Familial glucocorticoid deficiency

Familial glucocorticoid deficiency is a condition that occurs when the adrenal glands, which are hormone-producing glands located on top of each kidney, do not produce certain hormones called glucocorticoids. These hormones, which include cortisol and corticosterone, aid in immune system function, play a role in maintaining normal blood sugar levels, help trigger nerve cell signaling in the brain, and serve many other purposes in the body.

A shortage of adrenal hormones (adrenal insufficiency) causes the signs and symptoms of familial glucocorticoid deficiency. These signs and symptoms often begin in infancy or early childhood. Most affected children first develop low blood sugar (hypoglycemia). These hypoglycemic children can fail to grow and gain weight at the expected rate (failure to thrive). If left untreated, hypoglycemia can lead to seizures, learning difficulties, and other neurological problems. Hypoglycemia that is left untreated for prolonged periods can lead to neurological damage and death. Other features of familial glucocorticoid deficiency can include recurrent infections and skin coloring darker than that of other family members (hyperpigmentation).

There are multiple types of familial glucocorticoid deficiency, which are distinguished by their genetic cause.

Frequency

The prevalence of familial glucocorticoid deficiency is unknown.

Genetic Changes

Mutations in the MC2R, MRAP, and NNT genes account for the majority of cases of familial glucocorticoid deficiency; mutations in other genes, some known and some unidentified, can also cause this condition.

The MC2R gene provides instructions for making a protein called adrenocorticotropic hormone (ACTH) receptor, which is found primarily in the adrenal glands. The protein produced from the MRAP gene transports the ACTH receptor from the interior of the cell to the cell membrane. When the ACTH receptor is embedded within the cell membrane, it is turned on (activated) by the MRAP protein. Activated ACTH receptor can then attach (bind) to ACTH, and this binding triggers the adrenal glands to produce glucocorticoids. MC2R gene mutations lead to the production of a receptor that cannot be transported to the cell membrane or, if it does get to the cell membrane, cannot bind to ACTH. MRAP gene mutations impair the transport of the ACTH receptor to the cell membrane. Without the binding of the ACTH receptor to its hormone, there is no signal to trigger the adrenal glands to produce glucocorticoids.
The *NNT* gene provides instructions for making an enzyme called nicotinamide nucleotide transhydrogenase. This enzyme is found embedded in the inner membrane of structures called mitochondria, which are the energy-producing centers of cells. This enzyme helps produce a substance called NADPH, which is involved in removing potentially toxic molecules called reactive oxygen species that can damage DNA, proteins, and cell membranes. *NNT* gene mutations impair the enzyme’s ability to produce NADPH, leading to an increase in reactive oxygen species in adrenal gland tissues. Over time, these toxic molecules can impair the function of adrenal gland cells and lead to their death (apoptosis), diminishing the production of glucocorticoids.

**Inheritance Pattern**

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.

**Other Names for This Condition**

- ACTH resistance
- adrenal unresponsiveness to ACTH
- glucocorticoid deficiency
- hereditary unresponsiveness to adrenocorticotropic hormone
- isolated glucocorticoid deficiency

**Diagnosis & Management**

**Genetic Testing**

- Genetic Testing Registry: ACTH resistance  
- Genetic Testing Registry: Glucocorticoid deficiency 2  
- Genetic Testing Registry: Glucocorticoid deficiency 3  
- Genetic Testing Registry: Glucocorticoid deficiency 4 with or without mineralocorticoid deficiency  
- Genetic Testing Registry: Natural killer cell and glucocorticoid deficiency with DNA repair defect  
General Information from MedlinePlus

- Diagnostic Tests
  https://medlineplus.gov/diagnostictests.html
- Drug Therapy
  https://medlineplus.gov/drugtherapy.html
- Genetic Counseling
  https://medlineplus.gov/geneticcounseling.html
- Palliative Care
  https://medlineplus.gov/palliativecare.html
- Surgery and Rehabilitation
  https://medlineplus.gov/surgeryandrehabilitation.html

Additional Information & Resources

MedlinePlus

- Encyclopedia: Adrenal Glands
  https://medlineplus.gov/ency/article/002219.htm
- Health Topic: Hypoglycemia
  https://medlineplus.gov/hypoglycemia.html

Genetic and Rare Diseases Information Center

- Familial glucocorticoid deficiency
  https://rarediseases.info.nih.gov/diseases/2498/familial-glucocorticoid-deficiency

Additional NIH Resources

- Eunice Kennedy Shriver National Institute of Child Health and Human Development: Adrenal Gland Disorders
  https://www.nichd.nih.gov/health/topics/adrenalgland/conditioninfo
- National Endocrine and Metabolic Diseases Information Service: Adrenal Insufficiency and Addison’s Disease
- National Institute of Neurological Disorders and Stroke: Seizures and Epilepsy: Hope Through Research
Educational Resources

- Disease InfoSearch: ACTH Resistance
  http://www.diseaseinfosearch.org/ACTH+Resistance/176
- Disease InfoSearch: Glucocorticoid Deficiency, Familial
  http://www.diseaseinfosearch.org/Glucocorticoid+Deficiency%2C+Familial/3093
- Hormone Health Network: Nondiabetic Hypoglycemia
- Johns Hopkins Medicine: The Adrenal Glands
  https://www.hopkinsmedicine.org/healthlibrary/conditions/adult/endocrinology/the_adrenal_glands_85,p00399
- KidsHealth from Nemours: Adrenal Gland
  http://kidshealth.org/en/parents/endocrine.html#kha_41
- MalaCards: familial glucocorticoid deficiency
  http://www.malacards.org/card/familial_glucocorticoid_deficiency
- Merck Manual Consumer Version: Hypoglycemia
- Orphanet: Familial glucocorticoid deficiency
  https://www.orpha.net/consor/cgi-bin/OC_Exp.php?Lng=EN&Expert=361

Patient Support and Advocacy Resources

- Hormone Health Network: Adrenal Insufficiency
  https://www.hormone.org/diseases-and-conditions/adrenal/adrenal-insufficiency
- National Adrenal Diseases Foundation
  http://www.nadf.us/
- Resource List from the University of Kansas Medical Center: Endocrine Genetic Conditions
  http://www.kumc.edu/gec/support/endocrin.html
- The Hypoglycemia Support Foundation, Inc.
  http://hypoglycemia.org/

ClinicalTrials.gov

- ClinicalTrials.gov
  https://clinicaltrials.gov/ct2/results?cond=%22familial+glucocorticoid+deficiency%22+OR+%22Adrenal+Insufficiency%22
Scientific Articles on PubMed

- PubMed
  https://www.ncbi.nlm.nih.gov/pubmed?term=Adrenal+Insufficiency%5BMAJR%5D%29+AND+familial+glucocorticoid+deficiency%5BTIAB%5D%29+AND+english%5Bla%5D+AND+human%5Bmh%5D+AND+%22last+3600+days%22%5Bdp%5D

OMIM

- GLUCOCORTICOID DEFICIENCY 1
  http://omim.org/entry/202200
- GLUCOCORTICOID DEFICIENCY 2
  http://omim.org/entry/607398
- GLUCOCORTICOID DEFICIENCY 3
  http://omim.org/entry/609197
- GLUCOCORTICOID DEFICIENCY 4 WITH OR WITHOUT MINERALOCORTICOID DEFICIENCY
  http://omim.org/entry/614736
- IMMUNODEFICIENCY 54
  http://omim.org/entry/609981

Sources for This Summary

  Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/19558534
  Free article on PubMed Central: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2855830/

  Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/18840636
  Free article on PubMed Central: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2635546/

  Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/8094489

  Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/20427498


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