Correlation Between Myometrial Thickness and the Latency Interval in Preterm Premature Rupture of Membranes

M. Kalantari MD[1]
N. Mostaghel MD[2]
M. Khoshnood Shariati MD[3]
Z. Amiri PhD[4]
S. Piri MD[5]
A. Ghazal MD[6]

1. Assistant Professor, Department of Radiology, Mahdieh Hospital, Shahid Beheshti University of Medical Sciences, Tehran, Iran.
2. Assistant Professor, Department of Obstetrics and Gynecology, Taleghani Hospital, Shahid Beheshti University of Medical Sciences, Tehran, Iran.
3. Assistant Professor, Department of Pediatrics, Mahdieh Hospital, Shahid Beheshti University of Medical Sciences, Tehran, Iran.
4. Assistant Professor, Department of Basic Sciences, National Nutrition and Food Research Institute, Shahid Beheshti University of Medical Sciences, Tehran, Iran.
5. Fellowship of Perinatology, Tehran, Iran.
6. Obstetrician, Mahdieh Hospital, Tehran, Iran.

Corresponding Author:
Nahid Mostaghel
Address: Department of Obstetrics and Gynecology, Taleghani Hospital, Shahid Beheshti University of Medical Sciences, Tehran, Iran.
Tel: +9821 2303 1309
Fax: +9821 2243 2581
Email: n.mosy33@yahoo.com

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Background/Objective: In order to predict the time of labor in patients with preterm premature rupture of membrane (PPROM), different factors have been studied resulting in different detection rates. Recently, sonographic measurement of myometrial thickness (MT) has been introduced and studied as an applicable and noninvasive method in predicting the length of latency interval (LI) of labor (the period from PPROM to start of labor). The objective of our study was to determine the correlation between MT and LI in pregnant women with PPROM led to oligohydramnios.

Patients and Methods: This was a cross-sectional study on 24 cases with PPROM. The sonographic measurement of myometrial thickness and the latency interval of patients with PPROM without labor pain were recorded. Gestational age was between 26-34 weeks and amniotic fluid index (AFI) was less than 5 percentile. The data were analyzed using SPSS software.

Results: The mean±SD maternal age was 29.2±1.2 years. The AFI in all women was less than 5% percentile of normal fluid for that gestational age. The mean±SD of gestational age was 29.1±2.2 weeks. The mean±SD of MT was 6.5±1.5 mm interiorly, 7.9±4.2 mm fundal, 6.6±1.7 mm in the lower segment and 7.8±2.2 mm laterally. The mean LT was 545±4.7 hours.

Conclusion: Our study showed that there is no significant correlation between MT and LI in pregnant women with PPROM and reduced AFI.

Keywords: Myometrial Thickness, Amniotic Fluid Index, Latency Interval, PROM

Introduction

Rupture of membranes before the onset of labor is considered premature or PROM, which is usually followed by labor and delivery. Preterm premature rupture of membranes (PPROM) makes management of the patient more challenging during the latency interval (LI), the time from PPROM to labor and after that. PPROM and associated preterm delivery are the leading cause of perinatal morbidity and mortality. In the absence of symptoms and signs of infection, the management is usually expectant because of the assumption that even a minor delay in the interval to delivery will be beneficial to the fetus.

The incidence of PPROM ranges from 2% to 20% and is associated with 18%-20% of perinatal deaths.[1-3] Our understanding of the mechanisms regulating the events preventing and initiating labor remains limited so prediction of the latency interval is imprecise.

Different and numerous studies have been performed so far to find the predictive factors of the initiation of labor after PPROM for better assessment and management of the situation with the least complications. The factors studied with different predictive values in the timing of latency interval include AFI,[4] inflammatory factors in amniotic fluid,[5] cervical length[6-9] and gestational age at the time of PPROM.[10]

Recently, myometrial thickness has undergone sonographic evaluation during normal pregnancy,[11-13] labor and postpartum,[14] and in certain situations such as twin pregnancy, polyhydramnios[15] and PPROM.[16] Some studies showed the decrease of myometrial thickness in the 2nd and 3rd trimesters compared with the 1st trimester[12] and also in specific pregnancies which are associated with preterm labor such as twin pregnancy and polyhydramnios.[15] Recently, myometrial thickness as a predictive factor of latency interval has been studied in limited centers.

In a study carried out by Buhimschi et al.[16] a direct correlation was found between fundal myometrial thickness (MT) and the latency interval (LI). They showed that the thicker the fundal myometrium, the longer the latency interval.

