical length measurement and cervical volume estimation at 19–22 weeks.

Results: Patients' median of age was 35 years in term gestations and 34.5 years in prolonged pregnancies ($p = 0.313$). The mean of gestational age during delivery in the term gestation group was 275.41 days vs 289.34 days on prolonged gestations ($p < 0.001$). We did not observe differences in the mean cervical volume between term delivery (37.37 cm^3, 95% CI: 34.59–40.14) and those who had post-term delivery (38.06 cm^3, 95% CI: 33.34–42.77) ($p = 0.788$). In addition, we did not find differences in the median cervical length (39.0 mm vs 37.0 mm) ($p = 0.610$).

Conclusion: It seems that there is no relationship between the cervical volume measured in the ultrasound of 20-week gestation and the prolongation of pregnancy beyond week 41.

Keywords: Cervical length, Cervical volume, Post-term, Pregnancy, Volume.

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Introduction

Prolonged pregnancy occurs in approximately 10% of all singleton pregnancies and it is associated with an increased risk of fetal macrosomia, intrapartum fetal heart rate abnormalities, meconium staining, perinatal death, and cesarean delivery.[1–3] An early prediction of this condition is important because several methods to decrease the rate of prolonged pregnancy, such as membrane stripping and outpatient prostaglandin therapy, have already been proposed.[4,5] Therefore, there has been considerable interest in the development of tests for the prediction of a prolonged pregnancy. These tests include fetal fibronectin, cytokine, or nitric oxide concentrations in cervicovaginal secretions, as well as cervical length (as determined by ultrasonography).[6–10]

Cervical length measured by the transvaginal ultrasound in the second trimester has been known to be effective in identifying pregnancies at a high risk for a spontaneous preterm delivery.[11–16]

Recent studies have reported on the importance of ultrasonographic examinations of the uterine cervical length in predicting post-term pregnancies.[17] However, to the best of our knowledge, there are no ultrasound studies in the current literature analyzing the relationship between the cervical volume and prolonged pregnancies.

The aim of this study was to determine whether the transvaginal ultrasonographic measurement of the cervical volume at 19–22 weeks could predict post-term pregnancies.

Materials and Methods

After obtaining the approval of the ethics committee of the Clinica Universidad de Navarra (CUN), a retrospective case-control study was carried out. The women participating in the study have been evaluated at the Gynecology and Obstetrics Department of this tertiary care university hospital at least from 19th to 22th weeks until delivery. These women had signed an informed consent accepting that their clinical data could be used for this research.

At our institution, all pregnant women are offered a routine ultrasound examination at 19th–22th weeks for a fetal anomaly scan and for performing cervical biometry and volumetry. At CUN, a pregnancy is considered to be prolonged after week 41, when an induction of labor is advised.

Inclusion criteria for this study were as follows: live fetus, intact amniotic membranes, no fetal pathology, gestational age confirmed by ultrasound at 12th week, no previous uterine interventions, pregnancy had been followed at least from 19th to 22th weeks of gestation to delivery at our institution, and a screening ultrasound had been done between 19th week and 22th week, including cervical biometry.

Exclusion criteria were as follows: an induction of labor or a cesarean section for any reason before week 41 and no measurement of cervical volume in 19th–22th week scan.

Patients belonging to the cases group were a consecutive series of women who delivered at 41–42 weeks at our institution between April 2014 and August 2017. The control-group patients were randomly selected using the immediate woman who delivered

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spontaneously at 37–40 weeks prior to the cases-group patients, matched by age (±1 year old) and parity (same parity).

