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Pre- and Post-McDonald Cerclage Cervical Length, Width and Funneling Rate and their Association with Duration of Pregnancy

¹Zahra Fardi Azar, ¹Parvin Hakimi, ²Morteza Ghojzadeh and ³Fatemeh Ghatresamani

¹Department of Obstetrics and Gynecology, Alzahra Hospital,
Tabriz University of Medical Sciences, Tabriz, Iran

²Department of Physiology, Tabriz University of Medical Sciences, Tabriz, Iran

³Department of Radiology, Imam Reza Hospital, Tabriz University of Medical Sciences, Tabriz, Iran

Abstract: Changes of cervical ultrasonographic physical parameters and their association with outcome of cerclage have not been fully elucidated. This study aimed at evaluating association between ultrasonographic physical cervical shapes before and after McDonald cerclage with the length of pregnancy. Cervical length, width and funneling rate were assessed by transvaginal ultrasonography before and after the procedure. Mean pre-cerclage cervical length, width and funneling rate were 29.28 ± 5.54 , 19.92 ± 10.30 mm and $12.90 \pm 18.87\%$, respectively. The mean post-cerclage cervical length, diameter and funneling rate were 31.68 ± 4.21 , 9.78 ± 13.86 and $4.32 \pm 10.89\%$, respectively ($p < 0.001$ for all pre- and post-cerclage changes). The mean post-cerclage duration of pregnancy was 19.78 ± 5.94 weeks. There were significant direct correlations between the pre- and post-cerclage cervical lengths with pregnancy duration ($r = 0.24$, $p = 0.04$ and $r = 0.44$, $p < 0.001$, respectively). There were significant indirect correlations between the pre- and post-cerclage funneling rate with pregnancy duration ($r = -0.30$, $p = 0.01$ and $r = -0.20$, $p = 0.01$, respectively). Similar correlations were not significant for the cervical widths. This study showed that the pre- and post-cerclage ultrasonographically determined cervical length and funneling are good predictors of pregnancy duration.

Key words: Transvaginal ultrasonography, McDonald cervical cerclage, preterm labor, cervical insufficiency, cervical length, cervical funneling

INTRODUCTION

Preterm delivery is an important health problem and it is estimated that almost half of prenatal deaths are directly or indirectly associated with it (Ananth *et al.*, 2006). This condition raises the costs due to significant increasing of neonatal and maternal complications, as well (Cunningham *et al.*, 2009). Cervical incompetence or insufficiency is a preventive etiology of preterm deliveries which is routinely considered as a clinically diagnosed condition. Recurrent painless cervical dilatation induces spontaneous expelling of the pregnancy products out of uterus during the second trimester without presence of any evidence of beginning of delivery, bleeding, infection or rupture of membranes. In high-risk pregnancies, bed rest, tocolytics, mechanical cervical protectors and cerclage are among known prophylactic approaches in this regard. Cervical cerclage (tracheloplasty), also known as a cervical stitch is suturing of cervix by vaginal or abdominal approaches aiming to hinder its early and inappropriate dilatation (James *et al.*, 2006). The treatment

consists of a strong suture being inserted into and around the cervix early in the pregnancy, usually between weeks 12 to 14 and then removed towards the end of the pregnancy when the greatest risk of miscarriage has passed. A McDonald cerclage, described in 1957 is the most common and is essentially a pursestring stitch used to cinch the cervix shut; the cervix stitching involves a band of suture at the upper part of the cervix while the lower part has already started to efface. This cerclage is usually placed between 12 and 24 weeks of pregnancy. The stitch is generally removed around the 37th week of gestation (Fox and Chervenak, 2008; Daskalakis, 2009; Pramod *et al.*, 2004; Simcox and Shennan, 2007a, b; Debbs and Chen, 2009). Ultrasonographic examination in a pregnant candidate of cervical cerclage primarily focuses on controlling well being of fetus and excluding possible abnormalities. The post-cerclage ultrasonography assesses the fetal condition and excludes any probable rupture of membranes and any possible damage after the procedure (Varney Burst, 2005). Data regarding the application of ultrasonography in

cervical cerclage are heterogeneous and association between the ultrasonographic cervical parameters and the success rate of cerclage are not definite (Berghella and Seibel-Seamon, 2007; Berghella *et al.*, 1999; Rust *et al.*, 2001). In the current study it has been assumed that ultrasonographic evaluation of cervix before and after McDonald cerclage with regard to its length, width and funneling rate may correlate to the success rate of the procedure. Clinically significant findings may introduce cervical cerclage under ultrasonographic examination as a routine, non-invasive and inexpensive method in pregnant women with suspected cervical insufficiency.

