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A Review on Acatalasemia

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ABSTRACT

Catalase deficiency, also known as acatalasemia, is a disease marked by abnormally low levels of the enzyme catalase. Many individuals with acatalasemia have never had any health issues and are now diagnosed because they have affected family members. Some of the first people diagnosed with acatalasemia developed open sores (ulcers) within their mouths, resulting in soft tissue death (gangrene). Takahara disease is a disorder that occurs when acatalasemia causes mouth ulcers and gangrene. Because of changes in oral hygiene, these complications are rarely seen in more recent cases of acatalasemia. According to studies, people with acatalasemia are more likely to develop type 2 diabetes, which is the most common type of diabetes. Type 2 diabetes affects a higher proportion of people with acatalasemia than the general population, and the disorder strikes at a younger age. Acatalasemia may also be a risk factor for other common, complex diseases, according to researchers.

Keywords: Acatalasia, catalase, acatalasemia, Takahara disease, Diabetes.

INTRODUCTION

Acatalasia, or catalase deficiency, is another name for acatalasemia. It's a metabolic disorder (inborn error of metabolism) that causes erythrocytes to have very low catalase activity. Catalase is an antioxidant enzyme that breaks down hydrogen peroxide into oxygen and water. Acatalasemia is a very rare genetic condition that affects one out of every 31,250 people in the general population. According to numerous epidemiological reports, this disease affects one in every 12,500 people in Japan, one in every 25,000 in Switzerland, and one in every 20,000 in Hungary. [1]

Acatalasemia is a disease that is inherited in an autosomal recessive pattern and is usually asymptomatic. Takahara disease is a rare complication of the disease that results in the development of ulcers within the mouth and the death of soft tissue due to a lack of oxygen (gangrene). Furthermore, people with acatalasemia are more likely to develop diabetes and atherosclerosis.

Acatalasia is an autosomal recessive peroxisomal condition in which the enzyme catalase is absent or has very low levels. [two] In cells, catalase converts hydrogen peroxide to water and oxygen. Low levels

of catalase can lead to a buildup of hydrogen peroxide, which can harm cells. [3][Fig:1&2].

