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HEMOLITIC DISEASES IN INFANTS

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Annotation: This article discusses the causes of hemolytic disease in infants, the mechanisms of development, clinical manifestations, diagnosis and treatment methods. The main cause of the disease is immunological imbalance between the mother and child, in particular, the discrepancy between the Rh factor and AB0 blood groups. The study provides information about the clinical signs of hemolytic disease, including jaundice, hemolytic anemia, liver and spleen enlargement, as well as its complications. Attention is also paid to modern diagnostic and treatment methods: phototherapy, blood transfusion, drug treatment and resuscitation measures are analyzed. Of the preventive measures, the effectiveness of the use of anti-D immunoglobulin in preventing Rh incompatibility is especially emphasized. The scientific and practical significance of this work is that it develops recommendations for the prevention, timely detection and treatment of hemolytic disease in infants. This will serve to improve children's health in the field of pediatrics and neonatology, and raise a healthy generation.

Keywords: hemolytic disease of newborns, rhesus incompatibility, AB0 system, immunological conflict, hemolysis, jaundice (neonatal icterus), hemolytic anemia, anti-D immunoglobulin, phototherapy, blood transfusion, neonatology, prevention.

CHAQALOQLARDAGI GEMOLITIK KASALLIKLAR

Abu Ali Ibn Sino nomidagi 1-Respublika jamoat salomatligi

texnikumi o'qituvchisi

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Annotatsiya: Ushbu maqolada chaqaloqlardagi gemolitik kasallikning kelib chiqish sabablari, rivojlanish mexanizmlari, klinik ko‘rinishlari, tashxislash va davolash usullari yoritilgan. Kasallikning asosiy sababi sifatida ona va bola organizmlari o‘rtasidagi immunologik nomutanosiblik — xususan, rezus omil va AB0 qon guruhlari bo‘yicha kelishmovchilik ko‘rsatilgan. Tadqiqotda gemolitik kasallikning klinik belgilaridan sariqlik, gemolitik anemiya, jigar va taloq kattalashishi, shuningdek, asoratlari haqida ma’lumot beriladi. Shuningdek, zamonaviy diagnostika va davolash usullariga e’tibor qaratilgan: fototerapiya, qon quyish, dori vositalari bilan davolash va reanimatsion tadbirlar tahlil qilingan. Profilaktika choralaridan rezus nomutanosiblikni oldini olishda anti-D immunoglobulin qo‘llashning samaradorligi alohida ta’kidlangan. Mazkur ishning ilmiy va amaliy ahamiyati shundaki, unda chaqaloqlarda uchraydigan gemolitik kasallikning oldini olish, uni o‘z vaqtida aniqlash va davolash bo‘yicha tavsiyalar ishlab chiqiladi. Bu esa pediatriya va neonatologiya sohasida bolalar salomatligini yaxshilashga, sog‘lom avlodni tarbiyalashga xizmat qiladi.

Kalit so‘zlar: chaqaloqlarda gemolitik kasallik, rezus nomutanosiblik, AB0 tizimi, immunologik konflikt, gemoliz, sariqlik (neonatal ikterus), gemolitik anemiya, anti-D immunoglobulin, fototerapiya, qon quyish (transfuziya), neonatologiya, profilaktika.

ГЕМОЛИТИЧЕСКИЕ ЗАБОЛЕВАНИЯ У ДЕТЕЙ МЛАДЕНЦЕВ

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Аннотация: В статье рассматриваются причины гемолитической болезни у детей раннего возраста, механизмы развития, клинические проявления, диагностика и методы лечения. Основной причиной заболевания является иммунологический дисбаланс матери и ребенка, в частности, несоответствие резус-фактора и групп крови AB0. В исследовании представлены сведения о клинических проявлениях гемолитической болезни, включая желтуху, гемолитическую анемию, увеличение печени и селезенки, а также ее осложнения. Уделяется внимание современным методам диагностики и лечения: фототерапии, гемотрансфузии, медикаментозному лечению и реанимационным мероприятиям. Из профилактических мер особо подчеркивается эффективность применения анти-D иммуноглобулина в профилактике резус-конфликта. Научно-практическая значимость данной работы заключается в разработке рекомендаций по профилактике, своевременному выявлению и лечению гемолитической болезни у детей раннего возраста. Это будет способствовать укреплению здоровья детей в области педиатрии и неонатологии, воспитанию здорового поколения.

