International Journal of Clinical Obstetrics and Gynaecology

ISSN (P): 2522-6614
ISSN (E): 2522-6622

www.gynaecologyjournal.com
2024; 8(4): 178-184
Received: 02-05-2024
Accepted: 07-06-2024

Randa Gamal Al-Hadad
Department of Obstetrics and Gynecology, Faculty of Medicine, Tanta University, Tanta, Egypt

Sherin Barakat Elbhoty
Department of Obstetrics and Gynecology, Faculty of Medicine, Tanta University, Tanta, Egypt

Walid Mamdouh Atallah
Department of Obstetrics and Gynecology, Faculty of Medicine, Tanta University, Tanta, Egypt

Amal Elsayed Badran
Department of Obstetrics and Gynecology, Faculty of Medicine, Tanta University, Tanta, Egypt

Corresponding Author:
Randa Gamal Al-Hadad
Department of Obstetrics and Gynecology, Faculty of Medicine, Tanta University, Tanta, Egypt

Prediction of latency in preterm premature rupture of membrane by using measurement of myometrial thickness by ultrasound

Randa Gamal Al-Hadad, Sherin Barakat Elbhoty, Walid Mamdouh Atallah and Amal Elsayed Badran

DOI: https://doi.org/10.33545/gynae.2024.v8.i4c.1494

Abstract
Background: The measurement of myometrial thickness by ultrasound may be helpful in the management of pregnancy with preterm premature rupture of membranes (PPROM) and threatened preterm labor. The aim of this work was to assess the value of myometrial thickness measurement as a method in prediction of latency period in women with PPROM till delivery.
Methods: This case control study was carried out on 120 pregnant women aged from 20 to 35 years old, gestational age (GA) between 28 to 36 weeks, singleton pregnancy with premature rupture of membrane. Patients were divided into two equal groups: Group A: PPROM and were subdivided into four subgroups according to GA: [Group A1: 28 to 29 week +6 days, group A2: 30-to-31-week +6 days, group A3: 32 to 33 week +6 days and group A4: 34 to 36 week] and group B: normal pregnancy as control which subdivided into four subgroups according to GA: [Group B1: 28 to 29 week +6 days, group B2: 30 to 31 week +6 days, group B3: 32 to 33 week +6 days and group B4: 34 to 36 week].
Results: Fundal myometrial thickness and anterior wall myometrial thickness were significantly lower in group A1, A2, A3 and A4 than group B1, B2, B3 and B4 (p<0.001). Anterior wall myometrial thickness and fundal myometrial thickness can significantly predict labor (p<0.001). Posterior wall myometrial thickness can't predict labor (P =0.596, 0.400).
Conclusions: PPROM is associated with decreased thickness of anterior wall and fundal myometrial thickness. Anterior wall and fundal myometrial thickness measurement can predict labor and their thickness are increased with latency period.

Keywords: Prediction, latency, preterm premature rupture of membrane, myometrial thickness, ultrasound

Introduction
Preterm premature rupture of membranes (PPROM) and preterm delivery pose significant obstetric difficulties [1]. Predicting when a patient with PPROM is likely to go into labor is the primary challenge for an obstetrician managing the patient, particularly in expectant management situations [2, 3]. The time for fetal lung maturity is provided by expectant management, but there is a danger of infection for both the mother and the child [4].
Premature Rupture of Membranes (PROM) [5, 6] is defined as rupture of the amniotic fluid membrane prior to the beginning of uterine contractions or labor; this condition, known as PPROM, occurs before 37 full weeks and accounts for about one-third of all premature births. Over 90% of pregnant women who have PPROM before 34 weeks of gestation give birth within one week. PPROM is a major contributor to both illness and death among newborns.
The actual cause of PPROM is unknown [5], But there are several risk factors associated with this condition. Some of these risk factors are maternal in nature, such as a previous history of PPROM in a prior pregnancy, direct abdominal trauma, and cigarette smoking. Other risk factors are related to the uterus and placenta, such as uterine anomalies like a uterine septum, placental abruption, uterine overdistension as seen in cases of polyhydramnios and multiple pregnancy, and intra-amniotic infection (chorioamnionitis).
PPROM is characterized by a short period of time between the rupture of membranes and birth, which becomes shorter as the gestational age (GA) decreases. Since neonatal health problems are closely associated with the gestational age (GA) at birth, various approaches are frequently used to prolong the time before delivery for pregnancies that could benefit from the delay [4].
PPROM is characterized by a short period of time between the rupture of membranes and birth,

[6] which becomes shorter as the gestational age (GA) decreases. [7] Since neonatal health problems are closely linked to the gestational age (GA) at birth, methods to prolong the time before delivery are frequently used for pregnancies that could benefit from delaying childbirth [8]. PPROM is linked to various variables that contribute to fetal morbidity and mortality. [9], Chorioamnionitis, along with advanced labor and non-reassuring fetal condition, typically causes the clinician to continue with delivery, even if the fetus is not fully developed [10].

