Original Contribution

MAGNETIC RESONANCE IMAGING VS. TRANSVAGINAL ULTRASOUND FOR CERVICAL LENGTH ASSESSMENT IN THE SECOND HALF OF PREGNANCY

ROSENY SOUZA BRANDÃO, CLAUDIO RODRIGUES PIRES, EDUARDO DE SOUZA, LEONARDO LUIZ AVANZA, ROSIANE MATTAR, EDWARD ARAUJO JÚNIOR, LUCIANO MARCONDES MACHADO NARDIGA, AND ANTONIO FERNANDES MORON
Department of Obstetrics, São Paulo Federal University (UNIFESP), São Paulo, Brazil
(Received 11 July 2003; revised 25 November 2009; in final form 5 December 2009)

Abstract—The purpose of this cross-sectional study involving 42 women between 20 and 39 weeks gestation was to compare transvaginal ultrasound (TVUS) vs. magnetic resonance imaging (MRI) in the assessment of cervical length measurement during the second half of pregnancy and to evaluate the reproducibility of cervical measurements obtained through MRI. Cervical length was measured through TVUS by a single examiner. On the same day, all women also had MRI and cervical length was assessed by two independent blinded observers. There were no significant differences in the mean cervical length obtained through TVUS and MRI (paired t-test, \( p = 0.191 \)). The Bland-Altman test indicated concordance between measurements obtained through methods as well as good intra- and interobserver reproducibility for MRI measurements. Intraclass correlation coefficient was 0.990 (95% confidence interval [CI]: 0.982 to 0.995; \( p < 0.001 \)) for measurements performed using MRI by two different observers and 0.985 (95% CI: 0.991 to 0.997; \( p < 0.001 \)) for measurements performed using the same method by a single operator. Cervical length measured through TVUS and MRI does not differ significantly. There is a good reproducibility of cervical measurements obtained through MRI. (E-mail: crpires@uol.com.br) © 2010 World Federation for Ultrasound in Medicine & Biology.

Key Words: Pregnancy, Cervix, Transvaginal sonography, Magnetic resonance imaging.

INTRODUCTION

Preterm delivery is still one of the major existing perinatal health problems today. It is the single most important cause of neonatal mortality and is frequently associated with short- and long-term sequel among survivors (Godenberg et al. 2002, 2008; Iams et al. 1998).

Ultrasonography (US) has been used in the last three decades to assess the cervix during pregnancy, with the aim of identifying cervical structural modifications capable of predicting spontaneous preterm delivery (sPTD) (Iams et al. 1996; Sarti et al. 1979; Varma et al. 1986). Up to the present, cervical length has been most frequently used and reproducible sonographic parameter. Cervical length assessment is considered a screening test for the prediction of sPTD (Berghella et al. 2007) due to these characteristics, as well as its small intra and interobserver variability (Berghella and Berghella 2005).

There have been few publications assessing the cervix during pregnancy using magnetic resonance imaging (MRI) (Chan et al. 1998; House et al. 2005; McCarthy et al. 1985; Olah 1994; Powell et al. 1988; Pates et al. 2007a, 2007b; Rae et al. 2001; Sabir et al. 2000) and only a few actually measured cervical length using this method (Chan et al. 1998; McCarthy et al. 1985; Rae et al. 2001). McCarthy et al. (1985) were the first to use MRI to study the normal female pelvic anatomy. Using this technique, these authors identified the internal cervical os and measured the length of the cervix in a group of 16 patients, including 11 pregnant women. In 2001, Rae et al. (2001) used MRI to measure cervical length in the first trimester of pregnancy. However, up to the present, there have been no publications that compared cervical biometry obtained through transvaginal ultrasound (TVUS) and MRI or that assessed the reproducibility of cervical measurements obtained through MRI in pregnancy.

The main objective of this study was to compare TVUS and MRI in the assessment of cervical length...
measurement during the second half of pregnancy. A secondary objective was to evaluate the inter- and intraobserver variability of cervical length measurements obtained using MRI.

METHODS

The study was approved by the institutional review board of São Paulo Federal University. This cross-sectional study took place between August 2007 and August 2008 at the São Paulo Federal University (UNIFESP), Department of Obstetrics. All participants were managed in a free public antenatal clinic.

Women undergoing routine first trimester US were informed about the study and invited to participate. They were instructed to return in the second half of pregnancy when they were re-evaluated for possible inclusion.

