

# World Journal of *Hepatology*

*World J Hepatol* 2022 August 27; 14(8): 1530-1693



### OPINION REVIEW

- 1530** Sexual dysfunctions and their treatment in liver diseases  
*Jagdish RK*

### MINIREVIEWS

- 1541** Long-term liver allograft fibrosis: A review with emphasis on idiopathic post-transplant hepatitis and chronic antibody mediated rejection  
*Vij M, Rammohan A, Rela M*
- 1550** Outcomes of patients with post-hepatectomy hypophosphatemia: A narrative review  
*Chan KS, Mohan S, Shelat VG*

### ORIGINAL ARTICLE

#### Basic Study

- 1562** Assessment of circulating levels of microRNA-326, microRNA-424, and microRNA-511 as biomarkers for hepatocellular carcinoma in Egyptians  
*Youssef SS, Elfiky A, Nabeel MM, Shousha HI, Elbaz T, Omran D, Marie MS, Elzahry MA, Abul-Fotouh A, Hashem A, Guda MF, Abdelaziz AO*

#### Retrospective Cohort Study

- 1576** Missed opportunities for hepatitis C treatment at a tertiary care hospital in South Australia  
*Raja SS, Edwards S, Stewart J, Huynh D*
- 1584** Survival outcomes and predictors of mortality, re-bleeding and complications for acute severe variceal bleeding requiring balloon tamponade  
*Keung CY, Morgan A, Le ST, Robertson M, Urquhart P, Swan MP*

#### Retrospective Study

- 1598** Simple diagnostic algorithm identifying at-risk nonalcoholic fatty liver disease patients needing specialty referral within the United States  
*Alkhoury N, Aggarwal P, Le P, Payne J, Sakkal C, Polanco P, Harrison S, Nouredin M*
- 1608** Real-life multi-center retrospective analysis on nivolumab in difficult-to-treat patients with advanced hepatocellular carcinoma  
*De Wilde N, Vonghia L, Francque S, De Somer T, Bagdadi A, Staub E, Lambrechts J, Bucalau AM, Verset G, Van Steenkiste C*

#### Clinical Trials Study

- 1621** Iohexol plasma and urinary concentrations in cirrhotic patients: A pilot study  
*Carrier P, Destere A, Giguët B, Debette-Gratien M, Essig M, Monchaud C, Woillard JB, Loustaud-Ratti V*

**Observational Study**

- 1633** Higher cardiovascular risk scores and liver fibrosis risk estimated by biomarkers in patients with metabolic-dysfunction-associated fatty liver disease

*Salgado Alvarez GA, Pinto Galvez SM, Garcia Mora U, Cano Contreras AD, Durán Rosas C, Priego-Parra BA, Triana Romero A, Amieva Balmori M, Roesch Dietlen F, Martinez Vazquez SE, Mendez Guerrero IO, Chi-Cervera LA, Bernal Reyes R, Martinez Roriguez LA, Icaza Chavez ME, Remes Troche JM*

- 1643** Prevalence of sarcopenia using different methods in patients with non-alcoholic fatty liver disease

*Almeida NS, Rocha R, de Souza CA, da Cruz ACS, Ribeiro BDR, Vieira LV, Daltro C, Silva R, Sarno M, Cotrim HP*

- 1652** Metabolic-associated fatty liver disease is associated with low muscle mass and strength in patients with chronic hepatitis B

*Santos CML, Brito MD, Castro PASV, Vries TP, Viana NL, Coelho MPP, Malheiro OB, Bering T, Gonzalez MC, Teixeira R, Cambraia RD, Rocha GA, Silva LD*

**Randomized Controlled Trial**

- 1667** Effect of probiotics on hemodynamic changes and complications associated with cirrhosis: A pilot randomized controlled trial

*Maslennikov R, Efremova I, Ivashkin V, Zharkova M, Poluektova E, Shirokova E, Ivashkin K*