The objective of this study was to evaluate the utility of measuring myometrial thickness as a predictive tool for determining the latency period in women with PPROM until delivery.

Patients and Methods

This case-control study was conducted on a cohort of 120 pregnant women, aged between 20 and 35 years old, with GA ranging from 28 to 36 weeks. The study specifically focused on women with singleton pregnancies who experienced early rupture of membranes. The study was conducted between November 2021 and December 2023, following approval from the Ethical Committee of Tanta University Hospitals in Tanta, Egypt. The patients provided their informed written permission.

The exclusion criteria included fetal defects, any further medical or obstetric complications in the mother necessitating immediate delivery, any contraindications for maintaining the course of pregnancy, and patients who were already in labor upon their arrival at the hospital.

The patients were allocated into two groups of equal size: Group A: PPROM and were subdivided into four subgroups according to GA: [Group A1: 28 to 29 week +6 days, group A2: 30-to-31-week +6 days, group A3: 32 to 33 week +6 days and group A4: 34 to 36 week] and group B: normal pregnancy as control group and were subdivided into four subgroups according to GA: [Group B1: 28 to 29 week +6 days, group B2: 30 to 31 week +6 days, group B3: 32 to 33 week +6 days and group B4: 34 to 36 week].

Each subgroup in group A was compared to the corresponding one in group B regarding myometrial thickness as the myometrial thickness differs according to GA.

Each patient underwent a thorough history taking, a general examination, laboratory testing (complete blood count; CBC, CRP), and radiographic testing (2D ultrasound).

PPROM was confirmed by sudden gush of fluid from vagina, pelvic examination by sterile speculum observed amniotic fluid escaping from external OS, ultrasound: demonstrating oligohydramnios and in the case of chorioamnionitis offensive discharge, uterine tenderness, elevation of total leucocytic count, temperature, and CRP.

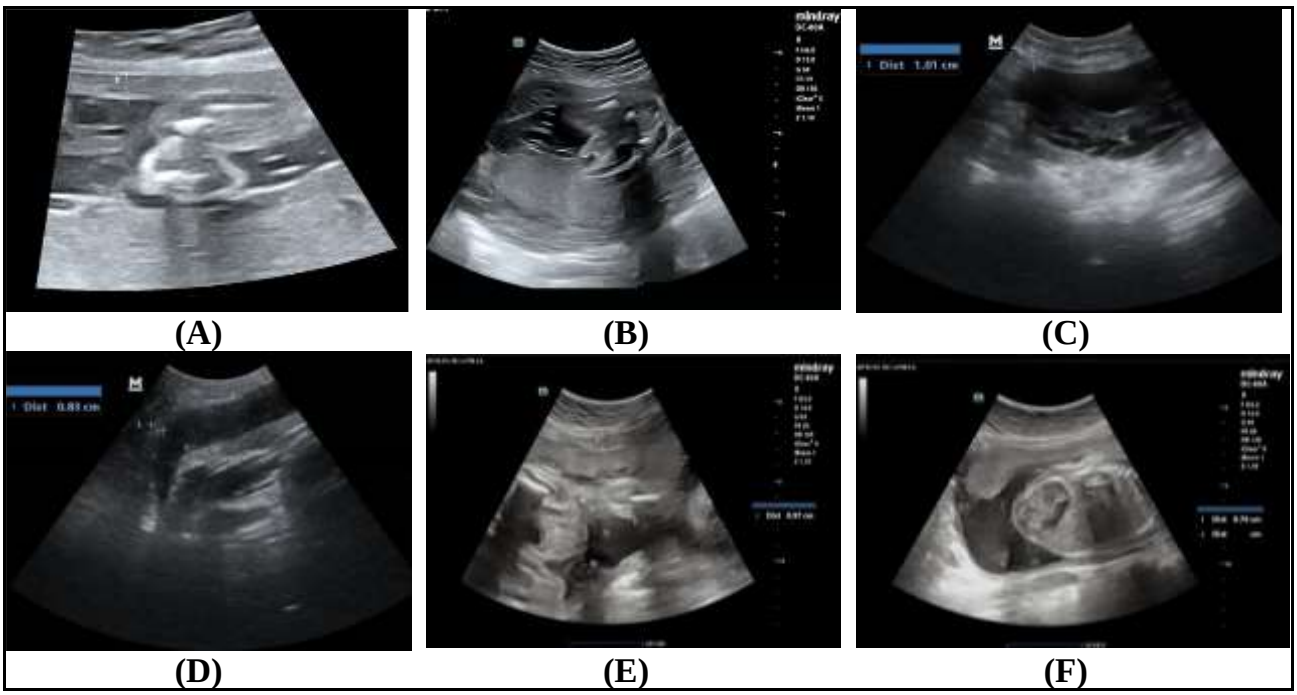
Follow up of PPROM

Daily fetal movement, temperature, offensive discharge, uterine tenderness, chorioamnionitis, two dimensional US, non-stress test, CRP and total Leukocytic count.