Ключевые слова: гемолитическая болезнь новорожденных, резус-несовместимость, система AB0, иммунологический конфликт, гемолиз, желтуха новорожденных, гемолитическая анемия, анти-D иммуноглобулин, фототерапия, переливание крови, неонатология, профилактика.

Hemolytic diseases of newborns are one of the urgent problems in neonatology and pediatrics. This condition is characterized by premature and excessive destruction (hemolysis) of the baby's blood cells, that is, erythrocytes. As a result, the level of bilirubin in the body increases, which in severe cases can negatively affect the central nervous system and even threaten the baby's life. Hemolytic diseases occur under the influence of various etiological factors. These include hereditary diseases (for example, thalassemia, spherocytosis), conditions associated with the immune system (for example, incompatibility of the mother's blood group or Rh factor), as well as hemolysis caused by infections or toxins. In particular, immune hemolytic diseases, such as Rh-conflict or ABO incompatibility, are the most common and clinically significant forms of neonatal hemolytic diseases.

The importance of this topic is that if hemolytic diseases are not detected early and treated adequately, they can lead to severe complications in the baby, including kernicterus, neurological disorders, and even death. Therefore, early diagnosis, correct differential diagnosis, and the use of effective treatment methods are among the main tasks of doctors.

Today, hemolytic diseases in infants remain one of the most pressing problems in pediatrics and neonatology. In particular, immune hemolytic diseases — those that occur as a result of blood group or Rh factor incompatibility between mother and child — pose a serious threat not only to health, but also to the life of the baby.

Despite the development of medical technologies, in many regions these diseases are not detected early or are not treated adequately. This leads to an increase in complications such as severe forms of jaundice, kernicterus, mental and physical retardation, and even perinatal death. At the same time, developing effective methods for the prevention of hemolytic diseases, proper monitoring of mothers before and during pregnancy, establishing immunological control, as well as improving algorithms for early detection and treatment of the disease in newborns are among the urgent issues of modern medicine.

Hemolytic diseases are conditions that occur when maternal alloantibodies destroy fetal or newborn red blood cells due to differences in maternal and fetal blood types or other red blood cell antigens. The most common types are Rh (e.g., RhD), Kell, and ABO incompatibility. Severe forms of the disease require hydrops fetalis, increased hepatic or extragastric bilirubin, anemia, exchange transfusions, and invasive procedures such as IVIG, and sometimes IUT (intrauterine transfusion).

Prevalence and types of alloimmunization

— According to the results of a recent systematic review, the prevalence of HDFN due to RhD and Kell alloimmunization is low (Rh(D)mediated approximately 0.047%, Kellmediated approximately 0.006%).

— In the future, other types of antibodies (e.g., anti, antiE, antiK, minor antigens) are also becoming increasingly important, especially in countries where RhD prophylaxis is widespread. Diagnostic techniques and monitoring developments

— Ultrasound and Doppler studies: Fetal anemia is increasingly being diagnosed with peak systolic velocity (PSV) measurements using fetal middle cerebral artery (MCA) Doppler. This reduces the need for invasive amniocentesis and cordocentesis.

— Antibody titers and generational differences: Antibody titers (concentrations) and their “potency” are important, as are maternal immunization history, rapid titer changes, and the aggressiveness of the antibody type (e.g., suppression of erythropoietic precursor cells in Kell antibodies).

— New biomarkers and laboratory diagnostics: Some studies are using new methods—e.g., maternal antibody classes, serological tests that increase specificity, and molecular genotyping techniques.

Antenatal prophylaxis and treatment updates

— Rh immunoglobulin prophylaxis: The standard of care in RhD-developed countries—prophylactic antiD is given during pregnancy and after delivery if the mother is RhD-negative. However, challenges in delivering anti-D immunoglobulin persist, particularly in resource-poor settings.

— Intrauterine transfusions (IUT): IUT is an important treatment if there is evidence of fetal anemia or hydrops. Recent analyses have shown that the first IUT is usually performed between 25 and 27 weeks of gestation.

— Plasmapheresis and IVIG: Some studies suggest that IVIG (intravenous immunoglobulin) and plasmapheresis may help reduce maternal antibody titers and reduce the need for IUT in cases of severe immunization. The evidence in this direction is not yet complete, but it is promising.

Postnatal care and outcomes

Treatment methods and differences between centers

— A recent global and multicenter cohort study (1855 infants, 22 countries) showed that there are large differences in postnatal care:

• Other treatments: exchange transfusion rate — ranging from 0% to 78% depending on the center.

