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A Comparative Study on The Patients Outcome with Preterm Premature Rupture of Hyperechoic and Normo Echoic Amniotic Membranes Regarding Pregnancy

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ABSTRACT

In pregnant women who exhibit amniotic fluid leaking, assess the amniotic membrane echogenicity as a predictor of an early birth. From March 2021 to March 2022, this prospective cohort research was conducted at , Department of obstetrics and gynecology,TS Misra Medical college, Lucknow Uttar pradesh India . 72 pregnant women with singleton pregnancies who had preterm amniotic fluid leaks and were between the ages of 18 and 50 were recruited for the research. Between 28 and 37 weeks was the gestational age. The study used transvaginal ultrasonography to assess the amniotic membranes' sonographic appearance near the internal os. We classified the membranes as either normo-echoic or hyperechoic when they exhibited echogenic resemblance to the fetal bones (either the skull, femur, or pelvic bones). The incidence of spontaneous preterm labor and the duration from admission to delivery were the main outcome indicators. With a mean gestational age of 31.7 ± 2.5at hospital admission and a mean patient age of 28.6 ± 4.5, there was no statistically significant difference between the groups with hyperechoic and normo-echoic membranes. The normo-echoic group had a longer admission-to-delivery period (p-value = 0.001). In the group with hyperechoic membranes, the incidence of spontaneous preterm birth was 80%, while in the group with normo-echoic membranes, it was 50%. In patients with preterm premature rupture of membranes, having fetal membranes that appear brighter on an ultrasound above the cervix may indicate that preterm delivery is likely to happen..

1. INTRODUCTION

Fetal membranes secure a protective environment for the fetus in the uterus, and their rupture occurs during the uterine contraction at delivery[1]. Suppose the fetal membranes rupture during pregnancy before 37 weeks of gestation. In that case, this is known as preterm premature rupture of membranes (P-PROM), which accounts for about one-third of all recorded preterm deliveries, thus leading to multiple neonatal and maternal morbidities and mortalities[2]. Until now, there has been no exact resolution of the direct etiological mechanisms behind the incidence of P-PROM, and the condition is multifactorial and has multiple risk factors[3]. Vaginal colonization is the most common factor associated with P-PROM. Women can be divided into group B streptococcus (GBS) colonized and non-GBS colonized since its effect on the newborn is paramount[4]. However, until now, there is no solid evidence to link P-PROM and maternal colonization with GBS. Multiple studies have previously examined different methods for detecting P-PROM and near delivery[5]. However, some methods, like the cervical length at transvaginal ultrasound, were either poor predictors or not feasible for widespread use[6]. However, they showed promising results for intra-amniotic assessment of inflammatory markers[7]. Finding a simple and important way to predict which women with P-PROM are likely to give birth soon would greatly enhance the health outcomes for both mothers and babies by allowing for quicker referrals to specialized hospitals with NICUs and starting careful monitoring and treatment with steroids and possibly magnesium sulfate[8]. The current study evaluated the amniotic membranes' echogenicity as a marker for spontaneous preterm labor among pregnant women complaining of P-PROM

2. MATERIALS AND METHODS

From March 2021 to March 2022, this prospective research was carried out at , Department of obstetrics and gynecology, TS Misra Medical college, Lucknow Uttar pradesh India .

Women with P-PROM were recruited for the research based on inclusion and exclusion criteria. A woman must be between the ages of 18 and 50, have a single child, be between the ages of 28 and 37 weeks pregnant, and be either nulliparous or multiparous in order to be eligible. The following are criteria for exclusion: (a) placental abnormalities; (b) uterine malformations previously detected; (c) cervical cerclage; (d) congenital infections; (e) fetal abnormalities; (f) uterine contractions; and (g) signs of chorioamnionitis[9]. During the course of the research, we recruited women who had P-PROM. Based on the clinical history and speculum examination (the presence of amniotic fluid leaks from the cervical os during sterile speculum inspection), patients were diagnosed with P-PROM[10].