All patients with PPROM were received ampicillin 1gm/6hrs for 48hrs then erythromycin 250mg/6hrs for 10 days and 2 repeated doses of Betamethasone 12 mg IM/ 24 hours.

Technique of measurement of myometrial thickness

Two-dimensional pelvis abdominal ultrasound was done to all patients within 24 hours from PPROM and follow up ultrasound was done every week till labor. The following data were assessed by ultrasound examination [Amniotic fluid index, placental localization and fetal biometry]. The measurement of myometrial thickness was conducted in three particular areas. The myometrial thickness refers to the echogenic and uniform layer located between the serosa and decidua. [Mid anterior uterine wall, uterine fundus: Measurement was done by maintaining the scan probe above the fundus, and posterior uterine wall: Anatomical mark was established by using the mother's abdomen aortic pulsation]. Figure 1.



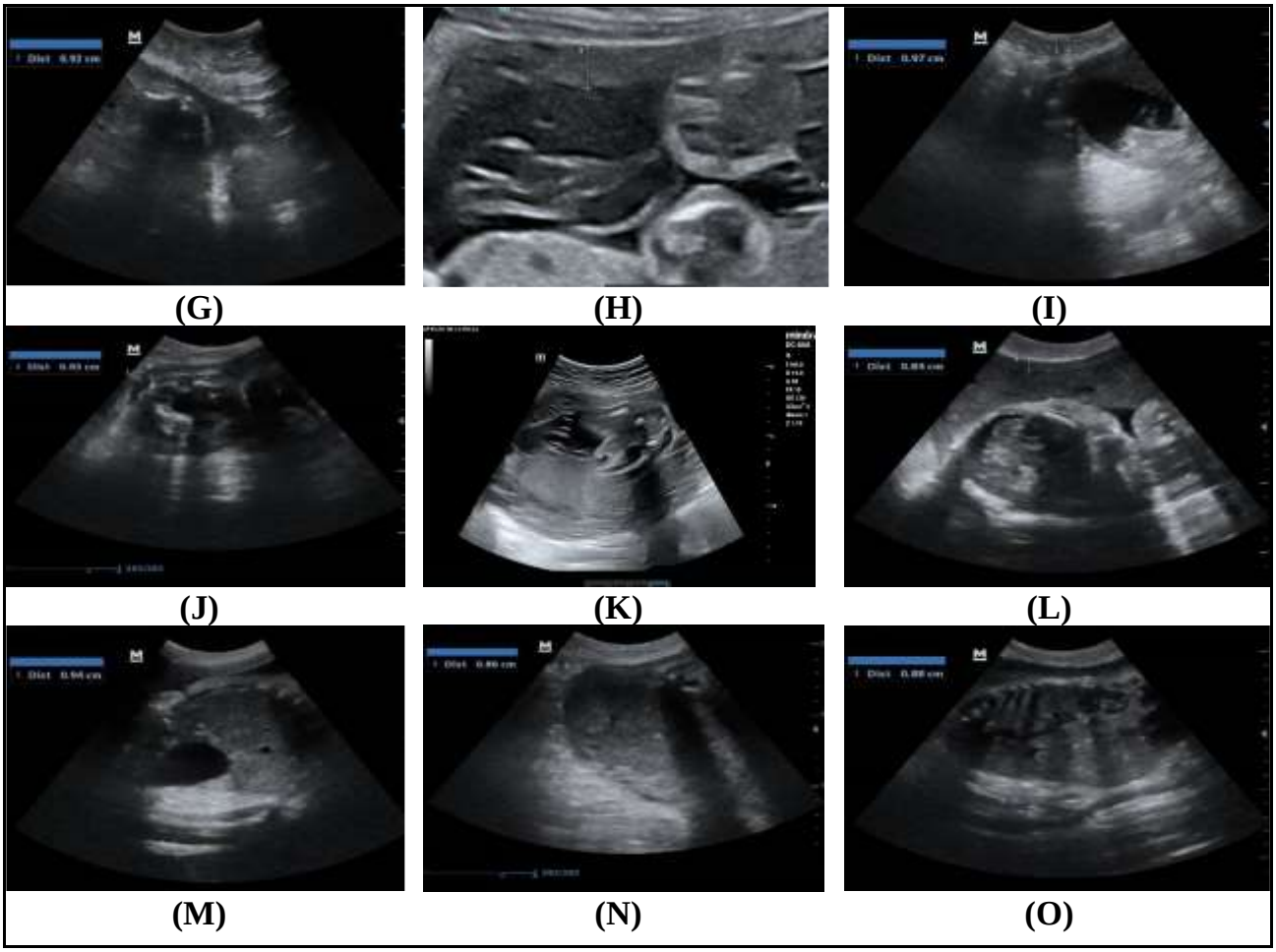


Fig 1: Ultrasound showing the measurement of anterior MT (A) Group A1, (B) Group B1 with gestational age 28 weeks, (G) Group B2, (H) Group A2 with gestational age 30 weeks, (K) Group A3, (L) Group B 3 with gestational age 32 weeks, fundal MT (C) Group B1, (D) Group A1 with gestational age 28 weeks, (I) Group B2, (J) Group A2 with gestational age 30 weeks,(M) Group A3, (N) Group B3 with gestational age 32 weeks, (E) MT at anterior, (F) MT at fundus, (O) posterior MT (Group A3) with gestational age 32 weeks

PPROM may be complicated with oligohydramnios, prematurity, chorioamnionitis and increased perinatal mortality rate.

Sample Size Calculation

The Epi-Info software statistical program, developed by the WHO and the Centers for Disease Control and Prevention in Atlanta, Georgia, USA, is being used in its 2002 edition. The calculation of the sample size was based on the following criteria: [95% confidence interval]. The sensitivity of latency period prediction in preterm rupture of membranes using ultrasound-based myometrium thickness assessment at 65% with a 10% margin of error. The sample size, determined by the aforementioned criteria, was found to be greater than 87 (N>87). The sample size was increased to 120 in order to account for any missing information and enhance the data quality of the study.

Statistical analysis