Women with any of the following were excluded from the study: fetal demise, preterm premature rupture of membranes, vaginal bleeding, placenta previa, history of cervical surgery, uterine malformation, multiple gestation or fetal malformation. All participants gave written informed consent.

Cervical length was measured using a Logic 5 (GE Medical Systems, Fairfield, WI, USA) equipment with a vaginal multifrequency (5.0–9.0 MHz) transducer. After emptying the bladder, the patient was placed in a gynecologic position and the transducer was positioned in the vagina to obtain a clear image of the cervix, including the internal and external os and the entire extension of the endocervical canal. After enlarging the image, the cervical length was obtained in the sagittal plane by placing calipers on the internal and external cervical os (Fig. 1) (Sonck and Shellhaas 1998; To et al. 2001). A single investigator (observer A), with over 10 years of experience in TVUS performed all sonographic cervical measurements.

Immediately after TVUS, the cervix was measured by 1.5 tesla magnetic resonance imager (Achieva equipment; Philips Medical Systems, Best, The Netherlands). All MRIs were performed by a single investigator (observer B), who had ample experience in the method. The cervix was measured in the sagittal plane, with the patient in dorsal decubitus, using turbo spin echo (TSE) sequences, T2 ponderation with 3 mm slices thickness, matrix 256 × 512 and field of view 25 cm. The cervical length was calculated as the distance between the internal and external os (Fig. 2). (Chan et al.1998) using the cervical canal as reference (Fig. 3). All images were saved in the MRI equipment console.

To assess interobserver variability, two independent observers (A and B) estimated MRI cervical measurements, blinded to the measurements of the other examiner. For intraobserver variability, one examiner (A) repeated

MRI measurements on two different occasions 7 days apart, 30 days after performing the sonographic cervical measurements. Sonographic cervical length was correlated with the measurement obtained through MRI. The sample size needed to detect differences between mean cervical lengths using TVUS and MRI was estimated to be 39, using paired-samples two-tailed tests.

Kolmogorov-Smirnov Z tests showed normal distributions of measurements performed with TVUS and MRI, as well as normal distributions of percentage differences between measurements performed with two methods, by two observers and by a single operator.

Proportionate Bland and Altman analysis was performed to determine the agreement between TVUS and MRI for cervical length measurement. Bias was defined as the difference between the two methods and limits of agreement were defined as 1.96 times the standard deviation of the mean difference. Paired-sample t-test was used to evaluate the differences between means of measurements performed using TVUS and MRI.
RESULTS

A total of 42 women with gestations age (GA) between 20 and 39 weeks entered the study. Two were excluded after TVUS due to the diagnosis of placenta previa and uterine malformation, resulting in 40 participants.

Mean maternal age was 27.3 years, ranging from 16 to 43 years. Most (51.5%) of the participants were nulliparas and 42.9% had at least one previous delivery. Mean gestational age at examination was 26 weeks and 5 days, ranging from 20 to 39 weeks. All MRI examinations were judged of adequate quality to measure cervical length and included in the final analysis.

The mean cervical length on TVUS and MRI was 31 ± 7.8 mm and 34 ± 8.5 mm, respectively. The minimum and maximum values were 16 and 50 mm and 12 mm and 58 mm for TVUS and MRI, respectively.

Proportionate Bland and Altman test demonstrated that the mean percentage difference between measurements performed using MRI and TVUS was −0.17% and the limits of agreement (95% confidence interval [CI]) were −35.7% to 35.36% (95% [CI]; −40.54 to −30.85 and 35.36% [CI]; 30.51 to 40.20) (Fig. 4). Paired-samples t-test showed no statistically significant difference between means of measurements performed with TVUS and MRI ($p = 0.191$).

DISCUSSION

Although the mean cervical length on TVUS was slightly shorter than on MRI (31 ± 7.8 mm vs.
Anexos

Fig. 6. Scatter diagram displaying the distribution of cervical measurements obtained by a single observer (Obs 1) using magnetic resonance imaging (MRI).

The mean cervical length was 34 ± 8.5 mm), there was no statistically significant difference between measurements obtained by either method. According to the Bland and Altman and paired t-tests (r = 0.17%; p = 0.191), cervical length on MRI and TVUS are equivalent and concordant. The mean MRI cervical length in the present study (34 ± 8.5 mm) was similar to that reported by House et al. (2005) for pregnancies in the same GA range (35.8 ± 8.6 mm).