METHODS AND MATERIALS

In this cohort study, 84 pregnant women with cervical insufficiency and candidates of cervical cerclage by McDonald approach were enrolled in a referral gynecologic teaching centre (Alzahra Hospital, Tabriz, Iran) in a 21-month period of time (July 2009 to April 2011). The inclusion criteria were 12-18 weeks of pregnancy and need of cervical cerclage. Women with structural abnormalities of cervix and uterus and active vaginal bleeding or infection were excluded. Transvaginal ultrasonographic examination was performed by a single skilled sonographer before and immediately after cervical cerclage. Cervical length, width and funneling rate were documented by the sonographer. The McDonald cervical cerclage was performed by a single skilled surgeon specialized in gynecology. For this reason, a pursestring stitch was used at the upper part of the cervix (Fig. 1). All the patients were discharged after 24 hospitalization and 48 h of bed rest was prescribed at home. Progesterone suppositories (400 mg day⁻¹) were prescribed by the end of week one after discharge. All the patients were followed up by the end of delivery. The stitches were removed on week 37. Time gap between the cerclage and delivery was considered as an indicator of success. This study was approved by the ethics committee of Tabriz University of Medical Sciences and informed consents were obtained from all the participants. Pre- and post-cerclage changes of cervical ultrasonographic parameters were determined and correlated with the duration of pregnancy after the procedure. Variables were compared between the cases with elective and urgent cerclage, as well.

Statistical analysis: Statistical evaluation was made using SPSS for Windows V 15.0 (SPSS Inc., IL, USA). Data were shown as frequency (percentage) or Mean±Standard Deviation (SD). Independent samples T, chi-square,



Fig. 1: Stitches in McDonald cerclage

Fishers' Exact and Pearson correlation (r) tests were employed for statistical analysis. The p-values of less than 0.05 were regarded as significant.

RESULTS

Eighty four pregnant women were studied. These patients' characteristics and general data are summarized in Table 1. Preterm delivery was documented in 27 patients. The etiologies of this condition were premature rupture of membranes in 17 patients (63%), delivery pains in 6 patients (22.2%), vaginal bleeding in 1 patient (3.7%), observation of dilatation/effacement in 1 patient (3.7%), premature rupture of membranes accompanied with delivery pain in 1 patient (3.7%) and delivery pain with observation of dilatation/effacement in 1 patient (3.7%).

Underlying causes of cervical cerclage are summarized in Table 2. Accordingly, the short cervical length (42 cases), previous premature delivery (38 cases), previous infertility (24 cases) and twin pregnancy or beyond (17) were the main causes of cervical cerclage in the studied population (Table 2).

The mean cervical length was 29.28±5.54 (10-38) mm before cervical cerclage which significantly increased to 31.68±4.21 (21-40) mm after the procedure ($p<0.001$). The mean cervical width was 19.92±10.30 (4-43) mm before cervical cerclage which significantly decreased to 11.25±9.47 (0-32) mm after the procedure ($p<0.001$). The mean funneling rate was 12.90±18.87 (0-86) % before cervical cerclage which significantly decreased to 4.32±10.89 (0-25) % after the procedure ($p<0.001$).

