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PREDICTORS OF UNFAVORABLE PERINATAL OUTCOMES IN PREMATURE RUPTURE OF MEMBRANES

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Abstract.

Introduction. Premature rupture of membranes (PROM) is a major cause of preterm birth and is associated with a high risk of adverse perinatal outcomes. Intra-amniotic inflammation, reduced amniotic fluid volume, and fetal immaturity play a critical role in the development of complications.

Aim. To identify clinical, laboratory, and ultrasound predictors of unfavorable perinatal outcomes in pregnancies complicated by PROM.

Materials and Methods. A single-center retrospective cohort study included 176 women with PROM at 28 0/7–36 6/7 weeks of gestation. Maternal obstetric history, inflammatory markers, amniotic fluid index, maximum vertical pocket, and neonatal clinical, laboratory, and microbiological data were analyzed. Neonates were stratified into favorable and unfavorable outcome groups.

Results. Unfavorable perinatal outcomes were significantly associated with lower gestational age and birth weight, presence of chorioamnionitis and anhydramnios, amniotic fluid index ≤ 32 mm before delivery, elevated maternal C-reactive protein and leukocyte counts, severe neonatal respiratory failure, and higher NEOMOD scores. Ureaplasma parvum was more frequently detected in neonates with adverse outcomes, along with increased procalcitonin and C-reactive protein levels during the first 72 hours of life.

Conclusion. An amniotic fluid index ≤ 32 mm, subclinical chorioamnionitis, and systemic inflammatory markers represent key predictors of unfavorable perinatal outcomes in PROM and may be useful for risk stratification and clinical decision-making.

Key words: premature rupture of membranes; prematurity; chorioamnionitis; amniotic fluid index; adverse perinatal outcomes; intra-amniotic infection

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ПРЕДИКТОРЫ НЕБЛАГОПРИЯТНЫХ ПЕРИНАТАЛЬНЫХ ИСХОДОВ ПРИ ПРЕЖДЕВРЕМЕННОМ РАЗРЫВЕ ПЛОДНЫХ ОБОЛОЧЕК

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Аннотация.

Введение. Преждевременный разрыв плодных оболочек (ПРПО) является одной из ведущих причин преждевременных родов и ассоциирован с высоким риском неблагоприятных перинатальных исходов. Особую роль в патогенезе осложнений играют внутриамниотическое воспаление, снижение объема околоплодных вод и незрелость плода.

Цель исследования. Выявить клинико-лабораторные и ультразвуковые предикторы неблагоприятных перинатальных исходов при ПРПО.

Материалы и методы. Проведено одноцентровое ретроспективное когортное исследование, включившее 176 беременных с ПРПО в сроке гестации от 28 0/7 до 36 6/7 недель. Проанализированы данные акушерского анамнеза, показатели воспаления у матери, индекс амниотической жидкости, максимальный вертикальный карман, а также клинические, лабораторные и инфекционные показатели у новорожденных. В зависимости от исхода новорожденные были разделены на группы с благоприятным и неблагоприятным исходом.

Результаты. Неблагоприятные перинатальные исходы ассоциировались с более низким гестационным возрастом и массой тела при рождении, наличием хориоамнионита и ангидрамниона, индексом амниотической жидкости перед родами ≤ 32 мм, повышенными уровнями С-реактивного белка и лейкоцитов у матери, а также с тяжелой дыхательной недостаточностью и более высокими значениями шкалы NEOMOD у новорожденных. В группе неблагоприятных исходов чаще выявлялась Ureaplasma parvum и отмечались более высокие уровни прокальцитонина и СРБ в первые 72 часа жизни.
Заключение. Индекс амниотической жидкости ≤ 32 мм, субклинический хориоамнионит и маркеры системного воспаления могут рассматриваться как ключевые предикторы неблагоприятных перинатальных исходов при ПРПО и использоваться для стратификации риска и оптимизации тактики ведения беременности и родов.
Ключевые слова: преждевременный разрыв плодных оболочек; недоношенность; хориоамнионит; индекс амниотической жидкости; неблагоприятные перинатальные исходы; внутриамниотическая инфекция.