For the statistical analysis, the software program SPSS v27 (IBM, Armonk, New York, United States) was utilized. Histograms and the Shapiro-Wilks test were utilized in order to determine whether or not the data distribution in question was normal. The statistical analysis made use of an unpaired Student's t-test to analyze the quantitative parametric data, which were presented in the form of the mean and the standard deviation (SD). Using the median and the interquartile range (IQR), the quantitative non-parametric data were given, and the Mann Whitney test was used to evaluate the data. The qualitative variables were analyzed using either the Chi-square test or Fisher's exact test, depending on the specifics of the situation. The results of the analysis were presented in the form of frequency and percentage (%). To be considered statistically significant, a two-tailed P value that was lower than 0.05 was required.

Results

The variables of age, gestational age, body mass index (BMI), parity, obstetrical history, and posterior wall myometrial thickness showed no significant differences between group A1 and B1, as well as between group A2 and B2. The fundal myometrial thickness and anterior wall myometrial thickness were considerably reduced in group A1 and A2 compared to group B1 and B2 (p<0.001). The gestational age (GA) of group A1 was 30.4±0.9 weeks, while the GA of group A2 was 32.3±0.59 weeks. Table 1.

Table 1: Demographic data, obstetrical history and myometrial thickness measurements within 24h from PROM of (group A1 and B1), (group A2 and B2) and GA at labor of group A1, A2

		Group A1(n=15)	Group B1(n=15)	P
Age (years)		26.7±3.67	28.5±3.74	0.194
GA (weeks)		28.5±0.52	28.4±0.51	0.724
BMI (kg/m^2)		24.9±1.44	25.5±2.1	0.424
Parity		0.8±0.86	1.1±0.74	0.266
Obstetrical history	Primigravida	6 (40%)	3 (20%)	0.260
	Previous CS	6 (40%)	5 (33.33%)	
	NVD	3 (20%)	7 (46.67%)	
Fundal myometrial thickness (mm)		7.6±1.2	10.4±0.44	<0.001*
Anterior myometrial thickness (mm)		7.3±0.78	9.3±0.37	<0.001*
Posterior myometrial thickness (mm)		11.1±0.13	11.1±0.14	0.820
GA at labour (weeks)		30,4±0.9	--	--
		Group A2(n=15)	Group B2 (n=15)	P
Age (years)		26.9±3.4	29.1±3.76	0.094
GA (weeks)		30.5±0.52	30.4±0.51	0.724
BMI (kg/m^2)		25.9±1.39	25.9±1.62	1.000
Parity		1.2±0.94	1.3±1.1	0.860
Obstetrical history	Primigravida	3 (20%)	5 (33.33%)	0.727
	Previous CS	2 (13.33%)	3 (20%)	
	NVD	5 (33.33%)	4 (26.67%)	
Fundal myometrial thickness (mm)		7.6±0.99	9.8±0.59	<0.001*
Anterior myometrial thickness (mm)		6.9±0.7	9.1±0.52	<0.001*
Posterior myometrial thickness (mm)		10.93±0.34	10.77±0.13	0.096
GA at labour (weeks)		32,3d±0.59	--	--

Data are presented as mean±SD or frequency (%). * Significant as P value ≤0.05. BMI: Body mass index. CS: Cesarean section, NVD: Normal vaginal delivery, GA: Gestational age.

