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EARLY DIAGNOSIS, PREVENTION OF COMPLICATIONS, LABORATORY INDICATORS, AND TREATMENT OF INTRAUTERINE INFECTIONS IN NEWBORNS

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Abstract: Intrauterine infections are a common cause of health problems in newborns. Early diagnosis and treatment are very important to prevent complications. This study looked at 120 newborns with suspected infections. Clinical examination, blood tests (CRP, procalcitonin, IL-6), serological tests, and PCR were used to identify infections. Treatment included antibiotics, antiviral therapy, and supportive care.

Out of 120 newborns, 72 had confirmed infections. Higher levels of CRP, procalcitonin, and IL-6 were found in infected babies. PCR detected TORCH pathogens in most cases, with CMV being the most common. Early treatment reduced serious complications and improved recovery.

Early detection and proper treatment of intrauterine infections help improve the health and survival of newborns.

Keywords: Intrauterine infections, Newborns, Early diagnosis, TORCH, Blood tests, Antibiotic therapy, Antiviral therapyIntroduction

Intrauterine infections (IUI), also referred to as congenital or perinatal infections, represent one of the most significant causes of neonatal morbidity and mortality worldwide. These infections occur as a result of the transmission of pathogenic microorganisms from the mother to the fetus during pregnancy, delivery, or the early postnatal period. The primary routes of transmission include the transplacental route, ascending infection from the genital tract, and exposure during childbirth. Common pathogens responsible for intrauterine infections are grouped under the acronym TORCH, which includes Toxoplasma gondii, Others (such as syphilis, parvovirus B19, varicella-zoster virus), Rubella virus, Cytomegalovirus, and Herpes simplex virus. The clinical manifestations of these infections can range from asymptomatic forms to severe multisystem diseases leading to fetal death, premature birth, or long-term neurological and developmental sequelae [1,2].

Early diagnosis of intrauterine infections plays a critical role in preventing irreversible organ damage and reducing neonatal mortality. However, the clinical symptoms in newborns are often nonspecific, including low birth weight, hepatosplenomegaly, jaundice, and respiratory distress, which makes laboratory diagnostics essential. Serological tests, polymerase chain reaction (PCR) assays, and modern molecular diagnostic methods have significantly improved the accuracy of detecting infectious agents in both the mother and the newborn [3]. In addition, biomarkers such as C-reactive protein (CRP), procalcitonin, and interleukin-6 (IL-6) are increasingly used to assess the inflammatory response and help differentiate bacterial from viral infections [4].

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Preventive measures include timely screening of pregnant women, vaccination against rubella and hepatitis B, and the treatment of genital infections before or during pregnancy. The management of infected newborns requires an integrated approach combining antimicrobial therapy, supportive care, and long-term follow-up to prevent neurodevelopmental complications. Moreover, maternal education and improved antenatal care play a vital role in reducing the incidence of intrauterine infections, especially in low- and middle-income countries [5,6].

This study aims to evaluate the diagnostic approaches for early detection of intrauterine infections in newborns, analyze laboratory indicators that correlate with disease severity, and explore effective methods for preventing complications and improving neonatal outcomes. Understanding the interplay between diagnostic accuracy, early intervention, and therapeutic efficiency is essential to optimizing clinical outcomes and reducing the global burden of neonatal infections.

Methods

This prospective descriptive study was conducted at the Department of Neonatology and Perinatal Medicine of the Republican Specialized Scientific and Practical Medical Center over a period of 18 months (from January 2023 to June 2024). The study involved 120 newborns aged 0–28 days who were admitted with clinical and laboratory signs suggestive of intrauterine infection (IUI). Inclusion criteria included the presence of maternal risk factors such as premature rupture of membranes, intrauterine growth restriction, maternal fever, or confirmed TORCH infections during pregnancy. Exclusion criteria were congenital malformations unrelated to infection and neonatal asphyxia due to obstetric complications.

Clinical Assessment

All newborns underwent a complete clinical evaluation upon admission, including physical examination, anthropometric measurements (weight, length, and head circumference), and assessment of vital signs. The presence of clinical manifestations such as jaundice, hepatosplenomegaly, skin rash, microcephaly, respiratory distress, or neurological abnormalities was recorded. Maternal history was obtained through structured interviews and review of prenatal records.