HOMILA QOBIQCHALARI MUDDATIDAN OLDIN YORILISHI HOLATLARIDA NOQULAY PERINATAL NATIJALAR PREDIKTORLARI

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Annotatsiya.
Kirish. Homila qobiqchalarining muddatidan oldin yorilishi (PROM) muddatidan oldin tug‘ruqlarning asosiy sabablaridan biri bo‘lib, noqulay perinatal natijalar xavfi bilan kechadi. Intraamniotik yallig‘lanish, amniotik suyuqlik hajmining kamayishi va homilaning yetilmaganligi asoratlar rivojlanishida muhim rol o‘ynaydi.
Tadqiqot maqsadi. PROM bilan kechuvchi homiladorliklarda noqulay perinatal natijalar bilan bog‘liq klinik, laborator va ultratovush prediktorlarini aniqlash.
Materiallar va usullar. Bir markazli retrospektiv kohort tadqiqotga 28 0/7–36 6/7 haftalik gestatsiya davrida PROM aniqlangan 176 nafar homilador ayol kiritildi. Onalarning akusherlik anamnezi, yallig‘lanish markerlari, amniotik suyuqlik indeksi, maksimal vertikal cho‘ntak va yangi tug‘ilgan chaqaloqlarning klinik hamda laborator ko‘rsatkichlari tahlil qilindi.
Natijalar. Noqulay perinatal natijalar past gestatsion yosh va tug‘ilish vazni, xorionamnionit va angidramnion mavjudligi, tug‘ruqdan oldin amniotik suyuqlik indeksining ≤ 32 mm bo‘lishi, onada yallig‘lanish markerlarining oshishi, shuningdek, yangi tug‘ilgan chaqaloqlarda og‘ir nafas yetishmovchiligi va NEOMOD shkalasi bo‘yicha yuqori ballar bilan bog‘liq bo‘ldi. Noqulay natijalar guruhida Ureaplasma parvum ko‘proq aniqlangan.
Xulosa. Amniotik suyuqlik indeksining ≤ 32 mm bo‘lishi, subklinik xorionamnionit va yallig‘lanish markerlari PROM holatlarida noqulay perinatal natijalarni prognoz qilishda muhim ahamiyatga ega.
Kalit so’zlar: homila qobiqchalarining muddatidan oldin yorilishi; muddatidan oldin tug‘ilish; xorionamnionit; amniotik suyuqlik indeksi; noqulay perinatal natijalar; intraamniotik infeksiya

Introduction. Preterm birth remains one of the leading causes of adverse perinatal outcomes worldwide and is responsible for the majority of neonatal mortality, a substantial proportion of infant mortality, and a significant burden of long-term neurodevelopmental impairment. A strong association between preterm delivery and intra-amniotic infection has been consistently demonstrated, with approximately one in ten women with preterm labor exhibiting signs of intra-amniotic inflammation. In most cases, this inflammatory process remains subclinical and substantially increases the risk of premature rupture of membranes. Infectious and inflammatory degradation of the extracellular matrix leads to structural remodeling and weakening of the amniotic membranes, thereby facilitating membrane rupture [1-7]. Prolonged persistence of infection may

result in overt chorioamnionitis and the development of a fetal systemic inflammatory response, both of which are associated with poor neonatal outcomes.

Ultrasound assessment of amniotic fluid volume plays a central role in the diagnosis and management of pregnancies complicated by premature rupture of membranes. Both the amniotic fluid index and the maximum vertical pocket are widely used to quantify residual amniotic fluid volume, yet there is no consensus regarding the most prognostically significant threshold values. Previous studies have demonstrated associations between reduced amniotic fluid volume and adverse neonatal outcomes, including respiratory morbidity, sepsis, intraventricular hemorrhage, and bronchopulmonary dysplasia [4,9]. However, reported cut-off values vary considerably, and data remain inconsistent, particularly across different gestational ages. In this context, identifying objective and clinically applicable predictors of unfavorable perinatal outcomes in pregnancies complicated by premature rupture of membranes remains an important clinical challenge.

The aim of the present study was to identify maternal, obstetric, and neonatal predictors associated with unfavorable perinatal outcomes in cases of premature rupture of membranes occurring between 28 and 36 weeks of gestation.

Materials and Methods. A single-center retrospective cohort study was conducted at a tertiary perinatal center between January 1 and November 1, 2023. The study included pregnant women with premature rupture of membranes occurring between 28 0/7 and 36 6/7 weeks of gestation who were hospitalized throughout the entire latency period until delivery. Neonates born to these women were followed from birth until discharge. A total of 176 maternal and corresponding neonatal medical records were analyzed. Inclusion criteria comprised gestational age greater than 28 0/7 and less than 37 0/7 weeks, a documented latency period exceeding 18 hours, and the need for neonatal intensive care unit admission immediately after birth. Exclusion criteria included major congenital anomalies affecting outcomes, chromosomal or genetic syndromes, and transfer of neonates to other institutions.

Maternal data included age, parity, gestational age at delivery, duration of membrane rupture, mode of delivery, presence of maternal fever or tachycardia, clinical diagnosis of chorioamnionitis, presence of anhydramnios, amniotic fluid index at admission and before delivery, maximum vertical pocket before delivery, maternal C-reactive protein levels and leukocyte counts before delivery, and cervical bacterial cultures. Amniotic fluid index was measured using a standard four-quadrant ultrasound technique, with values calculated as the sum of the deepest vertical pockets in each quadrant. Maximum vertical pocket was measured as the deepest single pocket of amniotic fluid free of fetal parts and umbilical cord.