The measurement of the cervical length and volume was performed using the transvaginal ultrasound between week 19 and week 22 by different sonographers from the Department of Obstetrics and Gynecology, who are properly trained for this type of ultrasound examinations. The ultrasound machine used for all measurements was a Voluson E8 (General Electric Healthcare, Milwaukee, WI, USA) equipped with a 5–9 MHz endovaginal probe. The women were examined at the lithotomy position, with an empty bladder according to the methodology described elsewhere.[18,19] Briefly, the ultrasound probe is inserted slowly into the vagina, avoiding excessive pressure, which can artificially lengthen the cervix. After obtaining a satisfactory image of the cervix, the probe was removed until the image became blurred. Then, the probe moved forward gradually with just enough pressure to restore a satisfactory image. A sagittal view of the cervix was obtained where the internal os, the cervical canal, and the external os were all visible simultaneously. The image was enlarged so that the cervix occupies approximately 75% of the screen. The cervical length was measured from the external to the internal cervical os, being careful to include only the segment of the cervix canal that was bordered by the endocervical mucosa. Three measurements were performed and the average of them was used for our analysis (Fig. 1). Once 2D

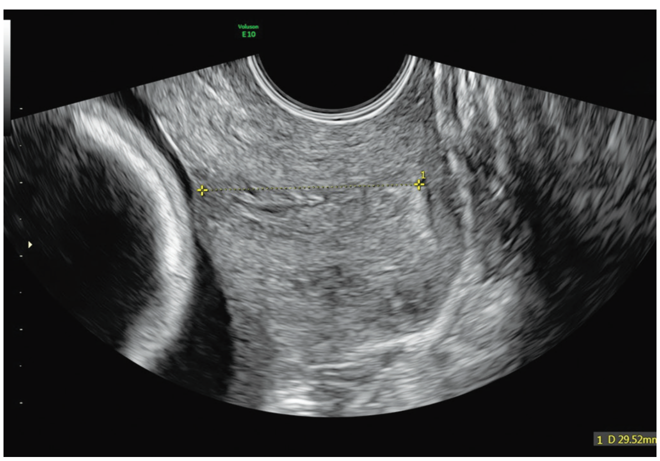

Fig. 1: Cervical length measurement by the transvaginal ultrasound

sonography was done, a 3D mode was activated and the cervix was centralized within the 3D sector appearing on ultrasound screen. Then, a 3D volume was acquired by using the maximum angle (120°). The probe was rotated 90°, and a second 3D volume was acquired in the transverse plane. Both 3D volumes were stored for a subsequent analysis. As stated before, all 2D measurements and 3D volume acquisitions were performed by several trained sonographers.

The 4D View program (General Electric Healthcare, Zipf, Austria) was used to measure the cervical volume. The program was set to manual. The drawing started from a longitudinal section through the cervix. The rotation steps were set at 30° and six contours of the cervix were drawn manually using the cursor of the system. Once all contours had been drawn, the volume of the cervix was calculated automatically and expressed in cubic centimeters[19,20] (Fig. 2).

All cervical volume measurements were performed by the same examiner. This examiner was blinded to whether the patients belonged to the group of cases or that of controls.

The following variables were studied: patient's age, number of past pregnancies, number of past abortions, late abortions in previous pregnancies, a threatened abortion in the first trimester of the current gestation, number of deliveries, date of the ultrasound at 19th–22th week (in days), cervical length measured at 19th–22th week ultrasound scan (in mm), cervical volume measured at 19th–22th week ultrasound scan (in cm^3), hypothyroidism in the pregnancy studied, diabetes in the gestation studied, gestational age at the time of delivery, the gestation studied in days, type of delivery, and newborn's weight.

Statistical Analysis

The Kolmogorov–Smirnov test was used to determine the distribution of data in continuous variables. The categorical variables are presented as absolute number and percentage, and compared with the Pearson's X^2 test. The continuous variables were compared using the one-way variance analysis (ANOVA) or the Mann–Whitney U test, depending on the distribution of data.

The statistical power analysis was not performed and $p < 0.05$ is considered statistically significant. Statistical analyses were conducted using SPSS 15.0 (SPSS Inc., Chicago, IL).