**CASE REPORT**

- 1678** Secondary sclerosing cholangitis after critical COVID-19: Three case reports

*Mayorquín-Aguilar JM, Lara-Reyes A, Revuelta-Rodríguez LA, Flores-García NC, Ruiz-Margáin A, Jiménez-Ferreira MA, Macías-Rodríguez RU*

- 1687** Hemorrhagic colitis induced by trientine in a 51-year-old patient with Wilson's disease waiting for liver transplantation: A case report

*Schult A, Andersson M, Asin-Cayuela J, Olsson KS*

**CORRECTION**

- 1692** Author affiliation addition: "Hepatitis B virus detected in paper currencies in a densely populated city of India: A plausible source of horizontal transmission?"

*Das P, Supekar R, Chatterjee R, Roy S, Ghosh A, Biswas S*

**ABOUT COVER**

Editorial Board Member of *World Journal of Hepatology*, Dmitry Victorovich Garbuzenko, MD, PhD, DSc (Med), Professor, Department of Faculty Surgery, South Ural State Medical University, Chelyabinsk 454092, Russia. garb@inbox.ru

**AIMS AND SCOPE**

The primary aim of *World Journal of Hepatology* (*WJH*, *World J Hepatol*) is to provide scholars and readers from various fields of hepatology with a platform to publish high-quality basic and clinical research articles and communicate their research findings online.

*WJH* mainly publishes articles reporting research results and findings obtained in the field of hepatology and covering a wide range of topics including chronic cholestatic liver diseases, cirrhosis and its complications, clinical alcoholic liver disease, drug induced liver disease autoimmune, fatty liver disease, genetic and pediatric liver diseases, hepatocellular carcinoma, hepatic stellate cells and fibrosis, liver immunology, liver regeneration, hepatic surgery, liver transplantation, biliary tract pathophysiology, non-invasive markers of liver fibrosis, viral hepatitis.

**INDEXING/ABSTRACTING**

The *WJH* is now abstracted and indexed in PubMed, PubMed Central, Emerging Sources Citation Index (Web of Science), Scopus, Reference Citation Analysis, China National Knowledge Infrastructure, China Science and Technology Journal Database, and Superstar Journals Database. The 2022 edition of Journal Citation Reports® cites the 2021 Journal Citation Indicator (JCI) for *WJH* as 0.52. The *WJH*'s CiteScore for 2021 is 3.6 and Scopus CiteScore rank 2021: Hepatology is 42/70.

**RESPONSIBLE EDITORS FOR THIS ISSUE**

Production Editor: Yi-Xuan Cai; Production Department Director: Xiang Li; Editorial Office Director: Xiang Li.

**NAME OF JOURNAL**

*World Journal of Hepatology*

**ISSN**

ISSN 1948-5182 (online)

**LAUNCH DATE**

October 31, 2009

**FREQUENCY**

Monthly

**EDITORS-IN-CHIEF**

Nikolaos Pylsopoulos, Ke-Qin Hu, Koo Jeong Kang

**EDITORIAL BOARD MEMBERS**

<https://www.wjnet.com/1948-5182/editorialboard.htm>

**PUBLICATION DATE**

August 27, 2022

**COPYRIGHT**

© 2022 Baishideng Publishing Group Inc

**INSTRUCTIONS TO AUTHORS**

<https://www.wjnet.com/bpg/gerinfo/204>

**GUIDELINES FOR ETHICS DOCUMENTS**

<https://www.wjnet.com/bpg/GerInfo/287>

**GUIDELINES FOR NON-NATIVE SPEAKERS OF ENGLISH**

<https://www.wjnet.com/bpg/gerinfo/240>

**PUBLICATION ETHICS**

<https://www.wjnet.com/bpg/GerInfo/288>

**PUBLICATION MISCONDUCT**

<https://www.wjnet.com/bpg/gerinfo/208>

**ARTICLE PROCESSING CHARGE**

<https://www.wjnet.com/bpg/gerinfo/242>

**STEPS FOR SUBMITTING MANUSCRIPTS**

<https://www.wjnet.com/bpg/GerInfo/239>

**ONLINE SUBMISSION**

<https://www.f6publishing.com>





## Hemorrhagic colitis induced by trientine in a 51-year-old patient with Wilson's disease waiting for liver transplantation: A case report