Correlations between the ultrasonographic findings before cervical cerclage with the duration of pregnancy thereafter are summarized in Table 3. Accordingly, there were positive significant correlations between the

Table 1: General data of the studied population

Variable	Mean±SD (Frequency %)
Age (year)	27.92±4.74 (18-45)
Gravidity	2.64±1.45 (1-8)
Parity	0.95±0.43 (0-5)
Educational level	
Illiterate	12 (14.3)
High school	67 (79.8)
University degree	5 (6)
Previous still birth	13 (15.5)
History of chronic disease	9 (10.7)
Previous abortion	1.69±1.30 (0-6)
Age at cervical cerclage (week)	16.62±3.22 (13-25)
Type of cervical cerclage	
Elective	54 (64.3)
Urgent	30 (35.7)
Age at delivery (week)	37.01±2.26 (30-41)
Cervical cerclage to delivery (week)	19.78±5.94 (11-27)
Delivery status	
Term	57 (67.9)
Preterm	27 (32.1)
Type of delivery	
Caesarian section	48 (57.1)
Vaginal	36 (42.9)

Data are shown as Mean±Standard Deviation (range) or frequency (percentage)

Table 2: Etiologies of cervical cerclage in the studied population

Etiology	Frequency (%)
Short cervical length	15 (17.9)
Previous premature delivery	16 (19)
Previous infertility	12 (14.3)
Twin pregnancy or beyond	4 (4.8)
Short cervical length plus previous premature delivery	20 (23.8)
Twin pregnancy or beyond plus previous infertility	8 (9.5)
Short cervical length plus twin pregnancy or beyond	5 (6)
Short cervical length plus previous infertility	2 (2.4)
Previous infertility plus previous premature delivery	2 (2.4)

Table 3: Correlations between ultrasonographic findings before cervical cerclage with duration of pregnancy after the procedure

Variable	Pearson's (r)	p-value
Pre-cerclage cervical length	0.24	0.04*
Post-cerclage cervical length	0.44	<0.001*
Pre-cerclage cervical width	-0.06	0.63
Post-cerclage cervical width	-0.09	0.52
Pre-cerclage cervical funneling percentage	-0.30	0.01*
Post-cerclage cervical funneling percentage	-0.20	0.01*

*p<0.05 considered statistically significant

duration of pregnancy after cervical cerclage and the cervical length before and after procedure ($r = 0.24$, $p = 0.04$ and $r = 0.44$, $p < 0.001$, respectively). In other words, more cervical lengths before and after cervical cerclage were associated with longer duration of pregnancy after the procedure. The correlations between the pre- and post-cerclage cervical widths with the duration of pregnancy after cerclage were not statistically significant ($r = -0.06$, $p = 0.63$ and $r = -0.09$, $p = 0.52$, respectively). There were negative significant correlations between the duration of pregnancy after cervical cerclage and the cervical funneling rates before and after procedure. i.e., higher cervical funneling rate before and after cervical cerclage were associated with shorter

Table 4: Comparing different variable in patients with elective or urgent cervical cerclage

Variable	Elective cerclage (n = 54)	Urgent cerclage (n = 30)	p-value
Age (year)	28.07±4.26	27.63±5.57	0.69
Gravidity	2.57±1.47	2.69±1.43	0.56
Parity	0.98±0.14	0.90±0.66	0.65
Abortion	1.79±1.30	1.87±1.31	0.36
Pregnancy age at cerclage (week)	17.63±2.87	14.80±3.06	<0.001*
Pre-cerclage cervical length (mm)	31.03±4.64	26.13±5.69	<0.001*
Post-cerclage cervical length (mm)	32.82±3.25	29.63±4.98	0.001*
Pre-cerclage cervical funneling (%)	00.00±0.00	36.11±12.32	<0.001*
Post-cerclage cervical funneling (%)	00.00±0.00	12.10±15.56	<0.001*
Delivery age (week)	37.48±2.20	36.14±2.13	0.01*

Data are shown as Mean±Standard Deviation, *p<0.05 considered statistically significant

duration of pregnancy after the procedure ($r = -0.30$, $p = 0.01$ and $r = -0.20$, $p = 0.01$, respectively). (Table 3).