Relationship between latency period and myometrial thickness of group A1 and A2 within 24 h from PPROM were explained in this table. Table 2.

Table 2: Relationship between latency period and myometrial thickness of group A1 and A2 within 24 h from PPROM

	Anterior myometrial thickness	Fundal myometrial thickness
Group A1		
<1 day n= 2 (13.3%)	6.6±0.5	5.7±0.3
1-3 days n= 4 (26.6%)	6.7±0.62	7.2±1.22
3-7 days n= 3 (20%)	7.1±0.2	7.6±0.41
7-14 days n= 3 (20%)	7.7±0.14	8.2±0.89
>14 days n= 3 (20%)	8.5±0.32	8.8±0.3
Group A2		
<1 day n= 2 (13.3%)	5.9±0.05	6.6±0.14
1-3 days n= 4 (26.6%)	6.4±0.52	6.7±0.5
3-7 days n= 3 (20%)	6.7±0.13	7.8±0.95
7-14 days n= 3 (20%)	7.3±0.05	8.5±0.4
>14 days n= 3 (20%)	7.8±0.37	8.5±0.31

Data are presented as mean±SD. PPROM: Preterm premature rupture of membranes.

The thickness of the anterior wall myometrium and the thickness of the fundal myometrium are strong predictors of labor, with a significant correlation (p<0.001) and high AUC values of 0.989 and 0.996, respectively for the anterior wall myometrial thickness, and 0.987 and 0.954, respectively for the fundal myometrial thickness. Posterior wall myometrial thickness can't predict labor (P =0.596, 0.400 and AUC = 0.558, 0.602). Figure 2.

