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The Sensitivity and Specificity of Measuring the Thickness of Myometrium to Predict the Time of Spontaneous Labour in Preterm Prelabor Rupture of Membranes and Oligohydramnios

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ABSTRACT

Background: Preterm prelabour rupture of membranes (PPROM) accounts for one- third of cases of preterm labour which is the leading cause of perinatal morbidity and mortality. The time from the rupture of membranes until labour, i.e. the latent period (LP), is an important factor in neonatal outcome. **Aim of the study:** The present study aims to determine the sensitivity and specificity of measuring the thickness of myometrium for the prediction of LP. **Patients and methods:** This cross-sectional observational study was performed in Az-Zahraa Teaching Hospital in Najaf-Iraq during the period from the first of August 2016 to the first of October 2017. A total of 89 patients who admitted with the diagnosis of PPROM at the 26th to the 34th weeks of gestation with oligohydramnios were included in the study. The thickness of myometrium was measured via transabdominal ultrasound in the lower uterine segment (LSMT), anterior (AMT), posterior (PMT) and fundal (FMT) parts of uterus within 24 hours of membranes rupture. **Results:** The mean measurements of LSMT, AMT, PMT and FMT in patients with PPROM and oligohydramnios were 7.25±2.31, 7.87±3.45, 8.71±3.88 and 8.65±3.72 respectively. The sensitivity and specificity of measuring AMT for prediction of LP > 7 days were 80% and 53%; those for PFT were 80% and 34.1% respectively at a cut-off point of 6.5 mm while the FMT was found to be 60% sensitive and 34.1% specific. LSMT was 80% sensitive and 43.9% specific for recognition of LP > 7 days at a cut-off point of 7.5mm. **Conclusions:** measurement of the thickness of the myometrium may be a sensitive but non-specific tool for the prediction of the latent period.

Keywords: Latent Period, PPROM, Sensitivity, Specificity, Thickness of Myometrium.

Article Information

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INTRUDUCTION

Preterm prelabour rupture of membranes PPROM is a syndrome characterized by spontaneous rupture of the fetal membranes before 37 completed weeks in the absence of uterine contractions, i.e. before the onset of labour(1). It occurs in up to 3% of all pregnancies and accounts for approximately one-third of all deliveries before 37 weeks gestation (2). As preterm delivery is the most common consequence of PPROM, prediction of the time of spontaneous labour cannot be overemphasized. Approximately 50% of patients with PPROM deliver within 7 days, 75% within 14 days and 85% within 30 days (3). Currently, there is a limited capability to predict latent period (LP), i.e. time from rupture of membranes until labour; this results in difficulties in counseling the patients that suffer from PPROM. Several factors are postulated to affect the LP. An inverse relationship exists between gestational age (GA) at the time of PPROM and LP (4,5).

The relationship between the oligohydramnios and LP is controversial. Some studies showed that oligohydramnios is associated with shortening of LP (6) while another study by Test et al (7) showed that the LP was prolonged in women who had oligohydramnios. A more recent study could not reveal any association between oligohydramnios and LP (8). A twin pregnancy complicated with PPROM has shorter LP than a singleton pregnancy (9). Pregnancy complications such as chorioamnionitis, placental abruption or non-reassuring fetal testing result in early delivery and shorter LP. It has been suggested that shorter length of cervix might be associated with shorter LP. The digital cervical examination has been investigated as a predictor for LP and has been shown to be of limited value. Furthermore, a digital cervical examination may increase the risk of ascending infection. A study done by Fischer et al (10) that measured the length of the cervix by trans-labial ultrasound revealed that cervical length had no association with the duration of the LP in patients with PPROM.

Measurement of the thickness of the myometrium by transabdominal ultrasound in patients with PPORM as a predictor for the time of spontaneous labour has been studied and it has been suggested that the thicker the myometrium the longer the LP. Uterine contractions during labour are associated with diffuse thinning of the myometrium (11). This is consistent with the well-known fact in physics that the applied force per unit of cross-sectional area, i.e. wall stress, is directly proportional to the intra-cavitary pressure and radius of the curvature but inversely proportional to the thickness of the myometrium. Thus, the thinner the myometrium during contraction, the greater will be the generated uterine wall stress(12). These findings suggest that the direction of the force paths, fundal dominance, is not determined by asymmetrical myometrial hypertrophy but, rather may be a function of increased myometrial mass that results from the increased surface area at the fundus (13). A positive correlation between the thickness of myometrium and LP has been revealed by several studies (11, 14). However; the data regarding this association is contradictory and the sensitivity and specificity of measuring the thickness of myometrium in the prediction of LP are not yet verified (14).