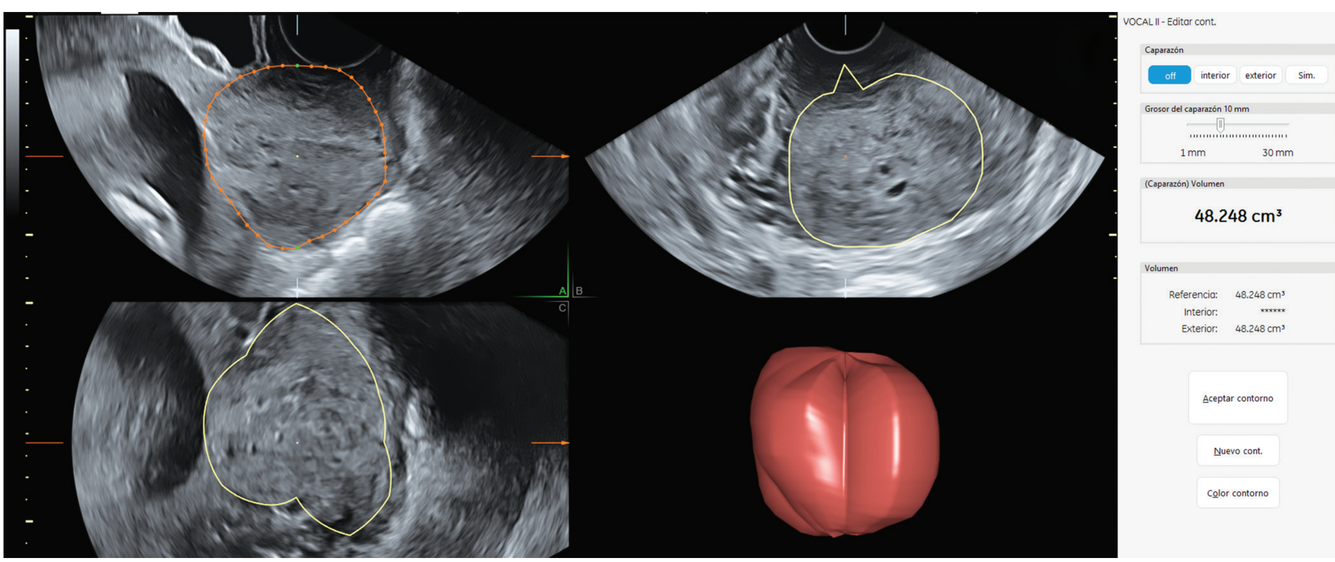

Fig. 2: Cervical volume estimation using the 3D ultrasound

Results

An estimated 105 term gestation patients (37–40 + 6 weeks) and 104 post-term patients (41 weeks and over) were enrolled for the study. Although there is an indication to perform the measurement of the cervical volume in all ultrasound examinations at 19- to 22 weeks scan, this was not carried out in all patients. Thus, we had cervical volume data from 131 patients: 44 cases and 87 controls.

Most continuous variables did not follow a normal distribution, except the weight of the newborn, date of the ultrasound of the week 19–22, cervical volume, and gestational age at the time of delivery.

When comparing the demographic characteristics between both groups, we found only statistical differences for the gestational age at the time of delivery, the weight of the newborn, and the rate of vaginal delivery (Table 1).

When we compared cervical volume and length measured by ultrasound at week 19–22 of gestation, we did not observe significant differences between both groups (Table 2).

Discussion

In the present study, we have observed that both median cervical length and volume measured at 19- to 22-weeks scan using the transvaginal ultrasound are similar for prolonged gestations and term gestations.

Previous studies have used the sonographic evaluation of the cervical length to predict the onset of a preterm labor.[13–16] However, there are scanty and controversial data about the relationship of this measurement and a post-term pregnancy.[17,21–24]

Firstly, this topic deserves attention because the measurement of cervical volume in the second trimester can identify patients at a high risk for a prolonged pregnancy; the incidence of a prolonged pregnancy or the risks associated with a prolonged pregnancy will be reduced because a simple method to promote the spontaneous onset of a labor (i.e., membranes stripping and outpatient prostaglandin therapy) was already proposed. Secondly, these data might be used in individualizing the timing of an elective cesarean section rather than in the performance of this operation at 37 weeks—for example, delaying a cesarean section until 39 weeks if there were any other indications. Thirdly, from the patients' point of view, these data may give patients some information to arrange their social activities and to deal with their anxieties.