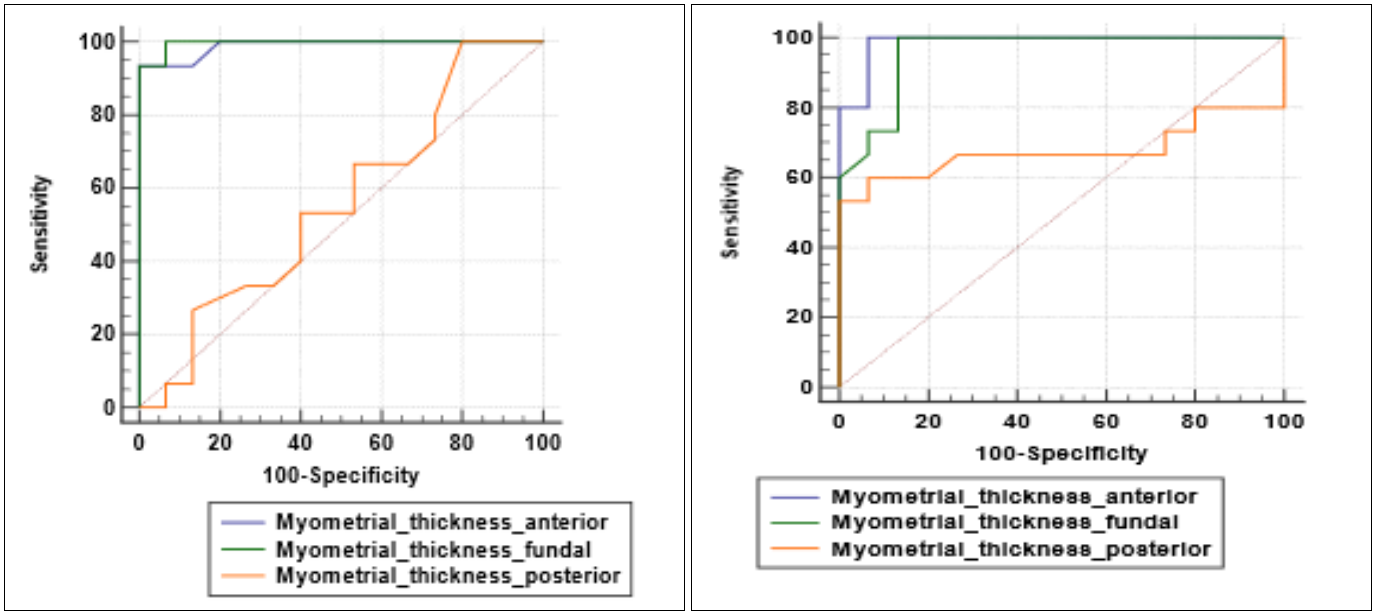


Fig 2: ROC curve of myometrial thickness in prediction of labor

There were no significant differences in age, gestational age, BMI, parity, obstetrical history, and posterior wall myometrial thickness between group A3 and B3, as well as between group A4 and B4. The fundal myometrial thickness and anterior wall myometrial thickness were considerably reduced in group A3 and A4 compared to group B3 and B4 (p<0.001). The mean of GA in A3 and A4 respectively was 33, 6 days±0.47 and 35,1±0.31 weeks. Table 3.

Table 3: Demographic data, obstetrical history and myometrial thickness measurements within 24h from PROM of (group A3 and B3), (group A4 and B4) and GA at labor of group A3, A4

		Group A3(n=15)	Group B3(n=15)	P
Age (years)		27±2.73	27.5±3.58	0.691
GA (weeks)		32.4±0.51	32.3±0.46	0.456
BMI (kg/m^2)		25.5±1.73	25.7±2.09	0.777
Parity		1.5±0.92	1.3±0.9	0.691
Obstetrical history	Primigravida	2 (13.33%)	3 (20%)	0.541
	Previous CS	5 (33.33%)	7 (46.67%)	
	NVD	8 (53.33%)	5 (33.33%)	
Fundal myometrial thickness (mm)		7.2±1.11	8.9±0.72	<0.001*
Anterior myometrial thickness (mm)		7.01±0.86	8.7±0.45	<0.001*
Posterior myometrial thickness (mm)		10.1±0.17	10.1±0.21	0.721
GA at labour (weeks)		33,6±0.47	--	--
		Group A4(n=15)	Group B4 (n=15)	P
Age (years)		27.1±2.88	29.4±3.54	0.065
GA (weeks)		34.5±0.52	34.9±0.88	0.088
BMI (kg/m^2)		25.7±1.39	25.8±2.01	0.916
Parity		1±0.65	1.5±0.64	0.058
Obstetrical history	Primigravida	1 (6.67%)	4 (26.67%)	0.287
	Previous CS	6 (40%)	6 (40%)	
	NVD	5 (33.33%)	8 (53.33%)	
Fundal myometrial thickness (mm)		5.9±0.95	8.5±0.25	<0.001*
Anterior myometrial thickness (mm)		6.5±0.7	7.8±0.46	<0.001*
Posterior myometrial thickness (mm)		9.04±0.07	9±0.06	0.721
GA at labour (weeks)		35,1±0.31	--	--

Data are presented as mean±SD or frequency (%). * Significant as P value ≤0.05. BMI: Body mass index. CS: Cesarean section, NVD: Normal vaginal delivery, GA: Gestational age.

Relationship between latency period and myometrial thickness of group A3 and A4 within 24 h from PPROM were explained in this table. Table 2.

Table 4: Relationship between latency period and myometrial thickness of group A3 and A4 within 24 h from PPROM

	Anterior myometrial thickness	Fundal myometrial thickness
Group A3		
<1 day n= 2 (13.3%)	6.1±0.16	5.2±0.28
1-3 days n= 4 (26.6%)	6.4±0.31	6.7±0.86
3-7 days n= 3 (20%)	6.7±0.07	7.3±0.61
7-14 days n= 3 (20%)	7.5±0.87	8±0.16
>14 days n= 3 (20%)	8.2±0.13	8.3±0.27
Group A4		
<1 day n= 2 (13.3%)	5.8±0.17	4.6±0.16
1-3 days n= 4 (26.6%)	6.1±0.3	5.4±0.52
3-7 days n= 3 (20%)	6.2±0.21	5.6±0.39
7-14 days n= 3 (20%)	6.7±0.37	6.6±0.08
>14 days n= 3 (20%)	7.6±0.43	7.2±0.36

Data are presented as mean±SD. PPROM: Preterm premature rupture of membranes.

Myometrial thickness of anterior wall and fundus can significantly predict labor (p<0.001 and (AUC = 0.933 and 0.889 and 0.920 and 0.982). Myometrial thickness posterior can't predict labor (P =0.815, 0.179 and AUC = 0.527 and 0.642). Figure 3.