According to the findings of the present study, cervical length measurement obtained through MRI is highly reproducible. The intraclass correlation coefficient indicated a high inter-observer correlation (r = 0.99; p < 0.001), contrariwise to the findings of Chan et al. (1998) who reported a low correlation (r = 0.52) for this method. Nevertheless, the mean cervical length of the 91 women included in that study (mean GA of 36 5/7 weeks) was similar to our findings: 34.3 ± 0.92 mm vs. 34 ± 8.5 mm, respectively.

All MRI examinations in the study were considered of adequate quality for cervical measurement and could be included in the final analysis. In a study performed by House et al. (2005), MRI was considered of adequate quality for evaluation of the cervical stroma in 53 of 57 women (93%) between 17 and 36 weeks of gestation. Pates et al. (2007) assessed 119 pregnant women through MRI and obtained ideal cervical images in 93 of them (78%), which they included in their analyses. The available data and our experience suggest that cervical length measurement through MRI is a relatively simple technique, especially when compared to evaluation of the cervical stroma, since the internal and external os are easily identifiable landmarks through this method.

The results of the present study suggest that MRI is a promising method in the evaluation of cervical biometry that could be used as an alternative to TVUS. It could therefore be useful in patients who cannot or do not want, to have a vaginal scan during the pregnancy.

Although TVUS allows cervical measurements and the visualization of some morphologic modifications during pregnancy, MRI is capable of detecting the degree of cervical hydration, which is a reflection of physiologic modifications associated with the process of cervical ripening (Chan et al. 1998; Carbonne 2004; House et al. 2005; Olah 1994; Pates et al. 2007a; 2007b; Rae et al. 2001; Sabir et al. 2000). Cervical dilation is preceded by effacement, a process characterized by cervical shortening and modifications in the intensity of the signal from the cervical matrix. These modifications are thought to be caused by changes in the amount of water and collagen that lead to differences in stromal signal intensity, which can be detected through MRI and indicate that cervical ripening is ongoing. (Chan et al. 1998; House et al. 2005; Olah 1994; Pates et al. 2007a; 2007b; Rae et al. 2001; Sabir et al. 2000).

Due to its small intra and interobserver variability, in the future MRI may possibly become an alternative to TVUS in the assessment of cervical length, especially in women who refuse to have a vaginal scan or in those with contraindications for this procedure, such as in cases of premature rupture of membranes.

The study of the cervix through MRI offers the possibility of detailed anatomic and stromal evaluation, both in normal pregnancy and spontaneous preterm labor. Future investigations will confirm the promising potential use of this method for cervical assessment in pregnancy.

REFERENCES


Abstract

**Objective:** Verify the reproducibility of magnetic resonance imaging to measure the cervical length through the analysis of intra and interobserver variability in the second half of pregnancy and compare the transvaginal ultrasound and magnetic resonance imaging in the assessment of cervical length. **Methods:** Cross-sectional observational study that included 42 women with gestational ages between 20 and 39 weeks initially submitted to transvaginal ultrasound by a single observer to measure the cervical length. After the scan, patients underwent magnetic resonance imaging by independent observers in a double-blind for the analysis of intra and interobserver variability. Results: There was a distribution of measurements of the cervix measured by means of different methods by Gaussian distribution model (Komolgorov-Smirnov test Z). There was good correlation (intraclass correlation coefficient) for the measurements performed by magnetic resonance single investigator 0.995 (95% CI: 0.991 to 0.997, p <0.001) and by two different examiners 0.990 (95% CI: 0.995, p <0.001). In calculating the paired t test no significant difference between the mean measurements of the cervix for the analysis of intra and interobserver variability (p = 0.200 and p = 0.257, respectively) confirmed by Bland-Altman (-1.07% and 0.74%; respectively) which showed a small average difference percentage. No significant variation was observed between measurements taken by transvaginal ultrasound and magnetic resonance imaging in the paired t test (p=0.191) and Bland-Altman (-0.17%).

**Conclusions:** The results indicate good reproducibility of magnetic resonance imaging to measure the length cervical and no significant difference between transvaginal ultrasound and magnetic resonance imaging in the estimation of cervical biometry.

**Keywords:** Cervix uteri; Pregnancy; Magnetic resonance imaging, Transvaginal ultrasound.
Bibliografia consultada