Although finding a predictive factor of LT in PPROM patients can significantly affect assessment and management of these groups and MT is one of the new predictive factors proposed, there are only few studies about it. Therefore, we decided to design a study to assess the correlation between MT and LI in PPROM and decreased AFI without contractions.

Patients and Methods

It was a prospective cross-sectional study. The inclusion criteria consisted a singleton pregnancy with PPROM leading to oligohydramnios in 26 to 34 weaks gestational age patients without contraction. Twenty-four pregnant women were included, who were managed in Mahdieh Hospital on inpatient basis from 2007 to 2008.

The exclusion criteria were fetal or uterine anomalies, twin pregnancy, IUGR (estimated fetal weight less than the 10th percentile), previous scar in the uterus, placental abruption, placenta previa and other maternal or fetal indications for iatrogenic preterm delivery such as chorioamnionitis. Women without the above-mentioned exclusion criteria were enrolled in the study. The signs of chorioamnionitis and placental abruption were detected and the patients were excluded in this situation.

The diagnosis of PPROM was made on the basis of history and direct observation of leakage of fluid during examination with speculum. All suspicious cases underwent the fern test. Then each patient had an ultrasound scan in the same center and in case AFI was less than the 5th percentile of normal fluid for that gestational age, the rest of the indices like estimated fetal weight (EFW), or fetal and uterine anomalies was evaluated and recorded. Myometrial thickness was measured between serosa and decidua in the lower segment and in the middle of the fundus, anterior, posterior and lateral uterine walls by the same observer (radiology consultant of the center). It was performed free of charge and all patients signed informed consent.

The ultrasound machine was Acauvi x (XQ) and an abdominal 3.5 MHz probe was used. PPROM was managed expectantly. No tocolysis or vaginal exam was performed. All patients received corticosteroid (betamethazone) injections for lung maturity and antibiotics (ampicillin and erythromycin). Fetal monitoring, performed regularly, consisted of daily NST, weekly BPP and FHR check every 4 hours.

Finally, the start of contractions (complaint of pain and examination by physician) were recorded. Myometrial thickness measurement was performed at the time of admission by ultrasound scan. The sample size was equal to 24 calculated according to SD formula (α=0.05, d=0.4). The findings were calculated in terms of mean and standard deviation, and Pearson correlation coefficient was used to determine the correlation between variables. To test normal distribution of parameters, we used the Kolmogorov-Smirnov method. All the statistical calculations were carried out by SPSS software.

Results

The study was performed from 2007 to 2008 in Mahdieh university-affiliated hospital, Tehran. Table 1 presents a series of demographic and ultrasonographic variables assessed at the enrollment (i.e. EFW) with the mean latency interval of 545.3±4.7 hrs (min=12.5, max=1367).

Among the cases, approximately 54.2% were in their first pregnancy, 12.5% in their second pregnancy and 29.2% in their third pregnancy. 58.3% of these women had diploma of secondary school, 37.5% were under diploma and 4.2% had bachelors degree.

Table 2 presents the myometrial thickness, means and standard deviation. Overally, the greatest myometrial thickness was seen in the lower uterine segment, while in the body of the uterus the greatest

value belonged to the fundal part.

We found no relationship between the overall mean myometrial thickness and the latency interval (LI) after calculating the Pearson correlation coefficient (Table 3).

Discussion

Recently, there have been researches about using myometrial thickness (MT) in PPROM patients to predict the time of labor. One study was performed by Buhimschi et al.[16] who found a direct relationship between fundal MT and LI in pregnant women with PPROM and without contractions. We could not find such a relationship in our study.

Comparing the results in our study with those in Buhimschi's study, we perceived:

- Similar mean maternal age, which in Buhimschi's study and in ours were 29.2±1.2 and 29.9 years, respectively.

- Different mean maternal weights, which was 90 kg in Buhimschi's study and 72.5 kg in our study which may be due to the smaller size of women under study in Mahdieh hospital. However, BMI would have been much better for comparison if we had the data.

- The mean gravidity in Buhimschi's study was 3 (range, 0-11) , but in our study, 54% of the women were nulliparas and 29% were in their third pregnancy, which shows significant difference. However, no relationship was found in our literature review between gravidity and MT.

- Similar mean gestational ages; 29.5 weeks in Buhimschi's study and 29.3 weeks in our study.

- Different inclusion criteria; AFI<5% percentile for gestational age in our study and lower than 2.5% percentile in Buhimschi's study. The reason may be the difference in oligohydramnios definition. Of course, the technical differences should also be taken into account.

Furthermore, the ultrasound probe was 3.5 MHz in our study and 5-7.5 MHz in Buhimschi's study. The women's weight were more (more subcutaneous fat) in Buhimschi's study compared with our study which may technically affect the ultrasound examination quality.