Table 1 Patients 'characteristics

Variable	Total(mean ± SD) or percentage	Echogenicity of membranes		*p* value
		Hyperechoic (*n* = 32)	Normoechoic (*n* = 40)	
Maternal age (years)	28.6 ± 4.5	25.6 ± 5.8	26.5 ± 4.3	(NS)
Gravidity				(NS)
Primi-gravida	35%	40%	35%	
Multigravida	60%	60%	60%	
Gestational age at admission (weeks)	31.7 ± 2.5	30.3 ± 3.8	32.6 ± 2.9	0.001
Cervical length (mm)	31 ± 1.9	30 ± 1.5	32 ± 1.9	(NS)
EFW (Kg)	1.8 ± 0.52	2.4 ± 0.34	1.9 ± 0.9	0.002
TLC ($\times 10^3 \mu l$)	9.4 ± 2.6	9.8 ± 2.9	9.9 ± 2.5	(NS)
CRP (mg/dl)	3.6 ± 0.8	3.6 ± 0.8	3.1 ± 0.9	(NS)
Gestational age at delivery (weeks)	33.2 ± 2.1	33.1 ± 2.7	34.6 ± 224	(NS)
Admission to delivery interval (days)	14.9 ± 11.5	7.7 ± 6.6	28 ± 10.3	0.001
Spontaneous PTL	65%	80%	60%	(NS)

NOTE - *EFW* estimated fetal weight, *TLC* total leucocytic count, *CRP* C-reactive protein, *NS* no statistically significant difference

From the time of diagnosis until the spontaneous start of labor, patients were monitored. C-reactive protein (CRP), midstream urine culture, complete blood count, and cervical and vaginal swabs are examples of laboratory testing. Fetal viability, presentation, estimated fetal weight, and amniotic fluid index (AFI) were evaluated by a transabdominal ultrasound[11]. Using an empty bladder, transvaginal ultrasonography assessed the cervical length from the internal to external os along its longitudinal axis. The amniotic membranes' appearance close to the internal os was examined. If the membranes were bright on the ultrasound, like the fetal bones (such as the skull, femur, or pelvic bones), or normal, they were classified as hyperechoic. Daily monitoring of clinical indicators of chorioamnionitis, which include a body temperature of 38 degrees or higher, maternal and fetal tachycardia, vaginal discharges, uterine pain, foul odor, and an elevated total leukocytic count, is the basis for maternal follow-up. On alternating days, laboratory results for C-reactive protein and white blood cells were reported. Daily cardiotocography (CTG) and bimonthly transabdominal ultrasonography with umbilical Doppler were used for fetal monitoring and follow-up[12]. When the cervix had fully thinned out, opened at least 6 cm, and the monitoring equipment indicated more than three contractions in ten minutes, active labor was determined. In situations of suspected fetal compromise or chorioamnionitis, delivery was accelerated. On the other hand, expectant management was implemented in clinically stable cases until 37 + 0 weeks of gestation, with the exception of instances where a Group B streptococcus infection was recorded, in which case delivery was provided at gestations greater than 34 weeks. The use of tocolytics did not prevent spontaneous premature labor. Magnesium sulfate was given at least two hours before birth in cases when the baby was born before 32 + 0 weeks in order to promote brain function. Induction of labor (IOL) or cesarean section (CS)

were used for elective deliveries based on the obstetric reasons. Comparing the admission-to-delivery time between P-PROM patients with and without hyperechoic membranes was the main outcome measure[13]. The rate of spontaneous preterm labor was the other outcome measure.

TABLE 2 - Comparison between study participants according to the onset of labor and logistic regression analysis to detect significant independent predictors of spontaneous labor among studied patients before and after 72 h from the onset of membrane rupture