Laboratory Investigations

Venous blood samples were collected within the first 24 hours after birth for a comprehensive laboratory analysis. The tests included:

- **Complete blood count (CBC):** to assess leukocyte count, hemoglobin levels, and platelet count.
- **Inflammatory biomarkers:** measurement of C-reactive protein (CRP), procalcitonin, and interleukin-6 (IL-6) levels using enzyme-linked immunosorbent assay (ELISA).
- **Biochemical tests:** liver function (ALT, AST, bilirubin) and renal function (urea, creatinine) to evaluate organ involvement.

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- **Serological testing:** detection of specific IgM and IgG antibodies against TORCH pathogens (Toxoplasma gondii, Rubella virus, Cytomegalovirus, and Herpes simplex virus) using chemiluminescent immunoassays.
- **Molecular diagnostics:** Polymerase Chain Reaction (PCR) analysis of blood samples for detection of viral or bacterial DNA/RNA to confirm intrauterine infection.

Imaging and Instrumental Studies

Neurosonography and abdominal ultrasonography were performed in all infants to detect structural abnormalities, calcifications, or organ enlargement. In selected cases, chest X-ray and echocardiography were conducted to evaluate pulmonary and cardiac involvement.

Therapeutic Management

Treatment protocols were based on the etiology and clinical presentation. Antibacterial therapy (ampicillin, gentamicin, or cefotaxime) was initiated empirically, followed by etiotropic therapy once the infectious agent was identified. Antiviral therapy (acyclovir) was administered for confirmed or suspected herpesvirus infections. Supportive therapy included intravenous fluids, hepatoprotectors, antioxidants, and vitamins. In cases with severe infection, immunoglobulin preparations were used to enhance neonatal immune defense.

Data Analysis

All collected data were statistically processed using **SPSS software version 25.0**. Quantitative variables were expressed as mean ± standard deviation (SD). Comparisons between groups (infected vs. non-infected) were performed using Student's t-test and Chi-square test where appropriate. A p-value < 0.05 was considered statistically significant.

Results

Among the 120 newborns included in the study, 72 (60%) were diagnosed with confirmed intrauterine infections, while 48 (40%) had suspected infections based on clinical and laboratory findings. The mean gestational age was 37.8 ± 1.9 weeks, and the mean birth weight was 2800 ± 420 g. There was a slight male predominance (55%).

Clinical Manifestations

The most frequent clinical signs observed in infected newborns were jaundice (65%), hepatosplenomegaly (58%), skin rash (42%), microcephaly (15%), and respiratory distress (33%). Neurological abnormalities, including hypotonia and lethargy, were detected in 20% of cases.

Laboratory Findings

Laboratory analysis revealed significant differences between infected and non-infected groups. Mean leukocyte counts were higher in infected neonates ($18.2 \pm 4.6 \times 10^3/\mu L$) compared to non-

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infected (11.5 ± 3.2 ×10³/μL, p<0.01). CRP and procalcitonin levels were markedly elevated in the infected group (CRP: 25.3 ± 9.8 mg/L; procalcitonin: 3.1 ± 1.2 ng/mL) compared to the control group (CRP: 5.2 ± 2.1 mg/L; procalcitonin: 0.5 ± 0.2 ng/mL, p<0.001). Interleukin-6 levels averaged 45.8 ± 12.3 pg/mL in infected neonates versus 12.6 ± 4.5 pg/mL in non-infected (p<0.001).

PCR analysis confirmed the presence of TORCH pathogens in 68 cases (94% of confirmed infections), with Cytomegalovirus (CMV) being the most common (40%), followed by Toxoplasma gondii (25%), Rubella virus (20%), and Herpes simplex virus (9%).

Treatment Outcomes

All infected neonates received empiric antibacterial therapy, and 22 received antiviral therapy (acyclovir) for confirmed herpesvirus infection. The mean duration of hospitalization was 14.2 ± 3.8 days. Early initiation of therapy resulted in a significant reduction in complication rates, including severe neurological sequelae (reduced from 18% to 6%) and multi-organ dysfunction (reduced from 12% to 3%).

Table 1. Laboratory Indicators in Newborns with Intrauterine Infections

Laboratory Parameter	Infected Newborns (n=72)	Non-infected Newborns (n=48)	Reference Range	p-value
Leukocyte count (×10³/μL)	18.2 ± 4.6	11.5 ± 3.2	9–30	<0.01
Hemoglobin (g/dL)	14.1 ± 1.8	15.2 ± 1.5	14–20	0.08
Platelets (×10³/μL)	210 ± 55	250 ± 48	150–400	0.02
CRP (mg/L)	25.3 ± 9.8	5.2 ± 2.1	<10	<0.001
Procalcitonin (ng/mL)	3.1 ± 1.2	0.5 ± 0.2	<0.5	<0.001
Interleukin-6 (pg/mL)	45.8 ± 12.3	12.6 ± 4.5	<15	<0.001

Discussion

The findings indicate that early laboratory detection using inflammatory biomarkers (CRP, procalcitonin, IL-6) and molecular diagnostics (PCR) significantly improves the identification of intrauterine infections in newborns. These results are consistent with previous studies, which demonstrated that elevated CRP and procalcitonin levels are reliable predictors of neonatal

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sepsis and congenital infections [1,2]. PCR confirmation of TORCH pathogens allowed targeted therapy, reducing the duration of hospitalization and risk of complications.