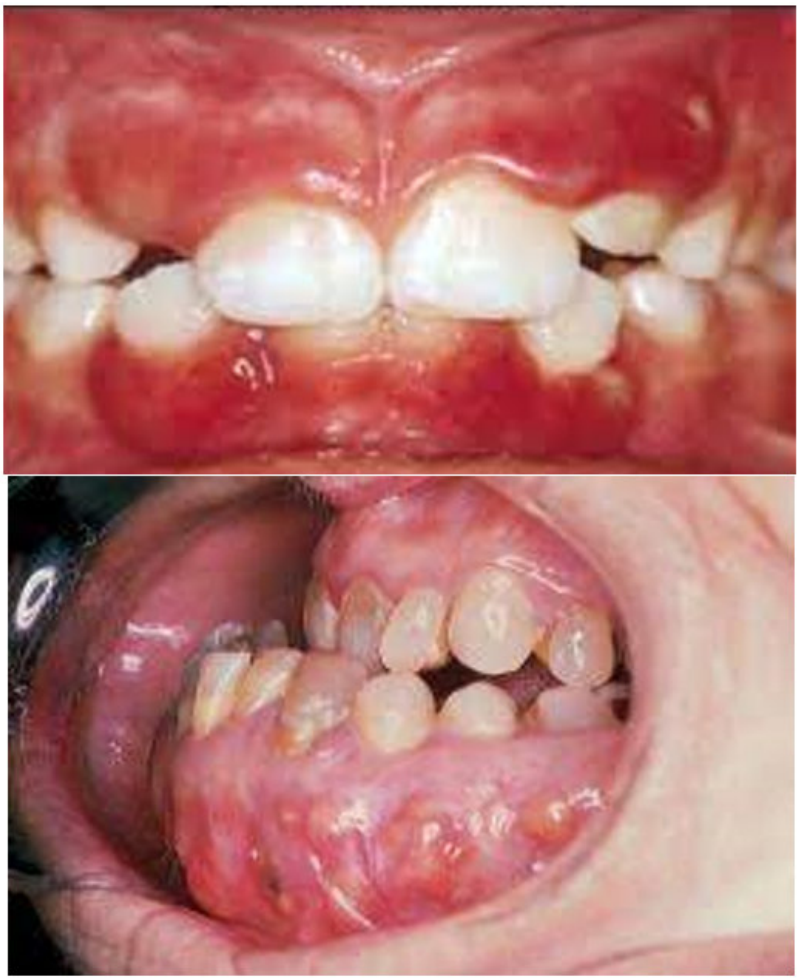

Fig 1: Acatalasemia

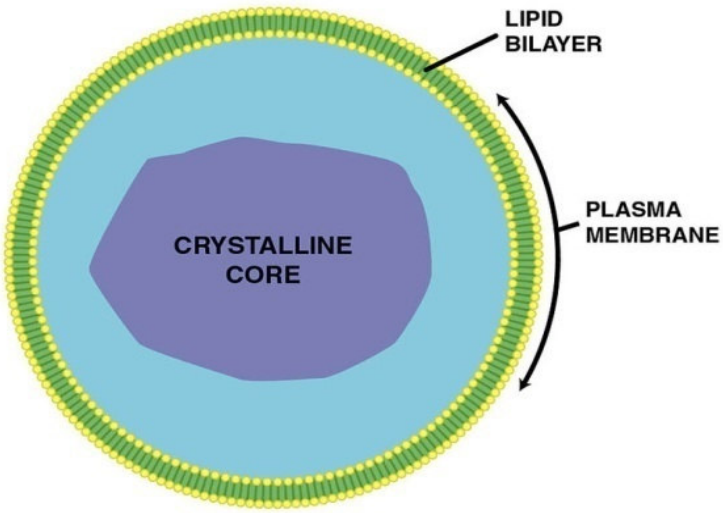

Fig 2: Peroxisome

HISTORY

Dr. Shigeo Takahara (1908–1994), a Japanese otolaryngologist, was the first to mention the disease in 1948. [4] He had just finished examining a patient who had an oral ulcer. He sprayed hydrogen peroxide on the infected area, but due to a lack of catalase, no oxygen was produced.

CAUSES

Acatalasemia is caused by mutations in the CAT gene. This gene directs the development of the enzyme catalase, which converts hydrogen peroxide molecules into oxygen and water. Within cells, hydrogen peroxide is formed by chemical reactions. It is involved in many chemical signalling pathways at low levels, but it is toxic to cells at high levels. Additional reactions transform hydrogen peroxide into reactive oxygen species, which can destroy DNA, proteins, and cell membranes if it is not broken down by catalase.

Catalase activity is significantly reduced by mutations in the CAT gene. In some cells, a lack of this enzyme may cause hydrogen peroxide to build up to toxic levels. Hydrogen peroxide formed by bacteria in the mouth, for example, can accumulate in soft tissues and cause mouth ulcers and gangrene. The beta cells of the pancreas, which release the hormone insulin to help regulate blood sugar, can be damaged by hydrogen peroxide accumulation. The increased risk of type 2 diabetes in people with acatalasemia is believed to be due to malfunctioning beta cells. It's unknown why certain people have no health issues when their catalase activity is reduced. [5], [6].

Many people with low catalase activity don't have a known mutation in the CAT gene, so the cause of their disorder is unclear. Other genetic and environmental factors, according to researchers, may influence catalase behaviour.[7]

Mutations in both copies of the CAT gene, which codes for the enzyme catalase, are often the cause of acatalasia. [8] This disorder can be caused by a variety of genetic mutations. Hypocatalasia is caused by inheriting a single CAT mutation, in which catalase levels are decreased but still functional. [9]

Acatalasemia is caused by mutations in the CAT gene, which codes for catalase. Owing to inadequate decomposition, a catalase deficiency results in an unnecessary accumulation of hydrogen peroxide. While hydrogen peroxide acts as a signalling molecule at low concentrations, it is extremely toxic at higher concentrations.

Hydrogen peroxide can be converted into more toxic reactive oxygen species through a series of chemical reactions, causing oxidative damage to DNA, proteins, and lipids, resulting in oxidative stress. The asymptomatic aspect of the disorder, on the other hand, may be attributed to the compensatory action of other catalase-like enzymes, such as glutathione peroxidase.[10], [11]

Soft tissue damage caused by hydrogen peroxide causes mouth ulcers and gangrene in people with acatalasemia. Furthermore, hydrogen peroxide kills pancreatic beta cells and impairs insulin secretion. This may be the primary explanation for acatalasemia patients' increased vulnerability to diabetes mellitus. In some people, acatalasemia is not associated with *CAT* gene mutation, suggesting that epigenetic and environmental factors may also be responsible for both the disease development and the ensuing complications.

INHERITANCE

Acatalasemia has an autosomal recessive pattern of inheritance, which means both copies of the CAT gene in each cell have mutations. When both copies of the gene are altered, the activity of catalase is reduced to less than 10 percent of normal.