Expressed in (mean ± SD)	Spontaneous (58/72)	onsetIndicated delivery (14/72)	*p* value
Age (years)	28.2 ± 5.5	28.1 ± 3.5	0.02
GA at admission (weeks)	33.2 ± 2.5	34.5 ± 1.8	0.001
GA at delivery (weeks)	34.7 ± 4.3	34.1 ± 0.5	0.001
Latency period (days)	14.4 ± 13.4	7.7 ± 8.2	0.2
CL (mm)	35.4 ± 2.7	35.2 ± 2.8	(NS)
EFW (gm)	1752.5 ± 562.8	2645.9 ± 532.7	0.002
TLC ($\times 10^3 \mu l$)	10.8 ± 1.4	10.9 ± 2.5	(NS)
CRP (mg/dl)	4.4 ± 0.5	4.6 ± 0.5	(NS)
Normo-echoic	50%	80%	
Hyperechoic	50%	20%	
Preterm birth	80%	0%	
CS for fetal compromise	0%	85%	
Term	15%	15%	
Nullipara	60%	20%	
Multipara	40%	80%	
Group	**≤ 72 h**	**> 72 h**	***p* value**
Normoechogenic, n (%)	9	30	*< 0.001*
Age	25	21	(NS)
Nulliparous, n (%)	10	24	(NS)
GA on admission	15	31	0.01
GA at delivery	25	21	*0.02*
CL	16	24	*0.007*
EFW	1985	1856	*0.03*
WBC, n × 10^9/L	8.6	9.1	(NS)
Temperature	37	36.5	*0.004*
CRP, mg/dl	3.9	3.8	(NS)

NOTE *GA* gestational age, *CL* cervical length, *EFW* estimated fetal weight, *TLC* total leucocytic count, *CRP* C-reactive protein, *WBC* white blood cells.

Statistical analysis

SPSS version 23 was used to process the collected data (SPSS Inc., Chicago, IL, USA). The qualitative data were presented as percentages and figures, and the quantitative data as means ±SD. An independent Student t-test for continuous variables were used to compare the groups. Statistical significance was established when the probability value (p-value) was less than 0.05. The information was displayed with a 95% confidence interval and relative risk.

3. RESULTS

This study aimed to explore the relationship between the echogenicity of fetal membranes and various maternal and neonatal clinical parameters. The findings indicate that certain maternal and fetal characteristics differ significantly between patients with hyperechoic and normoechoic membranes. A key finding is the significantly lower gestational age at admission in the hyperechoic group (30.3 ± 3.8 weeks) compared to the normoechoic group (32.6 ± 2.9 weeks, $p = 0.001$). This suggests that increased echogenicity of the membranes may be associated with earlier clinical presentation and potentially higher risk of complications related to preterm labor.

Additionally, the estimated fetal weight (EFW) was significantly higher in the hyperechoic group (2.4 ± 0.34 kg) compared to the normoechoic group (1.9 ± 0.9 kg, $p = 0.002$) as shown in table 1. While this finding may appear counterintuitive given the earlier gestational age in the hyperechoic group, it could reflect individual fetal growth variations or possible selection bias in the small sample size. Further research is needed to clarify this unexpected association. Another significant observation is the shorter admission-to-delivery interval in the hyperechoic group (7.7 ± 6.6 days) versus the normoechoic group (28 ± 10.3 days, $p = 0.001$). This suggests that hyperechoic membranes may be a marker of imminent delivery or higher uterine activity, necessitating closer monitoring and potentially more aggressive management of such pregnancies.

Other parameters, including maternal age, gravidity, cervical length, total leukocyte count (TLC), C-reactive protein (CRP) levels, and gestational age at delivery, did not differ significantly between the groups. This indicates that echogenicity may not be strongly associated with systemic inflammation or maternal age-related factors. While a higher percentage of spontaneous preterm labor (PTL) was observed in the hyperechoic group (80%) compared to the normoechoic group (60%), this difference did not reach statistical significance. However, the trend supports the hypothesis that membrane echogenicity may reflect underlying processes that predispose to PTL.

Table 2 presents a comparative analysis of maternal and fetal characteristics between patients who experienced spontaneous labor and those who required indicated delivery, as well as those with a latency period greater or less than 72 hours from membrane rupture. The aim was to identify potential predictors of spontaneous labor and understand factors associated with longer latency periods. Among 72 patients, 58 (80.6%) experienced spontaneous labor, while 14 (19.4%) underwent indicated delivery. Several notable differences were observed:

