

Wilson Disease – an Overview

Disease Summary

Wilson disease is an autosomal recessive disorder of copper metabolism characterized by abnormal accumulation of copper in the liver, brain, and other organs.¹ Prevalence of the disease is approximately 1 in 30,000 persons worldwide, and 1 in 10,000 in China, Japan, and Sardinia.^{1,2} Wilson disease typically first presents between the ages of 6 and 50 years, with acute or chronic liver disease (40% of affected), neurological movement disorders (40% of affected), or psychiatric disturbances such as depression or neurotic behaviors (20% of affected).¹ While all three types of manifestations can be present, this is rarely the case.¹ In children, liver disease is the most common presenting manifestation.¹ Early diagnosis of Wilson disease is very important as early treatment can preserve liver function and prevent the development of neuropsychiatric illness.¹

Wilson disease has been linked to mutations in the gene *ATP7B*, which codes for a P-type copper-transporting ATPase.² Presentation of the disease is highly variable even among families with the same causative mutations in *ATP7B*.^{2,3} Mutations that cause complete lack of function (e.g., nonsense and other mutations that cause truncation of the encoded protein) have been associated with earlier onset of the disease and, potentially, a more severe phenotype than mutations that allow residual activity (e.g., missense mutations that cause subtle changes in the encoded protein).¹ However, in general, severity or presentation of Wilson disease is difficult to predict from the mutation due to the influence of environ-

mental and other genetic factors.³ Among common mutations, H1069Q is found in 35% to 45% of disease alleles in European population and R778L is found in about 57% of disease alleles in Asians under the age of 18.¹

Wilson disease is usually diagnosed based on clinical symptoms and evidence of low serum ceruloplasmin and high urinary copper from biochemical testing.¹ An important clinical finding is the presence of Kayser-Fleischer rings in the cornea, which is observed in 50-60% of individuals with liver disease and 90% of individuals with either neurologic findings or psychiatric disturbance.¹ Biochemical testing has limitations in that age-specific reference ranges are required for appropriate interpretation of results (especially in young children), collection of urine over three days may be difficult, and the carrier (heterozygote) state and the presymptomatic state cannot be reliably distinguished.^{1,4} Genetic testing can confirm the diagnosis of Wilson disease and resolve equivocal biochemical test results.⁵ Once the mutations causing Wilson disease in a specific family have been identified, genetic testing for these mutations can also identify presymptomatic individuals among the patient's relatives, allowing preventative treatment. By distinguishing presymptomatic family members from heterozygous carriers, genetic testing can help to protect heterozygous carriers from unnecessary treatment.

For additional information, see Tables 1-2 below and references 1-5.

Table 1: Disease Facts about WD (based on references 1-7, unless otherwise noted)

Disease Fact	Wilson Disease
MIM* number	277900
Estimated Prevalence	1:30,000 (1)
Average Age at Diagnosis	Childhood or adolescence (liver disease) Young adults (neuropsychiatric illness)
Typical Symptoms	Hepatic: Liver disease, including recurrent jaundice, acute or chronic hepatitis, fulminant hepatic failure, and hemolytic anemia Neurological: movement disorders, drooling Psychiatric: depression, neuroses, personality changes Ophthalmological: Kayser-Fleischer rings in cornea
Therapy	Copper chelation treatment (penicillamine, trientine, tetrathiomolybdate) Copper absorption blocking treatment (zinc acetate) Restriction of high-copper foods (shellfish, liver, chocolate, mushrooms, nuts) Orthotopic liver transplantation when other treatments fail or cannot be tolerated

*MIM: Mendelian Inheritance in Man, see <http://www.ncbi.nlm.nih.gov/omim>

Table 2: Molecular Genetics of WD (based on references 1-7, unless otherwise noted)

Gene (Protein)	Transmission	Mutation type	Penetrance	Comments
ATP7B (P-type ATPase)	Autosomal recessive	Loss-of-function	Unknown	Mutations causing complete lack of function are associated with early onset of disease, while other specific mutations are associated with milder severity and later onset of disease. ¹

References

1. Cox DW, and Roberts E. Wilson disease. GeneReviews. <http://www.ncbi.nlm.nih.gov/bookshelf/br.fcgi?book=gene&part=wilson/>. Accessed 062810
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3. Ala A, Borjigin J, Rochwarger A, Schilsky M (2005) Wilson disease in septuagenarian siblings: raising the bar for diagnosis. *Hepatology*. 41(3): 668-670.
4. Wilson DC, Phillips MJ, Cox DW, Roberts EA (2000) Severe hepatic Wilson disease in preschool-aged children. *Journal of Pediatrics*. 137(5): 719-722.
5. Schilsky ML, Ala A (2010) Genetic testing for Wilson disease: availability and utility. *Current Gastroenterology Reports*. 12(1): 57-61.