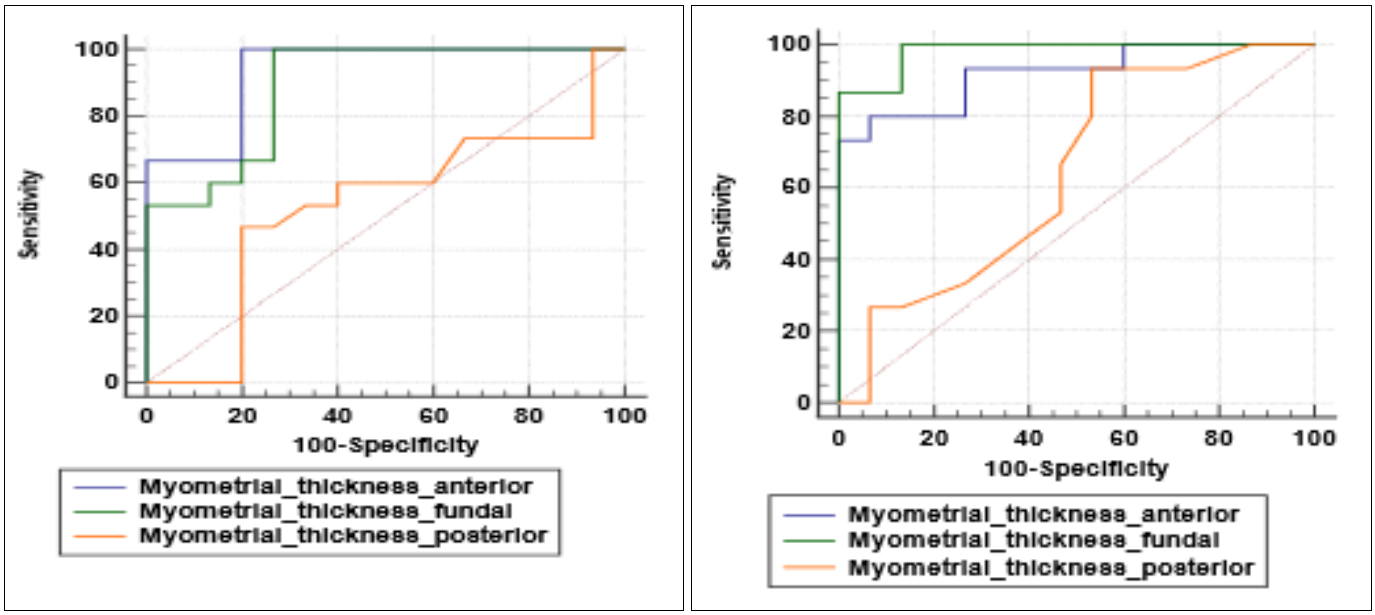


Fig 3: ROC curve of myometrial thickness in prediction of labor

Discussion

PPROM refers to foetal membrane rupture that occurs before the start of labour and before 37 weeks of gestation [11]. Three percent of pregnancies are complicated by PPROM, which is also a factor in one-third of preterm births. There is an increase in the probability of foetal death by 1 to 2 percent, along with a variety of additional perinatal and neonatal problems. A bigger risk is preterm delivery [12].

Our study showed that myometrial thickness anterior and fundal measurements were significantly lower in PPROM groups than control in the four comparison groups. Myometrial thickness posterior measurements were insignificantly different among PPROM and control groups in the four comparison groups.

The current study showed that anterior myometrial thickness and fundal myometrial thickness were thicker with prolonged latency period in groups A1, A2, A3, and A4.

These current results showed the relationship between latency period and myometrial thickness of group A1, A2, A3 and A4 within 24 h from PPROM.

The current study demonstrated that the thickness of the anterior wall myometrium and the thickness of the fundal myometrium are strong predictors of labor. The statistical analysis revealed a significant correlation between these variables and labor (p<0.001). The area under the curve (AUC) values for the anterior wall myometrial thickness were 0.989 and 0.996, while the AUC values for the fundal myometrial thickness were 0.987 and 0.954. Posterior wall myometrial thickness can't predict labor (P =0.596, 0.400 and AUC = 0.558, 0.602). Myometrial thickness of anterior wall and fundus can significantly predict labor (p<0.001 and (AUC = 0.933 and 0.889 and 0.920 and 0.982). Myometrial thickness posterior can't predict labor (P =0.815, 0.179 and AUC = 0.527 and 0.642).

A similar study was conducted by Singh *et al*. [13] showed There was no statistically significant difference observed between various groups and their corresponding controls in terms of age, which aligns with the findings of our study [13]. Another study was carried out by Sokkary *et al*. [14] reported that the anterior myometrial thickness was lower in the PROM group compared to the control group.