The mean MT in Buhimschi's study, except for the lower uterine segment, was more than those in our study (mean anterior, fundal and posterior thickness of 10.6, 10.7 and 9 versus 6.5, 7.9 and 6.6, respectively). The reason may be technical problems such as more subcutaneous fat in Buhimschi's cases or using a 3.5 MHz probe instead of 7.5 MHz in our study or more AFI in our study which may affect the ultrasonic measurement of MT.[15]

As the mean estimated fetal weight was similar in both studies (1287.6±99 versus 1258 g), it is unlikely that this difference is due to the variations in estimated fetal weight (EFW).

In a study by Darnwald,[12] the fundal MT in 2nd and 3rd trimesters in singletons was shown to be less than the thickness in anterior, superior and posterior parts ($P<0.05$), but in our study, the fundal MT was more than the anterior and posterior parts. The reason of this difference may be due to different gestational ages.

The mean gestational age in Durnwald's study and in our study was 34.1 and 29.1 weeks, respectively. The pregnant women in Durnwald's study had normal AFI, but in our study, AFI was less than 5% of the normal fluid for that gestational age (oligohydramnios) which may change the measurement of MT.

Table 1. The Characteristics of the Population of Women Under Study; Latency Interval (LI), AFI, Estimated Fetal Weight (EFW), Gestational Age (GA), BMI, Parity, and Age

	LI (hrs)	AFI	EFW (g)	GA (weeks)	BMI	Para (score)	Age (year)
Mean	545.3	51	1258	29.13	28.9	1.83	28.9
Min	12.5	23	539	24.4	21.3	1	21
Max	1367	39.2	1782	31.8	33.6	4	38
SD	4.7	1.6	3.4	2.2	3.3	1.007	5.1

Table 2. The Descriptive Statistics of Myometrial Thickness in Different Parts of the Uterus

MT	LUS (mm)	L. Lat. (mm)	R. Lat. (mm)	Pos. (mm)	Fun. (mm)	Ant. (mm)
Mean	8.2	7.8	7.8	6.5	7.9	6.5
Min	4.4	4.4	4.0	4.4	4.5	4.7
Max	15.0	13.5	12.5	9.8	13.6	9.0
SD	2.7	2.2	2.2	1.7	2.4	1.5

Table 3. The Pearson Correlation Coefficient Between Myometrial Thickness (MT) and Latency Interval (LI)

MT	LI	P Value
Ant.	0.020	0.925
Fund.	-0.052	0.809
Post.	-0.172	0.422
R. Lat.	0.041	0.850
L. Lat.	0.223	0.296
LUS	-0.245	0.248

Degani et al.[11] showed that placental position significantly changes the myometrial thickness (P<0.001), but in our study, the placental position was not mentioned similar to Buhimschi's study.

In 2008, Sfakianaki et al.[13] studied twin pregnancies with intact membranes and normal AFI, in which the fundal thickness was 5.8 mm (4.6-6.5 mm) and the lower uterine segment was 4.7 mm (3.5-5.6 mm). In our study, the mean±SD of fundal MT and the lower uterine segment were 7.9±2.4 and 8.2±2.7), respectively. The reason may be the difference in the number of fetuses and the amount of AFI which affects the ultrasonic measurement of MT.

The mean gestational ages in our study and in Sfakianaki's study[13] were 29.1 and 31.3 weeks, respectively. This dissimilarity may affect MT. Moreover, the genetic difference should be taken into account.

Lower uterine segment thickness in our study was slightly more than that in Buhimschi's study (8.2 versus 7.7 mm). Because all the characteristics of pregnant women which cause thinning of the lower segment (including history of prior cesarean section and multiple pregnancies) were the same, this difference which is not quite significant may be due to technical issues. However, as Sfakianti's study shows that the less the myometrial thickness in LUS the shorter the LI, we can explain the shorter LI in Buhimschi's study compared to our study.

Buhimschi's study showed that the thickness of the lower uterine segment in PPROM, PCTR (preterm control group) and term was less than the other parts, and in PPROM, the lower uterine segment is significantly thicker compared to PCTR and term. However, in our study, the LUS thickness was more than the other parts and was more than Buhimschi's study. The reason is not clear and may be due to genetic differences. It cannot be due to gestational age as there was no difference in these two studies regarding this issue. We also did not find any evidence in our literature review indicating fetal presentations as the cause. AFI which was higher in our study compared with Buhimschi's study can explain the difference in LUS in the two studies.