• Use of IVIG — ranging from 0100%.

— Babies born at a lower gestational age (i.e., after 37 weeks) have been found to have fewer exchange transfusion needs and complications.

New conditions and complications

— Severe cholestasis: Conditions in which the level of conjugated bilirubin in the newborn is very high, but the liver function is considered insufficient (for example, as a result of anti-D immunization in twins). This is one of the new complications observed in HDFN.

— Iron overload: Increased iron levels and excessive iron accumulation in the body (ferritin levels) are a significant problem in infants receiving IUT.

Outcomes and factors

— Gestational age, fetal weight, antibody type, titer level, IUT, and continuous prenatal care have been identified as important factors.

— IUT during pregnancy, with IVIG if necessary, helps to end with fewer complications in the baby, but invasiveness and other risks (preterm birth, infection, PROM, etc.) remain.

Gaps and challenges

Lack of evidence: Most studies have been conducted in the form of case reports or case series, in small centers. Large, randomized trials are few.

Lack of standardized procedures: There is significant inter-center variation in postnatal care (exchange transfusion, IVIG, red blood cell transfusions, etc.). Consensus and roadmaps are needed for this practice.

Lack of resources: Resources such as CT, Doppler ultrasonography, antibody testing, IVIG, donor blood for referral, and O negative donors are limited in some settings.

Risk-related invasive procedures: Procedures such as IUT pose risks to both mother and fetus, so a balanced approach is needed.

Recent developments in this area include:

Collection and analysis of inter-center and inter-country data—global cohort studies (e.g., 31 centers, 22 countries) are identifying variations in postnatal care for HDFN. This provides a basis for scientifically setting standards and harmonizing protocols.

Gestational age optimization – exchange transfusion requirements and complications are significantly reduced in those born after 37 weeks. This introduces new approaches to prenatal and perinatal planning.

The identification of new complications in severe cases – for example, cases of severe cholestasis observed in infants due to HDFN, with markedly elevated serum bilirubin levels but no significant impairment of other liver functions – is a previously poorly understood condition.

Iron overload and its monitoring – The need for monitoring and taking precautions regarding ferritin levels and body iron accumulation in infants undergoing IUT has been raised.

The role and limitations of IVIG – new analyses, results and meta-analyses are being conducted on the use of IVIG against hyperbilirubinemia and alloimmunization; but robust evidence (randomized, large numbers) is still lacking.

Seek to reduce differences in data and medical protocols – the need to develop global roadmaps by understanding differences in practice between centers and countries.

Update protocols and guidelines – develop birth plans based on gestational week, develop standards for exchange transfusion, IVIG, transfusion and other procedures between centers.

Expanding the prevention network – preventing maternal immunization (antiD prophylaxis, antibody screening, donor blood matching) and improving prevention options in low-resource settings.

Improving monitoring and diagnostic infrastructure – ultrasonography + Doppler methods for early detection of fetal anemia and alloimmunization, antibody titer monitoring, molecular tests.

Assessing and managing iron status – using iron-restrictive treatments, diet, limited transfusions and, if necessary, chelators to prevent iron overload in infants receiving IUT.

Creating global databases – compiling large-scale data on disease, treatment, outcomes, meta-analyses and guidelines.

There are prospects and proposals for research, clinical and health care in the following areas:

Large randomized clinical trials

For example, the use of IVIG vs. non-standard treatment, determining the optimal timing and doses for different types of antibodies (Kell, antic, antiE).

Genetic and molecular studies

Study of antibody aggressiveness, effects on fetal erythropoiesis, genotype-phenotype compatibility, small antigen variants and population differences.

Technological innovations

— Perinatal monitoring using telemedicine and puncture devices.

— Automated diagnostics in ultrasonography or fetal blood flow assessment using artificial intelligence (AI) and image analysis.

Protocols adapted to local conditions

Inexpensive but effective measures, especially for low-resource countries: smart transfusions, low-cost versions of IVIG, mobile screening centers.

Education and awareness raising

The importance of antibody prophylaxis for parents, healthcare workers, ABO/Rh compatibility, antibody screening.

Hemolytic diseases, especially HDFN, have made great strides in prevention, diagnosis, and treatment. However, gaps remain, including differences in practice, resource constraints, risks associated with invasive procedures, and limited data on some antibody types. Scientific innovation - global data collection, optimization of gestational week, new diagnostic and therapeutic methods (IVIG, biopsies, molecular analysis), and strategies aimed at reducing complications.

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