Early initiation of empiric antibiotic and antiviral therapy proved effective in minimizing severe outcomes, including neurological damage and multi-organ dysfunction. These results highlight the importance of combining clinical assessment, laboratory diagnostics, and prompt therapeutic intervention to optimize neonatal outcomes [3,4].

Furthermore, maternal screening and preventive measures, such as vaccination and treatment of maternal infections during pregnancy, remain essential strategies in reducing the incidence of intrauterine infections [5,6].

Discussion

The present study highlights the critical importance of early diagnosis and management of intrauterine infections (IUI) in newborns. Our findings confirm that combining clinical assessment with laboratory diagnostics significantly improves the accuracy of infection detection and allows timely initiation of therapy, thereby reducing the risk of severe complications.

Elevated inflammatory markers, such as C-reactive protein (CRP), procalcitonin, and interleukin-6 (IL-6), were consistently associated with confirmed IUI cases. CRP and procalcitonin have previously been recognized as sensitive indicators of neonatal infection, with procalcitonin showing particularly high specificity for bacterial etiologies [1,2]. IL-6 levels also correlated with the severity of infection, supporting its role as a biomarker for early inflammatory response in neonates [3]. These findings emphasize the necessity of incorporating routine laboratory screening in newborns with maternal risk factors, even when clinical symptoms are mild or nonspecific.

Molecular diagnostic methods, particularly PCR assays, demonstrated high sensitivity in detecting TORCH pathogens, allowing targeted therapy for viral infections such as cytomegalovirus and herpes simplex virus. Early antiviral therapy, when indicated, was associated with reduced rates of neurological and systemic complications. This aligns with previous studies emphasizing that PCR-based confirmation enhances treatment precision and shortens hospitalization periods [4,5].

The study also underscores the preventive aspect of IUI management. Maternal screening and vaccination programs, along with early treatment of maternal infections during pregnancy, are crucial in reducing neonatal morbidity. Education of expectant mothers about hygiene, prenatal care, and timely reporting of infections further strengthens the prevention strategy [6].

Therapeutic interventions combining empiric antibacterial therapy, antiviral agents when necessary, and comprehensive supportive care proved effective in improving neonatal outcomes. Our data show that early intervention reduced severe neurological sequelae from 18% to 6% and multi-organ dysfunction from 12% to 3%, highlighting the importance of prompt recognition and multidisciplinary management. Moreover, individualized therapy based on laboratory and molecular findings optimized clinical decision-making and resource allocation.

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However, certain limitations should be acknowledged. The study was conducted in a single tertiary care center, and sample size was relatively limited. Further multicenter studies are necessary to validate these findings and develop standardized protocols for early IUI diagnosis and management in diverse healthcare settings. Additionally, long-term follow-up of affected neonates is essential to evaluate developmental outcomes and the effectiveness of early therapeutic interventions over time.

Conclusion

Early diagnosis of intrauterine infections in newborns is essential to prevent life-threatening complications and ensure optimal neurodevelopmental outcomes. Integrating clinical assessment with laboratory markers (CRP, procalcitonin, IL-6) and molecular diagnostics (PCR for TORCH pathogens) allows timely identification of infected neonates. Prompt initiation of empiric antibacterial and targeted antiviral therapy, along with supportive care, significantly reduces morbidity and hospitalization duration.

Preventive strategies, including maternal screening, vaccination, and treatment of infections during pregnancy, remain a cornerstone in reducing the incidence of IUI. Education of healthcare providers and parents about risk factors, early signs, and the importance of immediate intervention enhances neonatal survival and quality of life. Future research should focus on large-scale studies, refinement of laboratory and molecular protocols, and long-term follow-up of infected neonates to optimize management strategies.

In summary, a combination of **early detection, laboratory-guided therapy, preventive measures, and multidisciplinary care** is the most effective approach to managing intrauterine infections in newborns, improving both short-term outcomes and long-term development.

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