In our study, there was no relationship between fundal myometrial thickness and LI (Table 3). However, in Buhimschi's study LI was related to fundal thickness. Difference in the definition of oligohydramnios may be the reason. As was mentioned earlier, in our study AFI was less than the 5% percentile for gestational age while in Buhimschi's study it was approximately 2.5%, considered to be oligohydramnios. We already know that amniotic fluid volume affects LI and fetal distress.

Mean LI in our study was significantly higher than that in Buhimschi's study (545 hours versus 96 hours), which may be due to:

1. Certain factors contributing to the prevalence of PPROM and preterm labor such as infections and substance abuse that may be different in some societies.
2. Genetic differences.
3. Different AFI in our study compared to Buhimschi's study.

There was no relationship between myometrial thickness and latency interval in our study compared to Buhimschi's study.

We assumed that the sample size could be a limitation in our study; therefore, we recommend studies with more cases to clarify this issue in the future.

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References

1. Gunn GC, Mishel DR Jr, Morton DG. Premature rupture of the fetal membrane. A review. Am J Obstet Gynecol 1970 Feb;106(3):469-83.
2. Cox SM, Williams ML, Leveno KJ .The natural history of preterm rupture of the membranes. What to expect of expectant management. Obstet Gynecol 1988 Apr;71(4):558-62.
3. Naeye RL. Cause of perinatal mortality in the US Collaborative Perinatal Project. JAMA 1977 Jul;238(3):228-9.
4. Park JS, Yoon BH, Romero R, Moon JB, Oh SY, Kim JC et al. The relationship between oligohydramnios and the onset of preterm labor in preterm premature rupture of membranes. Am J obstet Gynecol 2001 Feb;184(3):459-62.
5. Romero R, Avila C, Santhanam U, Sehgal PB. Amniotic fluid interlukin 6 in preterm labor. Association with infection. J Clin Invest 1990 May;85(5):1392-400.
6. Gire C, Faggianelli P, Nicaise C, Sojai R, Fiori A, Chau C et al. Ultrasonographic evaluation of cervical length in pregnancies complicated by preterm premature rupture of membranes. Ulrasound Obstet Gynecol 2002 Jun;19(6):565-9.
7. Bitter RE, da Fonseca EB, de Carvalho MH, Martinelli S, Zugaib M. Predicting pretem delivery in asymptomatic patients with prior preterm delivery by measurement of cervical length and phosphorylated insulin-like growth factor-binding protein-1. Ultasound Obstet Gynecol 2007 May;29(5):562-7.
8. Bergelin I, Valentin L. Pattern of normal change in cervical length and width during pregnancy in nulliparous women; a prospective,

longitudinal ultrasound study. Ultrasound obstet Gynecol 2001 Sep;18(3):217-22.
9. Yost Np, Owen J, Bergella V, MacPherson C, Swain M, Dildy GA 3 rd et al. Second trimester cervical sonography: feature other than cervical length to predict spontaneous preterm birth. Obstet Gynecol 2004 Mar;103(3):457-62.
10. Mercer BM, Goldenberg RL, Moawad AH, Meis PJ, Iams JD, Das AF et al. The preterm prediction study: effect of gestational age and cause of preterm birth on subsequent obstetric outcome. National Institute of Child Health and Human Development Maternal-Fetal Medicine Units Network. Am J Obstet Gynecol 1999 Nov;181(5 Pt 1):1216-21.
11. Degani S, Leibovitz Z, Shapiro I, Gonen R, Ohel G. Myometrial thickness in pregnancy: longitudinal sonographic study. J Ultrasonound Med 1998 Oct;17(10):661-5.
12. Durnwald CP, Mercer BM .Myometrial thickness according to uterine site , gestational age and prior cesarean delivery. J Maternal Fetal Neonatal Med 2008 Apr;21(4):247-50.
13. Sfakianaki AK ,Buhimschi IA, Pettker CM, Magloire LK, Turan OM, Hamar BD et al . Ultrasonographic evaluation of myometrial thickness. Am J obstet Gynecol 2008 May;198(5):530.e1-10.
14. Buhimschi CS, Buhimschi IA, Malinow AM, Weiner CP. Myometrial thickness during human labor and immediately postpartum. Am J Obstet Gynecol 2003 Feb;188(2):553-9.
15. Cunningham FG, Leveno KJ, Bloom S, Hauth JC, Rouse DJ, Spong C. Wiliams obstetric. 23rd ed. USA: McGraw-Hill; 2009.
16. Buhimschi CS, Buhimschi IA, Norwitz ER, Sfakianaki AK, Hama B, Copel JA et al. Sonographic myometrial thickness predicts the latency interval of women with preterm premature rupture of membranes and oligohydramnios. Am. J Obstet Gynecol 2005 Sep;193(3pt 1):762-70.