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MITOCHONDRIAL DISEASES

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Abstract: This article compiles information about the causes, types, and treatment methods of mitochondrial diseases. Additionally, it includes data on the onset of these diseases in children and the importance of early diagnosis.

Keywords: *clinical psychology, medical sociology, random mutation, free radicals, gastrointestinal disorders, psychomotor disorders, muscle tone, hypotension.*

Health is a state in which any living organism and all its organs can fully perform their functions: the absence of defects and diseases (a detailed definition of health is provided below). The sciences Health studying health include dietetics, pharmacology, biology, epidemiology, psychology (health psychology, developmental psychology, experimental and clinical psychology, social psychology), psychiatry, pediatrics, medical sociology and anthropology, psychogenetics, defectology, among others. Protecting human health (healthcare) is one of the responsibilities of the state. Globally, the World Health Organization (WHO) is engaged in safeguarding human health. Mitochondria are small components found in body cells (over 1000 per cell). Mitochondria produce the energy necessary for our cells to grow and function. If mitochondria are damaged or malfunctioning, cells may fail to perform their functions and may become injured or die. These damaged or failing cells can lead to mitochondrial disease. Diagnosing mitochondrial disease can be challenging because it can present with a wide range of symptoms that vary from mild to severe. There are hundreds of different types of mitochondrial diseases. The impact on your specific type of cells depends on how they are affected. Issues may arise at birth or manifest later. In most cases, diagnosis occurs during childhood; however, initial cases in adults are also common. Mitochondrial disease affects between 40,000 to 70,000 Americans; out of these individuals, between 2,500 to 4,000 are born with it. Mitochondrial disease is a genetic condition that can result from inheritance from your parents or random mutations in DNA. Mitochondria can also be damaged by drugs or harmful substances known as free radicals. Numerous genetic mutations can cause the disease; however, identical mutations in different individuals do not always produce the same symptoms.

Mitochondria are present in 90 percent of our cells, so they can affect various organs, including the brain and muscles.[1] The systems most affected are typically the brain, heart, liver, skeletal muscles, kidneys, endocrine system, and respiratory system. The symptoms you define may depend on which cells and organs are affected, which may include:

- Brain: developmental delays, cognitive impairments, seizures, dementia
- Nerves: weakness, pain;
- Muscles: weakness, low tone, cramps, pain;
- Heart diseases;
- Eyes: sensitivity issues and visual impairments;
- Kidney diseases;
- Respiratory problems;
- Hearing ability.

Other symptoms may include gastrointestinal disturbances, difficulty swallowing, heart disease, liver disease, diabetes, lactic acidosis and a higher likelihood of infections. In children, the disease can also lead to poor growth and developmental delays. Diagnosing mitochondrial diseases is often challenging because symptoms can vary and mimic other conditions.[2] The involvement of multiple organ systems often indicates mitochondrial disease when three or more locations are affected. Diagnosis is difficult because the symptoms of the disease can suggest other conditions as well. Mitochondrial diagnosis is typically established only when test results requested are inconclusive. Identifying mitochondrial diseases often involves genetic and molecular tests conducted by specialists in mitochondrial disorders. Mitochondrial diseases are genetic; that is to say they manifest depending on whether there are mutations in mitochondrial DNA or not and on the effects of mutations within the cell. Each cell in the body contains hundreds of mitochondria, each with its own specific genetic material.[3] Mitochondria within a single cell can differ from one another; for instance, both the amount and type of DNA in mitochondria can vary from cell to cell. A mitochondrial disease occurs when the genetic material within mitochondria in that same cell has mutated negatively impacting their function. Thus, the more defective the mitochondria are, the less energy is produced; consequently increasing the likelihood that a cell will die will detrimentally affect the functioning of the organ to which it belongs.

Mitochondrial syndromes can manifest in various systems of the body, but the most distinct symptoms are neurological. This is related to the strong impact of hypoxia on nerve tissues. When skeletal muscles are affected, characteristic signs that may indicate mitochondrial syndrome

include hypotonia, insufficient tolerance to physical activity, various myopathies, ophthalmoplegia (paralysis of the eye muscles), and ptosis. Neurological manifestations may resemble stroke, including seizures, pyramidal disorders, and psychiatric conditions. Typically, in children with mitochondrial syndrome, there is always a delay in development or a loss of already acquired skills accompanied by psychomotor disorders. Endocrine system involvement may lead to the development of diabetes, dysfunction of the thyroid gland and pancreas, as well as delayed growth and puberty. Heart involvement can develop either alongside pathologies of other organs or in isolation. In this case, mitochondrial syndrome manifests as cardiomyopathy. Mitochondrial diseases are often diagnosed during the neonatal period or within the first years of life; according to foreign studies, this pathology is diagnosed in one out of every 5,000 newborns. Diagnosis requires comprehensive clinical, genetic, instrumental, biochemical, and molecular investigations.[4] As of today, there are several methods available for detecting this pathology. Electromyography can raise suspicion for mitochondrial pathologies even when normal results are found against a background of significant muscle weakness. Unfortunately, prognosis is often bleak due to late diagnosis of the disease, lack of detailed information about its pathogenesis, severe condition of patients with multisystem damage and absence of a single criterion for evaluating treatment efficacy. Thus, treatment options for such diseases are still under development and generally involve symptomatic and supportive therapy.

In summary from the information provided above: lactic acidosis is often associated with mitochondrial diseases. While its mere presence is not sufficient for diagnosis alone; measuring blood lactate levels after exercise can be very informative. Biopsy of skeletal muscles along with histochemical examination of the obtained biopsy specimens is considered highly informative. Good results have been shown by using both light and electron microscopy simultaneously on skeletal muscles. One of the most common childhood diseases related to genetic changes in mitochondria is Leigh syndrome which was first described in 1951. The first signs appear between one and three years old; however early manifestation may occur—either within the first month of life or conversely after seven years. Initial presentations include developmental delay, weight loss, loss of appetite leading to recurrent vomiting. Over time neurological symptoms add-on—such as impaired muscle tone (hypotonia, dystonia), seizures and coordination issues.

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