Andreas Schult, Matts Andersson, Jorge Asin-Cayuela, Karl Sigvard Olsson

**Specialty type:** Gastroenterology and hepatology

**Provenance and peer review:** Unsolicited article; Externally peer reviewed.

**Peer-review model:** Single blind

**Peer-review report's scientific quality classification**

Grade A (Excellent): 0  
Grade B (Very good): 0  
Grade C (Good): C  
Grade D (Fair): D  
Grade E (Poor): 0

**P-Reviewer:** Li HL, China;  
Rodrigues AT, Brazil

**Received:** March 3, 2022

**Peer-review started:** March 3, 2022

**First decision:** June 8, 2022

**Revised:** July 1, 2022

**Accepted:** July 27, 2022

**Article in press:** July 27, 2022

**Published online:** August 27, 2022



**Andreas Schult**, Transplant Institute, Sahlgrenska University Hospital, Gothenburg 41345, Sweden

**Andreas Schult**, Department of Molecular and Clinical Medicine, Institute of Medicine, Sahlgrenska Academy, University of Gothenburg, Gothenburg 41345, Sweden

**Matts Andersson**, Department of Medicine, Örnköldsvik Hospital, Örnköldsvik 89145, Sweden

**Jorge Asin-Cayuela**, Department of Clinical Genetics, Sahlgrenska University Hospital, Gothenburg 41345, Sweden

**Karl Sigvard Olsson**, Section of Hematology and Coagulation, Department of Medicine and Clinical Nutrition, Institute of Medicine, Sahlgrenska Academy, University of Gothenburg, Gothenburg 41345, Sweden

**Corresponding author:** Andreas Schult, MD, Consultant Physician-Scientist, Transplant Institute, Sahlgrenska University Hospital, Bruna Stråket 5, Gothenburg 41345, Sweden. [andreas.schult@vgregion.se](mailto:andreas.schult@vgregion.se)

### Abstract

#### BACKGROUND

Wilson's disease (WD) is a rare inherited disorder of copper metabolism. Treatment consists of chelating agents, but side effects are common. We describe a patient who developed colitis during trientine treatment leading to decompensation of liver cirrhosis.

#### CASE SUMMARY

A healthy 51-year-old woman was diagnosed with liver cirrhosis due to decompensation with ascites. Etiologic evaluation raised suspicion of hereditary hemochromatosis because of compound heterozygosity *HFE* p.C282Y/p.H63D, and phlebotomy was started. Re-evaluation showed low ceruloplasmin, increased urinary copper excretion and the presence of Kayser-Fleischer rings. WD was confirmed by genetic analysis. Because of decompensated cirrhosis, she was referred for liver transplant evaluation. Simultaneously, treatment with trientine was initiated. Liver function initially stabilized, and the patient was not accepted for a liver transplant. Shortly after this, she developed severe hemorrhagic colitis, most probably a side effect of trientine. During that episode, she decompensated with hepatic encephalopathy. Because of a second decompensating event, she was

accepted for liver transplantation, and an uneventful transplantation was carried out after clinical improvement of colitis.

## CONCLUSION

Despite WD being a rare disorder, it is important to consider because it can present with a plethora of symptoms from childhood to an elderly age. Colitis should be recognized as a serious adverse drug reaction to trientine treatment that can result in decompensated liver disease.

**Key Words:** Wilson's disease; Colitis; Trientine; Liver transplantation; Adverse effect; Case report

©The Author(s) 2022. Published by Baishideng Publishing Group Inc. All rights reserved.