The aim of the current study is to determine the sensitivity and specificity of measuring the thickness of myometrium for the prediction of LP in patients with PPROM and oligohydramnios.

PATIENTS AND METHODS

This cross-sectional study was conducted upon 89 pregnant women at 26th to 34th weeks of GA who were admitted to Az-Zahra`a Teaching Hospital with the diagnosis of PPROM and oligohydramnios, amniotic fluid index (AFI) < 5 cm) during the period starting from first of August 2016 to the first of October 2017. The protocol of the study was approved by the Scientific and Ethical Committees at College of Medicine at the University of Kufa. Written informed consents were taken from all patients who participated in the study. A comprehensive history, general, abdominal and sterile speculum examinations were performed for all patients and those who are suitable for expectant management are included in the study. All patients underwent sterile Cusco's speculum examinations to detect cervical dilatation and amniotic fluid pooling, aided if necessary by mild pressure on the abdomen or Valsalva manoeuvre. A Confirmation of the leakage of amniotic fluid by a positive ferning test, i.e. observation of a crystallization pattern on a dried sample of fluid under the microscope and a positive nitrazine test, i.e. alkaline pH determination of fluid, were achieved for all patients in the study.

The exclusion criteria included:

- Multiple pregnancy.
- Intra-uterine growth restriction.

- Uterine or fetal anomalies.
- Uterine scar or fibroid.
- Placental abruption or placenta previa.
- Other maternal or fetal conditions that necessitated termination of pregnancy such as chorioamnionitis or fetal distress.

During the follow-up, five patients were excluded from the study as they required emergency termination of pregnancy by cesarean section: three of them due to development of chorioamnionitis, one of them due to non-reassuring fetal heart rate pattern and one of them due to placental abruption. Thus, the final analysis of data included only 84 patients.

Trans-abdominal ultrasound scan was performed for all patients initially within 24 hours of membrane rupture by the same experienced sonographer for determination of GA, placental localization, fetal well-being, congenital anomalies, amount of liquor by AFI and thickness of the myometrium at the lower uterine segment (LSMT), fundus (FMT), anterior wall (AMT) and posterior (PMT) wall of the uterus. All scans were performed abdominally by the use of GE (voluson E6) ultrasound via a transabdominal curvilinear probe with a 3.5 MHZ frequency.

Data from the study subjects were dedicated on the age, gravidity, parity, GA based on menstrual history and/or first-trimester ultrasound, LP, thickness of myometrium, i.e. LSMT, AMT, PMT and FMT. The thickness of the myometrium was measured between the serosa and decidua. For determination of LSMT, the ultrasound probe was positioned about 2 cm above the urinary bladder reflection anteriorly; for AMT the probe was positioned 1cm above the maternal umbilicus; for FMT the probe was positioned so that the total fundal curvature could be recognizable. The PMT was determined where the maternal pulse of the aorta was detected. During follow-up, all patients received prophylactic antibiotics and steroids for enhancement of lung maturity. Maternal monitoring was performed clinically and by laboratory investigations, including complete blood counts and C-reactive protein. Fetal monitoring was accomplished regularly including daily non-stress test, twice-weekly biophysical profile, and fetal heart rate monitoring four times a day. Digital vaginal examination and tocolytics were avoided. However, if the patient complained of pain and contractions, she could be fully assessed to identify the start of labour. LP was defined from the time of membrane rupture until the start of the spontaneous labour.

STATISTICAL ANALYSIS

Statistical analysis was done by using SPSS version 20. Independent sample T-test, Pearson's correlation coefficient and receiver operator curve (ROC) were used as needed. A P value of <0.05 was set as significant.

RESULTS

As the final analysis of data involved 84 patients with PPROM and oligohydramnios, Tab. (1) shows the demographic characteristics of those patients. The descriptive data of the mean, minimum, maximum thickness of myometrium at the lower uterine segment, fundus, and the anterior wall and posterior wall of the uterus were shown in Tab. (2). Pearson’s correlation between the LP and the thickness of myometrium at different parts of the uterus was estimated as seen in Tab. (3). There were significant positive correlations between the LP and LMST, AMT, PMT and FMT, as P= 0.01, 0.001, 0.036 and 0.041 respectively. The sensitivity and specificity of measurement of the thickness myometrium at different parts of the uterus for the prediction of the LP >7 days were

determined by the ROC curve analysis as seen in Fig. (1) and Tab. (4). Area under the curve (AUC) for anterior (AMT), posterior (PMT), fundal (FMT) parts and the lower segment (LSMT) of the uterus were 0.700, 0.602, 0.566 and 0.629 respectively.