Additionally, they stated that the best cutoff values for the prediction of the latency interval were: cervical length, which was ≤2.69 with sensitivity 78% and specificity 77%; amniotic fluid index, which was ≤8.5 with sensitivity 89% and specificity 77%; fundal myometrial thickness, which was ≤7.6 with

sensitivity 78% and specificity 76%; posterior myometrial thickness, which was ≤ 5.8mm with 65% and 65%; and LUS myometrial thickness, which was ≤4.5mm with sensitivity 100% and specificity 61%. Hamdi *et al.* [15] reported no statistically significant difference between both groups regarding baseline data. Similar to our findings, Singh *et al.* [13] showed that anterior and fundal myometrial thickness were higher with prolonged latency period. Similar to our findings, Sokkary *et al.* [14] observed There was no statistically significant difference observed between the group of cases and controls in terms of age, maternal weight, gravidity, parity, and number of previous abortions.

The study was limited by its relatively small sample size. Correlation tests were not conducted.

Conclusions

PPROM is associated with decreased thickness of anterior wall and fundal myometrial thickness. Anterior wall and fundal myometrial thickness measurement can predict labor and their thickness are increased with latency period.

Conflict of Interest

Not available

Financial Support

Not available

References

1. Skrypchenko NY, Lozova LA. Analysis of cases of premature rupture of membranes and preterm births to identify effective management measures to prevent them. Wiadomosci Lekarskie. 2024;25:214-224.
2. Pettke M. Prelabor rupture of membranes: ACOG practice bulletin, number 217. Obstetrics & Gynecology. 2020;135:80-97.
3. Bond DM, Middleton P, Levett KM, van der Ham DP, Crowther CA, Buchanan SL, *et al*. Planned early birth versus expectant management for women with preterm prelabour rupture of membranes prior to 37 weeks' gestation for improving pregnancy outcome. Cochrane Database of Systematic Reviews. 2017;30:2-10.
4. Goya M, Bernabeu A, García N, Plata J, Gonzalez F, Merced C, *et al*. Premature rupture of membranes before 34 weeks managed expectantly: maternal and perinatal outcomes in singletons. The Journal of Maternal-Fetal & Neonatal Medicine. 2013;26:290-293.
5. Practice bulletin No. 172: premature rupture of membranes. Obstetrics & Gynecology. 2016;128:165-177.
6. Lorthe E. [Epidemiology, risk factors and child prognosis: CNGOF Preterm Premature Rupture of Membranes Guidelines]. Gynécologie Obstétrique Fertilité & Sénologie. 2018;46:1004-1021.
7. Atarjavdan L, Khazaeipour Z, Shahbazi F. Correlation of myometrial thickness and the latency interval of women with preterm premature rupture of the membranes. Archives of Gynecology and Obstetrics. 2011;284:1339-1343.
8. Gupta R, Nagarsenkar A. Using sonographically estimated myometrial thickness in prediction of latency interval in cases of preterm premature rupture of membranes (PPROM). The Journal of Obstetrics and Gynecology of India. 2016;66:431-435.
9. Kim CJ, Romero R, Chaemsaithong P, Chaiyasit N, Yoon BH, Kim YM. Acute chorioamnionitis and funisitis: definition, pathologic features, and clinical significance. American Journal of Obstetrics & Gynecology. 2015;213:29-52.
10. Ocviyanti D, Wahono WT. Risk factors for neonatal sepsis in pregnant women with premature rupture of the membrane. Journal of Pregnancy. 2018;2018:3-15.
11. Caughey AB, Robinson JN, Norwitz ER. Contemporary diagnosis and management of preterm premature rupture of membranes. Reviews in Obstetrics and Gynecology. 2008;14:11-22.
12. Nossair WS. Relationship between myometrial thickness and latency interval of pregnancy after preterm premature rupture of membranes. International Journal of Reproduction, Contraception, Obstetrics and Gynecology. 2021;10:2932-2937.
13. Singh S, Sharma R, Gupta N, Suneja A. Sonographic evaluation of myometrial thickness at different gestations for prediction of labor in preterm premature rupture of membranes. South Asian Federation of Obstetrics and Gynecology. 2021;13:415-421.
14. Sokkary F, Nassef A, Zidan M. Prediction of latency interval of labour in preterm premature rupture of membranes by 2D ultrasound: Case control study. Evidence-Based Women's Health Journal. 2020;10:79-88.
15. Hamdi K, Bastani P, Saheb-Madarek EO, Hosseini H. Prediction of latency interval in preterm premature rupture of membranes using sonographic myometrial thickness. Pakistan Journal of Biological Sciences. 2010;130:841-846.

How to Cite This Article
Al-Hadad RG, Elbhoty SB, Atallah WM, Badran AE. Prediction of latency in preterm premature rupture of membrane by using measurement of myometrial thickness by ultrasound. International Journal of Clinical Obstetrics and Gynaecology. 2024;8(4):178-184.