Neonatal variables included gestational age, birth weight, Apgar scores, severity of respiratory failure assessed by the need for tracheal intubation, surfactant administration, mechanical ventilation, or high-frequency oscillatory ventilation within the first 72 hours of life. Hemodynamic instability was assessed using a modified inotropic index. The severity of multiple organ dysfunction was evaluated using the NEOMOD score during the first 72 hours of life. Neonatal morbidity included early-onset sepsis, congenital pneumonia, pulmonary hemorrhage, pneumothorax, intraventricular hemorrhage grade III, periventricular leukomalacia, severe bronchopulmonary dysplasia, necrotizing enterocolitis requiring surgical intervention, and retinopathy of prematurity requiring surgery. Laboratory parameters included leukocyte counts, hemoglobin levels, neutrophil index, procalcitonin and C-reactive protein levels, and detection of bacterial pathogens using polymerase chain reaction from sterile and non-sterile sites. Based on outcomes at discharge, neonates were divided into two groups: those with favorable outcomes and those with unfavorable outcomes, which included antenatal fetal death, neonatal death, severe neurological injury, severe bronchopulmonary dysplasia, or surgical necrotizing enterocolitis. Statistical analysis was performed using Python 3.11. Nonparametric methods were applied where appropriate. Odds ratios, relative risks, and receiver operating characteristic curve analyses were used to assess predictive performance, with statistical significance set at $p \leq 0.05$.

Results. Antenatal fetal death occurred in 3.9% of cases, while neonatal mortality among live-born infants was 4.1%. Neonates with unfavorable outcomes had a significantly lower gestational age at delivery compared with those with favorable outcomes, with a median of 193 days

versus 238 days. Maternal age, parity, and duration of membrane rupture did not differ significantly between groups.

Chorioamnionitis and anhydramnios were significantly more frequent in the unfavorable outcome group. Amniotic fluid index values at admission and immediately before delivery, as well as maximum vertical pocket measurements, were significantly lower in this group. An amniotic fluid index of 32 mm or less before delivery demonstrated strong predictive value for adverse outcomes. Maternal inflammatory markers were significantly elevated in cases with unfavorable outcomes, including higher C-reactive protein levels and leukocyte counts prior to delivery. Cesarean delivery was more common among neonates with adverse outcomes.

Neonates in the unfavorable outcome group had significantly lower birth weights and Apgar scores and required more intensive respiratory support, including higher rates of tracheal intubation, surfactant administration, prolonged mechanical ventilation, and initiation of high-frequency oscillatory ventilation within the first 72 hours of life. NEOMOD scores were significantly higher, reflecting more severe multiple organ dysfunction. Adverse neonatal outcomes, including pulmonary hemorrhage, pneumothorax, severe bronchopulmonary dysplasia, intraventricular hemorrhage grade III, and retinopathy of prematurity requiring surgical treatment, occurred significantly more frequently in the unfavorable outcome group. Diffuse ecchymosis present at birth was strongly associated with poor prognosis. Ureaplasma parvum was detected significantly more often in nasopharyngeal samples from neonates with unfavorable outcomes. These neonates also exhibited lower hemoglobin levels and higher procalcitonin and C-reactive protein concentrations during the first 72 hours of life.

Discussion. The findings of this study confirm that adverse perinatal outcomes in pregnancies complicated by premature rupture of membranes are multifactorial and strongly influenced by gestational age, inflammatory activity, residual amniotic fluid volume, and neonatal physiological instability [1,2,5,9]. Reduced amniotic fluid volume, particularly an amniotic fluid index of 32 mm or less prior to delivery, emerged as one of the most objective and clinically applicable predictors of unfavorable outcomes. This supports earlier reports suggesting that residual amniotic fluid volume plays a critical role in fetal lung development and protection against infection. The high prevalence of chorioamnionitis without overt maternal fever underscores the importance of recognizing subclinical intra-amniotic infection. Elevated maternal inflammatory markers prior to delivery may serve as early warning signs and should prompt intensified monitoring and management [8]. The strong association between Ureaplasma parvum colonization and adverse neonatal outcomes highlights the potential value of targeted microbial surveillance and preventive strategies. Severe respiratory morbidity and multiple organ dysfunction were central features of unfavorable outcomes, emphasizing the vulnerability of extremely preterm neonates exposed to prolonged intrauterine inflammation and oligohydramnios [10]. The presence of diffuse ecchymosis at birth may reflect underlying coagulopathy or systemic inflammation and warrants further investigation as an early prognostic indicator.

Conclusion. Unfavorable perinatal outcomes in pregnancies complicated by premature rupture of membranes are associated with anhydramnios, chorioamnionitis, lower gestational age and birth weight, cesarean delivery, elevated maternal inflammatory markers, reduced amniotic fluid index prior to delivery, severe neonatal respiratory failure, higher NEOMOD scores, diffuse ecchymosis at birth, detection of Ureaplasma parvum, lower hemoglobin levels, and increased neonatal procalcitonin and C-reactive protein levels. The amniotic fluid index before delivery, particularly values of 32 mm or less, represents a simple and objective predictor that may be incorporated into routine clinical practice to improve risk stratification and guide perinatal management in cases of premature rupture of membranes.

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