Suh et al. found that the cervical length measured at 20–24 weeks was not a predictor of prolonged pregnancies.[17] Our results are in agreement with these data.

However, Donelan et al. reported in a larger series that women with a cervical length above the third quartile, measured at 18–24 weeks had a higher risk for a prolonged pregnancy.[21]

Boeling et al. found that women with a cervical length >37 mm (beyond first quartile) during the second trimester had a twofold increase of a prolonged pregnancy than women with a cervical length <37 mm.[22] However, Van der Ven et al. reported that a post-term pregnancy was more likely (OR: 2.02) when the cervical length was >45 mm between 16 + 0 and 21 + 6 weeks of gestation.[23] More recently, Thangaraj et al. reported similar findings: 90% of women in their series with a cervical length >4 cm in midtrimester ($n = 50$) delivered beyond the 40th week of gestation.[24]

Table 1: Demographic characteristics in term and post-term pregnancies

	Term gestations	*Prolonged gestations*	*p value*
Gestational age at the time of delivery days	275.41 (273.84–276.98)*	289.34 (288.66–290.02)*	0.001
Weight of the newborn in kilograms	3.30 (3.20–3.40)*	3.61 (3.49–3.74)*	0.001
Patients' age (years old)	35 (5)**	34.5 (7)**	0.313
Number of pregnancies	2 (2)**	2 (2)**	0.520
Number of abortions	0 (1)**	0 (0)**	0.540
Number of deliveries	2 (2)**	1 (1)**	0.510
Date of the ultrasound of weeks 19–22 (days)	142 (4)**	143 (4)**	0.480
Late abortions in previous pregnancies	3 (3.4)†	0 (0)†	0.550
Threatened abortion in the first trimester	4 (4.6)†	1 (2.3)†	0.663
Hypothyroidism	17 (19.5)†	8 (18.2)†	1.000
Diabetes	3 (3.4)†	2 (4.5)†	1.000
Vaginal delivery	79 (90.8)†	34 (77.3)†	0.034
Premature rupture of membranes	21 (24.1)†	7 (15.9)†	0.368

*Mean with 95% confidence interval in parentheses
**Median with interquartile range in parentheses
†Absolute number, percentage in parentheses

Table 2: Cervical length and volume in term and post-term gestations as measured at 19–22 weeks

	Term gestations	*Prolonged gestations*	*p value*
Cervical volume measured in the ultrasound of weeks 19–22 in cm^3	37.37 (34.59–40.14)*	38.06 (33.34–42.77)*	0.788
Cervical length measured in the ultrasound of weeks 19–22 in mm	39 (9)**	37 (7.75)**	0.610

*Mean with 95% confidence interval in parentheses
**Median with interquartile range in parentheses

Owing to the controversial results related to the cervical length and its relationship with prolonged pregnancies, we wondered whether the cervical volume estimation could be useful for this purpose. We have observed that the cervical volume, as measured in the midtrimester ultrasound scan, is not useful to predict prolonged pregnancies.

The main strength of our study is its originality. To the best of our knowledge, this study is the first to describe the possible changes in the cervical volume at the mid-gestation and their relationship with a prolonged delivery.

However, we acknowledge that our study has several limitations. On the one hand, the retrospective design implies that there are variables that were not measured in all women, mainly cervical volume. Consequently, 78 patients had to be excluded. In addition, it is well known that parous women had slightly larger cervical volumes throughout the pregnancy than did nulliparous women.[19] In our study, we included parous women and this could have potentially affected the results because primiparity and prior prolonged pregnancy are the most common identifiable risk factors for the prolongation of pregnancies.

In conclusion, with the results obtained, it seems that there is no relationship between the cervical volume measured in the midtrimester ultrasound and prolonged pregnancies. However, further studies are needed to confirm or refute these findings.

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