Primary hyperoxaluria

Primary hyperoxaluria is a rare condition characterized by recurrent kidney and bladder stones. The condition often results in end stage renal disease (ESRD), which is a life-threatening condition that prevents the kidneys from filtering fluids and waste products from the body effectively.

Primary hyperoxaluria results from the overproduction of a substance called oxalate. Oxalate is filtered through the kidneys and excreted as a waste product in urine, leading to abnormally high levels of this substance in urine (hyperoxaluria). During its excretion, oxalate can combine with calcium to form calcium oxalate, a hard compound that is the main component of kidney and bladder stones. Deposits of calcium oxalate can damage the kidneys and other organs and lead to blood in the urine (hematuria), urinary tract infections, kidney damage, ESRD, and injury to other organs. Over time, kidney function decreases such that the kidneys can no longer excrete as much oxalate as they receive. As a result oxalate levels in the blood rise, and the substance gets deposited in tissues throughout the body (systemic oxalosis), particularly in bones and the walls of blood vessels. Oxalosis in bones can cause fractures.

There are three types of primary hyperoxaluria that differ in their severity and genetic cause. In primary hyperoxaluria type 1, kidney stones typically begin to appear anytime from childhood to early adulthood, and ESRD can develop at any age. Primary hyperoxaluria type 2 is similar to type 1, but ESRD develops later in life. In primary hyperoxaluria type 3, affected individuals often develop kidney stones in early childhood, but few cases of this type have been described so additional signs and symptoms of this type are unclear.

Frequency

Primary hyperoxaluria is estimated to affect 1 in 58,000 individuals worldwide. Type 1 is the most common form, accounting for approximately 80 percent of cases. Types 2 and 3 each account for about 10 percent of cases.

Causes

Mutations in the AGXT, GRHPR, and HOGA1 genes cause primary hyperoxaluria types 1, 2, and 3, respectively. These genes provide instructions for making enzymes that are involved in the breakdown and processing of protein building blocks (amino acids) and other compounds. The enzyme produced from the HOGA1 gene is involved in the breakdown of an amino acid, which results in the formation of a compound called glyoxylate. This compound is further broken down by the enzymes produced from the AGXT and GRHPR genes.
Mutations in the \textit{AGXT}, \textit{GRHPR}, or \textit{HOGA1} gene lead to a decrease in production or activity of the respective proteins, which prevents the normal breakdown of glyoxylate. \textit{AGXT} and \textit{GRHPR} gene mutations result in an accumulation of glyoxylate, which is then converted to oxalate for removal from the body as a waste product. \textit{HOGA1} gene mutations also result in excess oxalate, although researchers are unsure as to how this occurs. Oxalate that is not excreted from the body combines with calcium to form calcium oxalate deposits, which can damage the kidneys and other organs.

**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**

- congenital oxaluria
- D-glycerate dehydrogenase deficiency
- glyceric aciduria
- glycolic aciduria
- hepatic AGT deficiency
- hyperoxaluria, primary
- oxalosis
- oxaluria, primary
- peroxisomal alanine:glyoxylate aminotransferase deficiency
- primary oxalosis
- primary oxaluria

**Diagnosis & Management**

**Genetic Testing Information**

- What is genetic testing? /primer/testing/genetictesting
• Genetic Testing Registry: Primary hyperoxaluria, type II
• Genetic Testing Registry: Primary hyperoxaluria, type III

Research Studies from ClinicalTrials.gov
• ClinicalTrials.gov
  https://clinicaltrials.gov/ct2/results?cond=%22primary+hyperoxaluria%22

Other Diagnosis and Management Resources
• GeneReview: Primary Hyperoxaluria Type 1
  https://www.ncbi.nlm.nih.gov/books/NBK1283
• GeneReview: Primary Hyperoxaluria Type 2
  https://www.ncbi.nlm.nih.gov/books/NBK2692
• GeneReview: Primary Hyperoxaluria Type 3
  https://www.ncbi.nlm.nih.gov/books/NBK316514

Additional Information & Resources
Health Information from MedlinePlus
• Health Topic: Amino Acid Metabolism Disorders
  https://medlineplus.gov/aminoacidmetabolismdisorders.html
• Health Topic: Kidney Stones
  https://medlineplus.gov/kidneystones.html

Genetic and Rare Diseases Information Center
• Primary hyperoxaluria type 1
  https://rarediseases.info.nih.gov/diseases/2835/primary-hyperoxaluria-type-1
• Primary hyperoxaluria type 2
  https://rarediseases.info.nih.gov/diseases/2836/primary-hyperoxaluria-type-2
Additional NIH Resources

• National Institute of Diabetes and Digestive and Kidney Diseases: Kidney Stones
  https://www.niddk.nih.gov/health-information/urologic-diseases/kidney-stones

• National Institute of Diabetes and Digestive and Kidney Diseases: Kidney Stones in Children

• National Institute of Diabetes and Digestive and Kidney Diseases: Your Kidneys and How They Work
  https://www.niddk.nih.gov/health-information/kidney-disease/kidneys-how-they-work

Educational Resources

• International Registry for Hereditary Calcium Stone Diseases

• MalaCards: primary hyperoxaluria
  https://www.malacards.org/card/primary_hyperoxaluria

• Mayo Clinic: Division of Nephrology and Hypertension
  https://www.mayo.edu/research/departments-divisions/department-internal-medicine/division-nephrology-hypertension/primary-hyperoxaluria

• Nemours Foundation: Kidneys and Urinary Tract

• Orphanet: Primary hyperoxaluria type 1
  https://www.orpha.net/consor/cgi-bin/OC_Exp.php?Lng=EN&Expert=93598

• Orphanet: Primary hyperoxaluria type 2
  https://www.orpha.net/consor/cgi-bin/OC_Exp.php?Lng=EN&Expert=93599

• Orphanet: Primary hyperoxaluria type 3
  https://www.orpha.net/consor/cgi-bin/OC_Exp.php?Lng=EN&Expert=93600

Patient Support and Advocacy Resources

• Metabolic Support UK
  https://www.metabolicsupportuk.org/

• National Kidney Foundation: Kidney Stones
  https://www.kidney.org/atoz/content/kidneystones
• National Organization for Rare Disorders
  https://rarediseases.org/rare-diseases/primary-hyperoxaluria/

• Oxalosis and Hyperoxaluria Foundation
  https://ohf.org/overview/

Clinical Information from GeneReviews
• Primary Hyperoxaluria Type 1
  https://www.ncbi.nlm.nih.gov/books/NBK1283

• Primary Hyperoxaluria Type 2
  https://www.ncbi.nlm.nih.gov/books/NBK2692

• Primary Hyperoxaluria Type 3
  https://www.ncbi.nlm.nih.gov/books/NBK316514

Scientific Articles on PubMed
• PubMed
  https://www.ncbi.nlm.nih.gov/pubmed?term=%28Hyperoxaluria,+Primary%5B
  MAJR%5D%29+AND+%28hyperoxaluria,+primary%5BALL%5D%29+AND+english
  %5Bla%5D+AND+human%5Bmh%5D+AND+%22last+1080+days%22%5Bdp%5D

Catalog of Genes and Diseases from OMIM
• HYPEROXALURIA, PRIMARY, TYPE I
  http://omim.org/entry/259900

• HYPEROXALURIA, PRIMARY, TYPE II
  http://omim.org/entry/260000

• HYPEROXALURIA, PRIMARY, TYPE III
  http://omim.org/entry/613616

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  Free article on PubMed Central: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4587693/

  Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/22688746

  Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/26401545

  Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/20301742

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