Table (1): Demographic characteristics of the patients enrolled in the study.

Characteristic	Mean	Minimum	Maximum	SD
Age/years	28.66	20	35	±6.34
Gravidity	3.53	1	10	±2.98
Parity	1.81	0	8	±1.53
GA*/weeks	31.28	26	34	±3.88
AFI*	2.36	1	4	±1.7
LP */days	8.34	1	19	±1.1

* GA= gestational age, AFI= amniotic fluid index, LP= latent period.

Table (2): The measurements of the thickness of myometrium at different parts of uterus.

Thickness of myometrium /mm	Mean	Minimum	Maximum	SD
LSMT*	7.25	5.2	11.3	±2.31
AMT*	7.87	5.4	12.5	±3.45
PMT*	8.71	5.6	14.8	±3.88
FMT*	8.65	5.9	13.7	±3.72

* LSMT= lower segment myometrial-thickness, AMT= anterior myometrial-thickness, PMT=posterior myometrial-thickness and FMT= fundal myometrial-thickness.

Table (3): The correlation between the thicknesses of myometrium at different parts of the uterus with the LP.

Thickness of myometrium /mm	r	P value
LSMT*	0.64	0.01
AMT*	0.71	0.001
PMT*	0.38	0.036
FMT*	0.56	0.041

* LSMT= lower segment myometrial-thickness, AMT= anterior myometrial-thickness, PMT= posterior myometrial-thickness and FMT= fundal myometrial-thickness, r=Pearson's correlation coefficient.

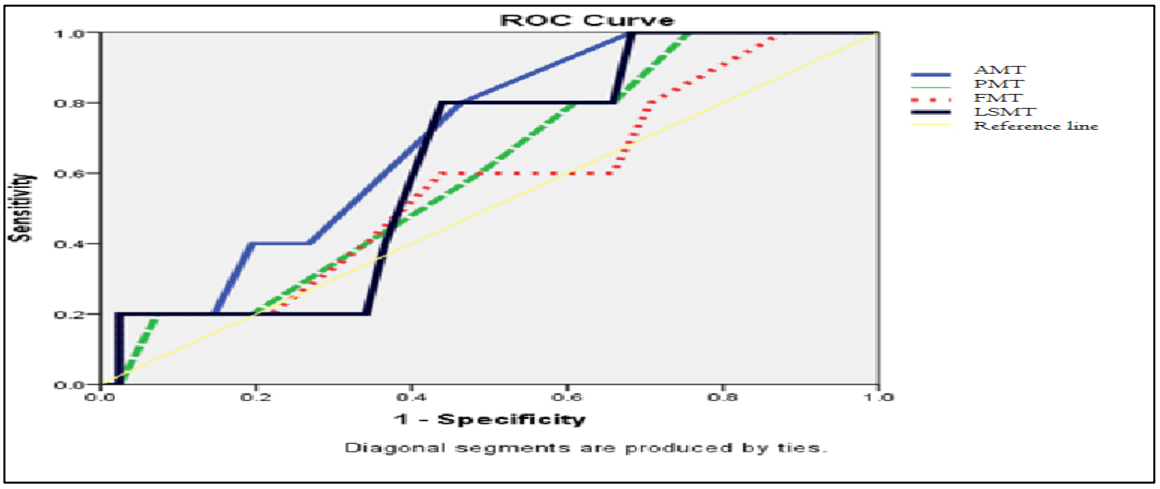

Figure (1): ROC curve represents the sensitivity and specificity of measurement of the thickness of myometrium and area under the curve (AUC) at different parts of uterus for patients whose LP was >7 days.

Table (4): Sensitivity and specificity for detection of LP >7 days.

	AMT	PMT	FMT	LSMT
Sensitivity	80%	80%	60%	80%
Specificity	53.7%	34.1%	34.1%	43.9%
Thickness of myometrium/mm	6.5	6.5	7.5	7.5
LP/ days	>7	>7	>7	>7

DISCUSSION

Several predictors have been investigated for their role in the assessment of spontaneous labour time in PPROM. None of these studied factors was found to be of reasonable predictive power. The focus of current study is to find practical, easy and available ultrasound-based measures that might be helpful in predicting the LP. One of these measures is to estimate the thickness of myometrium and to find out its relationship with the duration of LP. Although several studies have revealed a positive correlation between the thickness of myometrium and the length of LP, there is a paucity of data regarding sensitivity and specificity of this measure to predict the LP [11, 14, 15].