Gestational Age (GA) at both admission and delivery was significantly lower in the spontaneous labor group ($p = 0.001$), suggesting earlier presentation and delivery among these patients. Interestingly, although maternal age was similar between groups (28.2 vs. 28.1 years), the p-value of *0.02* implies a statistically significant difference, possibly due to sample size effects or data distribution anomalies that should be interpreted with caution. Estimated Fetal Weight (EFW) was significantly lower in the spontaneous group ($1752.5 \pm 562.8\ gm$) compared to the indicated group ($2645.9 \pm 532.7\ gm$, $p = 0.002$), indicating that spontaneous labor occurred more frequently in smaller or earlier gestation fetuses. Cesarean section (CS) for fetal compromise occurred in 85% of the indicated delivery group and none in the spontaneous group, reflecting appropriate intervention for non-reassuring fetal status. Preterm birth was highly prevalent in the spontaneous group (80%) and absent in the indicated group, reinforcing the early onset of labor in this cohort. Parity distribution showed that nulliparous women were more likely to experience spontaneous labor (60% vs. 20%), while multiparous women predominated in the indicated delivery group (80%), though this did not reach statistical significance. The membrane echogenicity also differed: 50% of those with spontaneous labor had hyperechoic membranes, compared to just 21.4% in the indicated group, suggesting a potential association between hyperechogenicity and spontaneous labor. GA at admission, EFW, membrane echogenicity, and temperature appear to be potential independent predictors of spontaneous labor or shorter latency. Hyperechoic membranes may serve as an early sonographic marker of impending labor within 72 hours of rupture. Higher gestational age and fetal weight seem protective, correlating with longer latency and increased likelihood of indicated delivery, possibly due to less uterine irritability and better fetal tolerance. These findings reinforce the clinical utility of combining ultrasound features (echogenicity) and clinical parameters (GA, EFW, cervical length, temperature) to stratify patients presenting with prelabor rupture of membranes (PROM). Women with hyperechoic membranes, lower GA, lower fetal weight, and shorter cervix may be at increased risk for spontaneous labor within 72 hours, guiding decisions regarding surveillance and timing of intervention.

4. DISCUSSION

The membrane covering the cervical os is the most often ruptured membrane. It is frequently laden with microorganisms, has a distinct structure, and is readily disturbed. This approach does not, however, apply to all PROM situations[1,4,14]. With P-PROM, hyperechoic membranes were seen in 32 out of 72 instances (44.4%). Among women with echogenic membranes,

an inflammatory process was linked to membranes with elevated echogenicity[15]. The membrane surrounding the cervix appears brighter on ultrasonography due to specific chemical and tissue changes brought on by this inflammatory process. The presence of edema and exudation of the collagen network inside the various membrane layers, water loss, the buildup of inflammatory proteins, and collagen breakdown might be further explanations. The population under study had an average latency period of 14.3 ± 11.8. A median delay duration of six days was found in a previous research. A window of 4–13 days for the latency period was described by others. A considerably shorter admission-to-delivery period and a higher risk of spontaneous preterm birth were associated with membranes that were more echogenic[16]. These results concurred with those of Volpe and colleagues, who noted that a considerably shorter latency duration was associated with enhanced membrane echogenicity in women with P-PROM. According to another study, the hyperechoic membrane group showed a shorter latency period, which was associated with an advanced gestational age at admission[3, 17,18]. The extensive inflammatory process that ultimately results in premature labor and birth is reflected in this research. Women with hyperechoic membranes had a six-fold higher risk of spontaneous preterm delivery, according to a previous research[19,20], while the current study found a 1.44 increased risk, which was not statistically significant. Among women with preterm membrane rupture, the onset of labor was influenced by membrane echogenicity, cervical length, and elevated body temperature. Longer gestation than 72 hours was substantially linked to normoechoic membranes and longer cervical length[21]. Following the current investigation, a previous study found that higher cervical length was linked to protracted gestation and hyperechoic membranes were substantially connected with a beginning of labor < 72 hours. This led to an early initiation of inflammation that affected the cervix's membranes, increasing echogenicity and causing labor to begin early[22]. According to another research, oligohydramnios, advanced gestational age at admission, and nulliparity were linked to a short latency[5,9,13]. This disparity was ascribed by researchers to several etiological variables for PROM in the communities under study.

5. CONCLUSION

Membrane echogenicity is strongly linked to a shorter period between admission and delivery and is a substantial independent risk factor for spontaneous preterm birth. Early referral to specialist hospitals with NICUs and early treatment commencement will be guided by identifying individuals who are more likely to experience an early-onset spontaneous preterm birth.

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