**Core Tip:** Even if Wilson's disease is a rare disorder, it is important to consider as a cause of liver disease. Treatment with chelating agents is associated with multiple side effects, and colitis should be recognized as a serious adverse drug reaction to trientine. Such a serious adverse event can trigger hepatic decompensation with the need for liver transplantation.

**Citation:** Schult A, Andersson M, Asin-Cayuela J, Olsson KS. Hemorrhagic colitis induced by trientine in a 51-year-old patient with Wilson's disease waiting for liver transplantation: A case report. *World J Hepatol* 2022; 14(8): 1687-1691

**URL:** <https://www.wjgnet.com/1948-5182/full/v14/i8/1687.htm>

**DOI:** <https://dx.doi.org/10.4254/wjh.v14.i8.1687>

## INTRODUCTION

Wilson's disease (WD) is a rare recessively inherited disorder in which toxic amounts of copper accumulate in the liver and the brain due to a defective excretion to the bile[1]. It is caused by mutations in the *ATP7B* gene, impairing copper excretion into bile. The prevalence of WD is estimated to be between 1 case in 10000 to 30000 live births[2]. WD can manifest with neuropsychiatric symptoms, chronic liver disease or acute liver failure. Treatment usually consists of copper chelating agents, such as penicillamine and trientine or zinc, which reduces enteric copper uptake. Patients with decompensated liver cirrhosis or acute liver failure may require liver transplantation, which corrects the underlying metabolic defect[3].

## CASE PRESENTATION

### Chief complaints

The present case was a 51-year-old married woman with two children who was employed as a worker at a warehouse. She had never smoked and consumed 1-2 glasses of wine per week. On a routine health check at age 50, the local general practitioner awarded her a star for excellent health. However, shortly afterward she began to feel fatigued and swollen and was diagnosed with ascites at her local hospital.

### Physical examination

She was not jaundiced.

### Laboratory examinations

The liver function tests showed slightly elevated bilirubin (30 µmol/L, reference 5-25), and albumin was decreased to 20 g/L (reference 36-45). Alkaline phosphatase was within the normal range, alanine aminotransferase was normal, and aspartate aminotransferase was just above the upper limit of normal, resulting in an aspartate aminotransferase/alanine aminotransferase ratio > 2. Because of a prothrombin time/international normalized ratio of 1.9, a liver biopsy was not undertaken.

Viral hepatitis was ruled out by serology, and negative autoantibodies (antinuclear, smooth muscle and antimitochondrial) made autoimmune hepatitis and primary biliary cholangitis unlikely. A negative phosphatidylethanol confirmed the absence of harmful drinking[4]. Transferrin saturation was 52% and ferritin 206 µg/L (reference 13-150), hence hereditary hemochromatosis (HH) was considered. Genetic analysis showed *HFE* p.C282Y/p.H63D compound heterozygosity, and iron removal by phlebotomy was initiated. There was a slight improvement, but after 3 mo, her liver tests were still abnormal, which led to the consideration of other diagnoses.

The suspicion of WD was supported by a low serum ceruloplasmin concentration (0.14 g/L, reference 0.22-0.58) and increased urinary copper excretion (4.8  $\mu\text{mol}/24\text{ h}$ , reference 0.15-0.60). Detailed eye examination revealed the presence of Kayser-Fleischer rings. Genetic analysis of *ATP7B*, covering all coding exons +/- 25 flanking intronic bases, showed the presence of two heterozygous pathogenic variants, namely c.3207C>A, p.(His1069Gln) and c.2305A>G, p.(Met769Val) (NM\_000053.3). The analysis was carried out on DNA extracted from blood after enrichment with a custom-made next-generation sequencing gene panel that included *ATP7B* (SureSelectQXT, Agilent TechnologiesR), on a MiSeq instrument (IlluminaR). Results were verified by Sanger sequencing. Compound heterozygosity of the two variants was confirmed by genotyping of the patient's parents.