Variables are compared between the two groups underwent elective or urgent cervical cerclage in Table 4. Accordingly, mean pregnancy age at cerclage was significantly lower in the urgent group ($p < 0.001$). Mean pre- and post-cerclage cervical lengths were significantly lower in the urgent group ($p < 0.001$ and $p = 0.001$, respectively). Mean cervical funneling rates before and after cerclage were significantly higher in the urgent group ($p < 0.001$ for both). Mean pregnancy age was significantly lower in the urgent group ($p = 0.01$). The other variables were comparable between the two groups ($p > 0.05$) (Table 4).

DISCUSSION

In this study, association between the cervical ultrasonographic physical shapes before and after McDonald cervical cerclage with the duration of pregnancy in cases with cervical insufficiency was evaluated. Cervical length, width and funneling rate were the studied three variables. Based on the findings, there was significant direct correlation between the cervical length and duration of pregnancy before and after the procedure. Significant but inverse correlation was also shown between the cervical funneling rate and duration of pregnancy. Berghella *et al.* (1999) proposed the ultrasonographic evaluation of cervix in patients at risk of cervical insufficiency. They also showed that the transvaginal ultrasonography is a noninvasive and safe screening tool for cervical insufficiency in pregnant women (Berghella *et al.*, 2003). Despite these findings, there is not yet any agreement on specific cervical parameters during ultrasonographic assessment with regard to performing or not performing a cervical cerclage in high-risk women (Pramod *et al.*, 2004). Rust *et al.* (2001)

concluded that the ultrasonographic findings before cervical cerclage did not significantly predict outcome. They did not evaluate the post-cerclage findings in their study. Berghella *et al.* (2004) randomized 61 high risk pregnancies for cervical insufficiency in two groups; 31 cases underwent cervical cerclage and 30 other cases were only treated conservatively. They finally concluded that the cervical length in ultrasonographic evaluation could have not determined need of cerclage and it was not associated with preterm delivery. This finding is also in contrast with ours. They compared the results between the two groups with and without cerclage and this may negatively affect the consequences. This might be the possible reason of contradiction. Low sample size is another limitation in the mentioned study. On the other hand, in another series by Berghella and Seibel-Seamon, (2007), 183 pregnant women were evaluated. They showed that mean duration of pregnancy after cerclage was significantly lower in cases with shortened cervix (<25 mm). We also showed that a longer cervix was accompanied more longer duration of pregnancy after cervical cerclage. Althuisius *et al.* (2001) also showed that a decreased cervical length (<25 mm) was a significant predictor of preterm labor. This also confirms our finding in this regard. Rust *et al.* (2005) reported that the cervical length as well as the funneling rate was parallel to the duration of pregnancy after cerclage but in opposite directions. They did not find a significant correlation between the cervical width and the duration of pregnancy. In our series, the cervical width was not a significant predictor of stability, too. So, one may conclude that the cervical length and funneling rate are two main ultrasonographic physical parameters which might be used as reliable predictors of outcome in patients undergoing McDonald cerclage. As mentioned earlier, the association between the cervical funneling rate and stability of pregnancy was also inversely significant in our study. Mancuso *et al.* (2010) also evaluated 147 pregnancies with cervical funneling in ultrasonographic examination and reported an inverse correlation between this finding and duration of pregnancy after cervical cerclage. This report also is in line with the final conclusion of current study. In a meta-analysis by Berghella *et al.* (2005), they proposed that the cerclage should be reserved in the patients with high risk patients with cervical insufficiency and this could be determined by the ultrasonographic evaluation. Indicating the importance of ultrasonography in these patients, we also determined the best cervical parameters in this regard. It should be born in mind that the pregnancy age at ultrasonographic examination, technique of cerclage and primary cervical length could potentially influence the results of different studies. We appropriately controlled these cofactors in the present study. Confining the

sample size to patients undergoing cerclage by McDonald technique, reporting outcome by a single sonographer and surgeon and obtaining both the pre- and post-cerclage results are major points in this study.

CONCLUSION

This study showed that the ultrasonographically determined cervical length and funneling rate before and after cervical cerclage by McDonald technique are good predictors of the procedural success. So we recommend this method under ultrasonography and use of the mentioned parameters for a better management of pregnant patients with insufficient cervix. Further studies on other known cerclage techniques might be beneficial.

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