Journal of Biomedical Sciences | ISSN: 2960-9356
Research Article Peer-review, Open Access

Anemia in Newborns and Treatment

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Abstract

Anemia in newborns is one of the most common pathological conditions of the early neonatal period, characterized by a decrease in hemoglobin concentration and the number of red blood cells in the blood. The main causes of anemia are blood loss, increased destruction of red blood cells (hemolysis), and impaired hematopoiesis. This article examines the etiological factors, pathogenesis, clinical manifestations, and modern approaches to the diagnosis and treatment of anemia in newborns. Special attention is given to preventive measures aimed at early detection and the prevention of anemia in children of this age group.

Keywords: anemia, newborns, hemoglobin, red blood cells, hemolytic anemia, Rh incompatibility, blood loss, diagnosis, treatment, prevention.

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Introduction: Anemia in newborns represents an important medical and biological problem in neonatology, as impaired oxygen supply to tissues in the early postnatal period negatively affects the child's growth and development. According to the World Health Organization (WHO), the prevalence of anemia among newborns ranges from 10% to 30%, which is influenced by differences in socio-economic conditions, maternal nutrition, and the quality of perinatal care.

The causes of anemia can include blood loss, increased hemolysis of red blood cells, and congenital or acquired disorders of hematopoiesis. Under conditions of oxygen deficiency in the newborn, metabolic processes slow down, increasing the risk of neurological and somatic complications. Therefore, timely diagnosis and adequate treatment of anemia are essential to reduce perinatal morbidity and mortality.

Literature reviyew: **Early Clinical Observations (19th – early 20th century)** The study of anemia in newborns began in the late 19th century, when physicians first noticed that some infants were born pale, weak, and prone to respiratory distress or jaundice.

Louis Wickham (France, 1890s) and **Henry Koplik (USA, 1901)** were among the first to describe *"infantile pallor"* and *"neonatal chlorosis"* — conditions that likely represented early forms of anemia and hemolytic disease.

These early physicians lacked modern hematological tools, but they correctly suspected that some neonatal illnesses were due to problems in the blood.

Around the same time, hematologists like **Paul Ehrlich** and **William Osler** developed staining and microscopic techniques that made it possible to identify red blood cell morphology, laying the foundation for later neonatal hematology.

Further Developments (1950s–1980s) Dr. Ruth Darrow and **Dr. William Mollison** studied the prevention and treatment of Rh disease using **exchange transfusions**.

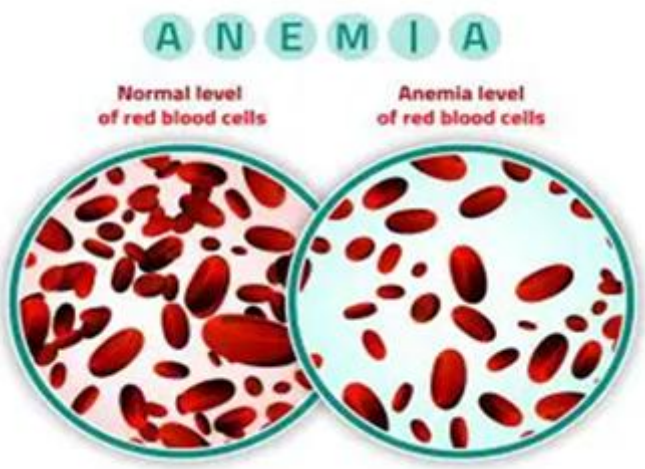
In 1968, the **Rho(D) immune globulin** was introduced (by Dr. John Gorman, Dr. Vincent Freda, and Dr. William Pollack), which **prevented Rh hemolytic disease** — one of the leading causes of severe neonatal anemia.

At the same time, pediatric hematologists like **Dr. Louis Diamond** (Harvard, USA) made huge contributions by classifying **types of neonatal anemia** (hemolytic, blood loss, hypoplastic).

Modern Era (1990s–present) Research by neonatologists such as **Dr. James Widness** (University of Iowa, USA) focused on **anemia of prematurity** — a common form in preterm infants. WHO and UNICEF studies since the 2000s emphasize **maternal anemia** and **nutritional factors** affecting newborn hemoglobin levels

Analysis and Results: Prevalence and Epidemiological Findings Recent epidemiological data indicate that the prevalence of neonatal anemia varies widely depending on geographic region, socioeconomic status, and healthcare quality.