In this study, the mean thickness of myometrium at lower segment (LSMT), anterior (AMT), posterior (PMT) and fundal (FMT) parts of the uterus were found to be 7.25±2.31, 7.87±3.45, 8.71±3.88 and 8.65±3.72 mm respectively. These findings were comparable to those found by Hamdi et al [16] who found out AMT, PMT and FMT to be 8.23 ±2.59, 8.9 ±2.86, and 9.1±3.54 mm respectively. Atarjavadan et al [17] and Gupta et al [18] also found similar ranges. However, the mean AMT, PMT and FMT were found to be higher in a previous study done by Buhimschi's et al [11] which were10. 6 ±0.6, 9.6 ±0.6 and10.7 ±0.7 mm respectively while they were found to be lower in Kalantari's et al [15] study, i.e. 6.5 ±1.5, 6.5 ±1.7, 7.9±2.4 mm

respectively. A small sample size, as in Kalantari's et al [15] study which included 24 PPROM patients only, and the use of 5.5-7.7 MHz probe frequency, as in Buhimschi's et al [11] study, might explain these differences.

Comparing the demographic data of the current study with that of previous studies revealed that the mean maternal age here was 28.66 ± 6.34 years, as in Tab. (1), while it was 29.2 ± 1.2 in Buhimschi et al's [11] study, 28.9 ±5.1 years in kalantari et al's [15], 27.2 ± 4.9 in Hamdi et al's [16], 27.9 ± 4.7 in Atarjavdan et al [17], 26.2± 4.9 mm in Gupta et al's [18] and 29.44±6.1 in Elshikh's [19]. Nevertheless, no association between the maternal age and the thickness of myometrium was found in the previous studies [14-17].

The mean gravidity and parity in the current study were 3.35, ranging from 1-10, and 1.81, ranging from 0-8, respectively. Previous studies had involved patients with different ranges of gravidity and parity [14-17]. However, no relationship was found on review of the literature between gravidity or parity and the thickness of myometrium or LP [17].

The mean gestation age in this study was 31.28±3.88 weeks, as seen in Tab.(1), while the mean gestation age was 29.5 weeks in Buhimschi's [11] study, 29.1 weeks in Kalantari's [15], 30.6 weeks in Hamdi's [16], 28.6 in Atarjavdan et al's [17] and 32 weeks in Gupta et al's [18]. These differences might explain difference in the results.

A significant positive correlation between the thickness of myometrium at the lower segment, anterior, posterior and fundal parts of the uterus and LP was evident in this study as seen in Tab. (3). These findings were consistent with the findings of Buhimschi et al's [11], and Elshikh's [19]. In contrary, the findings of Kalantari et al [15], Hamdi et al [16] and Naleini et al [20] had revealed no association between the thickness of myometrium and LP. Atarjavdan et al [17] found a significant positive correlation between the thickness of the myometrium at the anterior wall, fundus and lower uterine segment in patients with GA below 30 weeks while no such association was revealed in those with GA of 30 weeks and more. Finally, Gupta et al [18] found a significant positive correlation between the thickness of myometrium at the anterior wall and lower uterine segment whereas no significant correlation was found in the posterior and fundal myometrium.

The current data has revealed that the sensitivity and specificity of measuring AMT for prediction of LP > 7 days were 80% and 53% and those for PFT were 80% and 34.1% respectively at a cut-off point of 6.5 mm while the FMT is found to be 60% sensitive and 34.1% specific and LSMT was 80% sensitive and 43.9% specific respectively for recognition of LP > 7 days at a cut-off point of 7.5mm.

There were two previous studies that estimated the sensitivity and specificity of measuring the thickness of myometrium for the prediction of LP. In a study performed by Atarjavadan [17], FMT was 79% sensitive and 39% specific for prediction of LP >8 days at a cut-off point of 6.9 mm, AMT was found to be 89% specific and 42% specific at a cut-off point of 5.5 mm and LSMT was 89% sensitive and 85% specific for prediction of LP >8 days at a cut-off point of 7.35 mm respectively.

Buhimschi et al [11] found that the thickness of fundal myometrium (FMT) was 89%sensitive and 62.5% specific for prediction of LP > 7 days at a cut-off point of 12.6 mm.

CONCLUSIONS

The thickness of the myometrium at the lower segment, fundus, anterior and posterior parts of the uterus might be sensitive but not specific for prediction of LP > 7 days.

RECOMMENDATIONS

These data might be helpful in counseling and to optimize the management of patients with PPROM. Further studies are needed to confirm these results and to find better predictors of LP in patients with PPROM.

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