When only one of the two copies of the CAT gene has a mutation, the activity of catalase is reduced by approximately half. This reduction in catalase activity is often called hypocatalasemia. Like acatalasemia, hypocatalasemia usually does not cause any health problems.[12] [Fig:3]

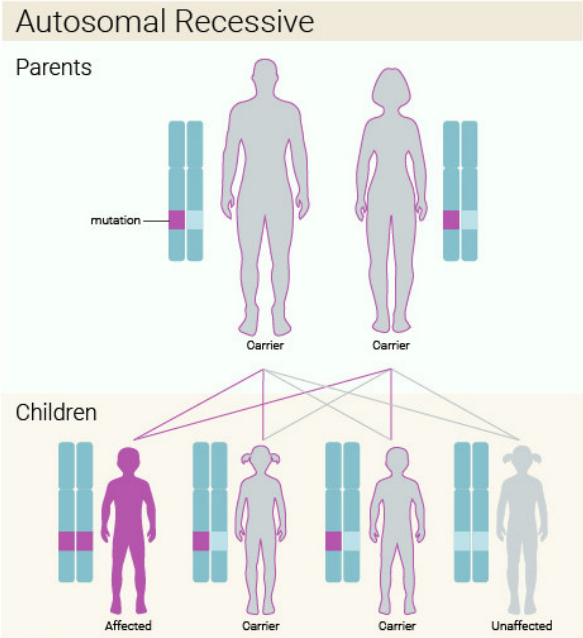

Fig 3: Autosomal recessive pattern of inheritance

DIAGNOSIS

An examination of the mouth is used to make the initial diagnosis of acatalasemia, which is accompanied by a detailed family history of the suspected patient. Molecular genetic testing (study of a single gene or short segments of DNA), chromosomal genetic testing (study of the entire chromosome or long segments of DNA), and biochemical genetic testing are used to validate the diagnosis (study of amount or activity of proteins).

Next generation sequencing of the entire coding region of *CAT* gene and deletion/duplication analysis are most commonly used diagnostic methods for acatalasemia. The tests are mainly employed to identify the causative mutations in suspected patients.

This disorder is commonly diagnosed pouring hydrogen peroxide on the patient's blood sample. Instead of a very bubbling reaction, blood turns brown-colored, which means the patient suffers from acatalasia [13]

TREATMENT

There is currently no treatment for acatalasemia. Periodontal therapies are usually known to minimise tissue damage and improve oral hygiene since the key symptoms of acatalasemia are oral ulcer and gangrene. In terms of gene and enzyme therapy, animal studies show that implanting artificial cells containing exogenous catalase can replace the non-functioning endogenous enzyme and improve acatalasemia symptoms. However, there are currently no human studies available to support this claim. [14, 16].

REFERENCES

[1]. Góth L, Eaton JW. Hereditary catalase deficiencies and increased risk of diabetes. Lancet. 2000 Nov 25;356(9244):1820-1.
[2]. Genetics Home. "acatalasemia". Genetics Home Reference. Retrieved 7 November 2017.
[3]. Góth L, Nagy T. Acatalasemia and diabetes mellitus. Arch BiochemBiophys. 2012 Sep 15;525(2):195-200. doi: 10.1016/j.abb.2012.02.005. Epub 2012 Feb 16. Review.
[4]. Takahara, Shigeo; Hamilton, H. B.; Neel, J. V.; Kobara, T. Y.; Ogura, Y.; Nishimura, E. T. (1960). "Hypocatalasemia: a new genetic carrier state". Journal of Clinical Investigation. 39 (4): 610–619. doi:10.1172/JCI104075. PMC 293346. PMID 13836629.
[5]. Góth L, Nagy T. Inherited catalase deficiency: is it benign or a factor in various age related disorders? Mutat Res. 2013 Oct-Dec;753(2):147-154. doi: 10.1016/j.mrrev.2013.08.002. Epub 2013 Sep 8. Review.
[6]. https://ghr.nlm.nih.gov/condition/acatalasemia#synonyms
[7]. Góth L, Rass P, Páy A. Catalase enzyme mutations and their association with diseases. Mol Diagn. 2004;8(3):141-9. Review.
[8]. "Acatalasemia". Genetics Home Reference. Retrieved 2015-09-28.
[9]. "OMIM Entry - # 614097 - ACATALASEMIA". www.omim.org

[10]. https://rarediseases.info.nih.gov/diseases/363/acatalasemia
[11]. https://www.ncbi.nlm.nih.gov/pubmed/24522161
[12]. Góth L. A new type of inherited catalase deficiencies: its characterization and comparison to the Japanese and Swiss type of acatalasemia. Blood Cells Mol Dis. 2001 Mar-Apr;27(2):512-7.
[13]. www.hopkinsmedicine.org/dnadiagnostic/tests/tests/acatalasemia-test
[14]. www.sciencedirect.com/.../catalase-deficiency.
[15]. James, William D.; Berger, Timothy G.; et al. (2006). Andrews' Diseases of the Skin: Clinical Dermatology. Saunders Elsevier. ISBN 978-0-7216-2921-6.
[16]. Takahara, Shigeo; Hamilton, H. B.; Neel, J. V.; Kobara, T. Y.; Ogura, Y.; Nishimura, E. T. (1960). "Hypocatalasemia: a new genetic carrier state". Journal of Clinical Investigation. 39 (4): 610–619. doi:10.1172/JCI104075. PMC 293346. PMID 13836629.

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