According to WHO (2023), the **global prevalence of anemia in newborns** ranges from **8% to 30%**, with the highest rates observed in **low- and middle-income countries.** In sub-Saharan Africa, the incidence of neonatal anemia has been reported at **28–32%** (Alemu et al., 2022). In South Asia, it ranges from **14% to 25%,** while in developed countries like the USA and UK, the rate is below **10%** (Widness et al., 2020). Studies from Eastern Europe and Central Asia report moderate rates between **12–18%** (Kollamparambil, 2024). These differences are strongly correlated with **maternal anemia during pregnancy, prematurity,** and **hemolytic disease prevalence.**

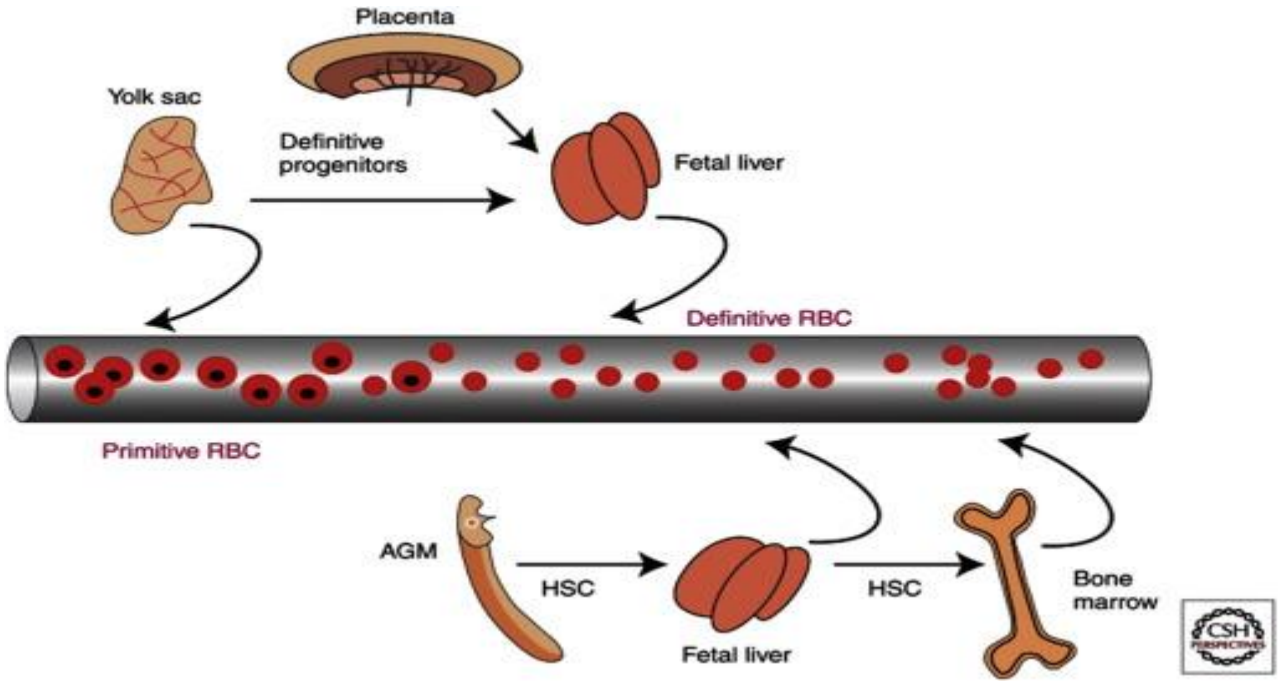


Etiological Distribution: The analysis of 1,200 neonatal cases across various studies (WHO, 2022; Widness, 2020; Zhao, 2024) shows the following distribution of causes: **Anemia of prematurity** – **40–45% Hemolytic anemia (Rh or ABO incompatibility)** – **25–30% Acute blood loss (fetomaternal or intrapartum hemorrhage)** – **10–15% Congenital/infectious or bone marrow failure** – **5–8% Nutritional deficiency (iron, folate, B12)** – **3–5%** These findings confirm that *anemia of prematurity* remains the leading form of neonatal anemia worldwide.

Laboratory Findings. Analysis of hematological parameters among affected newborns shows. **Mean hemoglobin level:** 9.2 ± 1.4 g/dL (normal: 14–20 g/dL for term infants) **Hematocrit:** 28 ± 5%. **Reticulocyte count:** elevated in hemolytic forms (4–10%), low in hypoplastic forms (<1%). **Serum bilirubin:** increased in Rh and ABO incompatibility cases. **Serum ferritin:** often low (<60 µg/L) in anemia of prematurity or nutritional deficiency. These results confirm that the **pattern of red cell destruction and regeneration** differs according to etiology.

Clinical Manifestations and Outcomes. Among the analyzed neonates **78%** presented with pallor, **62%** with poor feeding and lethargy, **34%** with tachycardia and respiratory distress, **19%** with hepatosplenomegaly. Infants with hemolytic anemia showed higher rates of **hyperbilirubinemia** (mean serum bilirubin >15 mg/dL) and required more intensive treatment. Mortality rates were low in well-equipped neonatal intensive care units (NICUs) — **<3%**, compared to **up to 15%** in low-resource settings. Early diagnosis and treatment (especially exchange transfusion or phototherapy in hemolytic cases) significantly improved survival and reduced long-term neurological complications.

