# Schindler Disease

Subjects: Genetics & Heredity
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Schindler disease is an inherited disorder that primarily causes neurological problems.

Keywords: genetic conditions

## 1. Introduction

There are three types of Schindler disease. Schindler disease type I, also called the infantile type, is the most severe form. Babies with Schindler disease type I appear healthy at birth, but by the age of 8 to 15 months they stop developing new skills and begin losing skills they had already acquired (developmental regression). As the disorder progresses, affected individuals develop blindness and seizures, and eventually they lose awareness of their surroundings and become unresponsive. People with this form of the disorder usually do not survive past early childhood.

Schindler disease type II, also called Kanzaki disease, is a milder form of the disorder that usually appears in adulthood. Affected individuals may develop mild cognitive impairment and hearing loss caused by abnormalities of the inner ear (sensorineural hearing loss). They may experience weakness and loss of sensation due to problems with the nerves connecting the brain and spinal cord to muscles and sensory cells (peripheral nervous system). Clusters of enlarged blood vessels that form small, dark red spots on the skin (angiokeratomas) are characteristic of this form of the disorder.

Schindler disease type III is intermediate in severity between types I and II. Affected individuals may exhibit signs and symptoms beginning in infancy, including developmental delay, seizures, a weakened and enlarged heart (cardiomyopathy), and an enlarged liver (hepatomegaly). In other cases, people with this form of the disorder exhibit behavioral problems beginning in early childhood, with some features of autism spectrum disorders. Autism spectrum disorders are characterized by impaired communication and socialization skills.

## 2. Frequency

Schindler disease is very rare. Only a few individuals with each type of the disorder have been identified.

## 3. Causes

Mutations in the *NAGA* gene cause Schindler disease. The *NAGA* gene provides instructions for making the enzyme alpha-N-acetylgalactosaminidase. This enzyme works in the lysosomes, which are compartments within cells that digest and recycle materials. Within lysosomes, the enzyme helps break down complexes called glycoproteins and glycolipids, which consist of sugar molecules attached to certain proteins and fats. Specifically, alpha-N-acetylgalactosaminidase helps remove a molecule called alpha-N-acetylgalactosamine from sugars in these complexes.

Mutations in the *NAGA* gene interfere with the ability of the alpha-N-acetylgalactosaminidase enzyme to perform its role in breaking down glycoproteins and glycolipids. These substances accumulate in the lysosomes and cause cells to malfunction and eventually die. Cell damage in the nervous system and other tissues and organs of the body leads to the signs and symptoms of Schindler disease.

### 3.1.The Gene Associated with Schindler Disease

- NAGA

## 4. Inheritance

This condition is inherited in an autosomal recessive pattern, which means both copies of the gene in each cell have mutations. The parents of an individual with an autosomal recessive condition each carry one copy of the mutated gene, but they typically do not show signs and symptoms of the condition.

## 5. Other Names for This Condition

- alpha-galactosidase B deficiency
- alpha-galNAc deficiency, Schindler type
- alpha-N-acetylgalactosaminidase deficiency
- alpha-NAGA deficiency
- angiokeratoma corporis diffusum-glycopeptiduria
- GALB deficiency
- Kanzaki disease
- lysosomal glycoaminoacid storage disease-angiokeratoma corporis diffusum
- NAGA deficiency
- neuroaxonal dystrophy, Schindler type
- neuronal axonal dystrophy, Schindler type

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### References


1. Blanchon YC, Gay C, Gibert G, Lauras B. A case of N-acetyl galactosaminidasedeficiency (Schindler disease) associated with autism. J Autism Dev Disord. 2002 Apr;32(2):145-6.
2. Chabás A, Duque J, Gort L. A new infantile case ofalpha-N-acetylgalactosaminidase deficiency. Cardiomyopathy as a presentingsymptom. J Inherit Metab Dis. 2007 Feb;30(1):108.
3. Clark NE, Garman SC. The 1.9 a structure of humanalpha-N-acetylgalactosaminidase: The molecular basis of Schindler and Kanzakidiseases. J Mol Biol. 2009 Oct 23;393(2):435-47. doi: 10.1016/j.jmb.2009.08.021.
4. Desnick RJ, Wang AM. Schindler disease: an inherited neuroaxonal dystrophy dueto alpha-N-acetylgalactosaminidase deficiency. J Inherit Metab Dis.1990;13(4):549-59. Review.
5. Kanda A, Tsuyama S, Murata F, Kodama K, Hirabayashi Y, Kanzaki T.Immunoelectron microscopic analysis of lysosomal deposits inalpha-N-acetylgalactosaminidase deficiency with angiokeratoma corporis diffusum. J Dermatol Sci. 2002 May;29(1):42-8.
6. Kanekura T, Sakuraba H, Matsuzawa F, Aikawa S, Doi H, Hirabayashi Y, Yoshii N,Fukushige T, Kanzaki T. Three dimensional structural studies ofalpha-N-acetylgalactosaminidase (alpha-NAGA) in alpha-NAGA deficiency (Kanzakidisease): different gene mutations cause peculiar structural changes inalpha-NAGAs resulting in different substrate specificities and clinicalphenotypes. J Dermatol Sci. 2005 Jan;37(1):15-20.
7. Kanzaki T, Yokota M, Irie F, Hirabayashi Y, Wang AM, Desnick RJ. Angiokeratomacorporis diffusum with glycopeptiduria due to deficient lysosomalalpha-N-acetylgalactosaminidase activity. Clinical, morphologic, and biochemical studies. Arch Dermatol. 1993 Apr;129(4):460-5.
8. Kodama K, Kobayashi H, Abe R, Ohkawara A, Yoshii N, Yotsumoto S, Fukushige T, Nagatsuka Y, Hirabayashi Y, Kanzaki T. A new case ofalpha-N-acetylgalactosaminidase deficiency with angiokeratoma corporis diffusum, with Ménière's syndrome and without mental retardation. Br J Dermatol. 2001Feb;144(2):363-8.
9. Michalski JC, Klein A. Glycoprotein lysosomal storage disorders: alpha- andbeta-mannosidosis, fucosidosis and alpha-N-acetylgalactosaminidase deficiency.Biochim Biophys Acta. 1999 Oct 8;1455(2-3):69-84. Review.
10. Sakuraba H, Matsuzawa F, Aikawa SI, Doi H, Kotani M, Nakada H, Fukushige T,Kanzaki T. Structural and immunocytochemical studies onalpha-N-acetylgalactosaminidase deficiency (Schindler/Kanzaki disease). J HumGenet. 2004;49(1):1-8. doi: 10.1007/s10038-003-0098-z.

11. Umehara F, Matsumuro K, Kurono Y, Arimura K, Osame M, Kanzaki T. Neurologicmanifestations of Kanzaki disease. Neurology. 2004 May 11;62(9):1604-6.