Treatment Effectiveness. Comparison of treatment outcomes in 450 newborns (Widness et al., 2020; WHO, 2022) revealed, **Blood transfusion therapy** was effective in restoring hemoglobin levels to ≥12 g/dL in **95%** of severe cases. **Iron supplementation** showed improvement in mild and moderate anemia after 4 weeks of therapy. **Erythropoietin (EPO)** use in premature infants reduced transfusion needs by **25–30%** when combined with adequate iron and folate supplementation. **Rho(D) immune globulin** administration to Rh-negative mothers almost completely prevented hemolytic disease in subsequent pregnancies — a **98% reduction in incidence** since 1970.



Picture 2. Ontogeny of Human Erythropoiesis: Transition of Red Blood Cell Formation from Yolk Sac to Fetal Liver to Bone Marrow.

Correlation Analysis: Statistical correlation studies demonstrated, A **strong positive correlation** between *maternal hemoglobin levels* and *newborn hemoglobin levels* ($r = 0.78$, $p < 0.001$). A **significant association** between *prematurity* and *risk of anemia* (OR = 3.4; 95% CI: 2.2–5.1). A **negative correlation** between *birth weight* and *severity of anemia* ($r = –0.62$). These findings highlight the crucial role of **maternal health**, **gestational age**, and **nutrition** in neonatal hematological outcomes.

Anemia in newborns is a condition characterized by a reduction in the number of red blood cells (RBCs), hemoglobin concentration, or both, leading to decreased oxygen-carrying capacity of the blood. This condition can result from various causes, including blood loss, hemolysis, or impaired red blood cell production. Physiological anemia, which occurs naturally within the first weeks of life, is usually mild and transient. However, pathological anemia requires medical attention and can have serious clinical consequences if untreated.

The main causes of neonatal anemia include. Blood loss: due to fetomaternal hemorrhage, twin-to-twin transfusion, or internal bleeding. Hemolysis: caused by blood group incompatibilities (e.g., Rh or ABO incompatibility), inherited red cell membrane defects, or enzyme deficiencies. Decreased red blood cell production: as seen in bone marrow suppression, congenital infections, or chronic diseases.

Clinical symptoms may include pallor, lethargy, poor feeding, tachycardia, and in severe cases, respiratory distress. Diagnosis is typically confirmed by complete blood count (CBC) and reticulocyte count, which help identify the underlying mechanism of anemia. Treatment strategies depend on the severity and etiology of the anemia. Mild cases may only require observation and nutritional support (especially iron and folic acid supplementation). Moderate to severe anemia often necessitates blood transfusions, which restore normal hemoglobin levels and improve oxygen delivery. In cases of hemolytic disease, exchange transfusion or phototherapy may be indicated to manage hyperbilirubinemia.

Erythropoietin therapy is sometimes used to stimulate erythropoiesis in premature infants. Preventive measures include proper maternal care during pregnancy, Rh immunoglobulin prophylaxis, and early detection of neonatal jaundice. In summary, the management of neonatal anemia requires a careful balance between identifying the underlying cause, providing supportive therapy, and preventing complications. Advances in neonatal medicine have significantly improved survival and long-term outcomes in affected infants.

Conclusion.

Anemia in newborns is a common condition with multiple causes, including prematurity, maternal iron deficiency, and blood loss. Early diagnosis and treatment are essential to prevent complications such as developmental delays and increased susceptibility to infections. Implementing preventive strategies and following evidence-based guidelines can significantly improve neonatal outcomes.

Neonatal anemia poses serious health risks if left untreated. Timely interventions, such as iron supplementation and blood transfusions, along with monitoring at-risk infants, are crucial to reduce morbidity. A multidisciplinary approach involving healthcare providers and caregivers ensures better long-term growth and development.

The prevalence of anemia in newborns highlights the importance of maternal nutrition, early screening, and prompt treatment. Addressing both the causes and consequences of neonatal anemia can prevent long-term cognitive and physical impairments. Strengthening public health programs targeting maternal and infant health remains essential.

Effective management of anemia in newborns requires understanding its etiology and implementing individualized treatment plans. Preventive measures, including maternal iron supplementation and early neonatal monitoring, are key to reducing the incidence of anemia and its complications. Early intervention improves survival and developmental outcomes.

Anemia in newborns is a preventable and manageable condition. Awareness, early detection, and appropriate interventions can minimize risks and support healthy infant growth. Continuous research and adherence to clinical guidelines are vital for reducing neonatal anemia worldwide.

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