## FINAL DIAGNOSIS

She was diagnosed with liver cirrhosis due to decompensation with ascites.

## TREATMENT

Upon confirmation of WD, the patient underwent neurological evaluation. Besides slight numbness of legs, especially at night, there were no neurologic symptoms. A complete neurological exam showed a slightly decreased blink rate and somewhat abrupt saccades. There were no signs of dysarthria, gait abnormalities or parkinsonism.

Chelating treatment with trientine 300 mg bid was initiated. Simultaneously, the patient was referred for liver transplant evaluation at Sahlgrenska University Hospital, Gothenburg, due to decompensated liver cirrhosis. At the time of evaluation, she had been on treatment with trientine for 6 wk. She was free from ascites on low-dose diuretics and had no other decompensating events. Her model for end-stage liver disease score was 13 and Child-Pugh class B (8 points). Because of stable disease during ongoing treatment, she was not accepted for liver transplantation.

However, on the day of leaving the university hospital, loose stools appeared. During the following days, her symptoms worsened, and her stools became bloodstained. At her local hospital, a sigmoidoscopy showed hemorrhagic colitis. Biopsies were negative for cytomegalovirus, and stool cultures returned negative. As colitis has been described as a side effect of trientine[5,6], the drug was withdrawn, and treatment with prednisolone 30 mg q.d. was initiated.

Her colitis improved rapidly, but after some days, she became somnolent. There were no clinical signs of gastrointestinal bleeding, spontaneous bacterial peritonitis or other infection. A cranial computed tomography showed normal findings, and electroencephalography was compatible with metabolic encephalopathy. A diagnosis of hepatic encephalopathy West Haven grade 3 was made. The patient improved on treatment with lactulose and rifaximin. Treatment with zinc acetate 25 mg t.i.d. to reduce copper absorption was started. Steroids were tapered within 1 wk. She was again referred for transplant evaluation and subsequently accepted.

## OUTCOME AND FOLLOW-UP

After another episode of severe hepatic encephalopathy requiring intubation, liver transplantation with a whole graft from a deceased donor was carried out 3 mo later. Vessel reconstruction consisted of a side-to-side cavo-caval, end-to-end artery and duct-to-duct biliary anastomosis. Immunosuppressive induction therapy was given by 1000 mg methylprednisolone intraoperatively and 20 mg basiliximab before reperfusion and on postoperative day 4. Mycophenolate mofetil 1 g b.i.d. was started before transplantation, and tacrolimus was introduced on postoperative day 4. No steroids were used for maintenance immunosuppression. The clinical course was uneventful, and the patient was discharged to home on postoperative day 10.

During the 1<sup>st</sup> month, a mild acute T-cell mediated rejection (rejection activity index 3) was treated with oral corticosteroids. Because of cytomegalovirus mismatch (D+/R-), she received prophylaxis for 6 mo with valganciclovir 450 mg q.d. After discontinuation of prophylaxis, she developed cytomegalovirus disease with pancytopenia, and oral treatment with valganciclovir was reinstated. After viral clearance, the further course was uneventful. Protocol liver biopsy after 1 year only showed mild inflammation without sign of rejection or fibrosis. Up to now, 3 years after liver transplantation, there have been no further complications, and the patient is now back to normal active life.

## DISCUSSION

This case illustrates two important learning points. The first one is the difficulty to diagnose WD. It can present with both neuropsychiatric as well as acute or chronic liver disease. Because WD is a rare disease, it may not be included in differential diagnosis of liver disease although its prevalence is probably significantly higher than the number of clinically diagnosed cases[7]. A delayed diagnosis is not uncommon, as in another Swedish female observed during family screening of HH[8] in which WD was confirmed by sequencing of *ATP7B* showing homozygosity for the variant c.3207C>A (His1069Gln) [9].

An initial diagnosis of HH was feasible because this is a common disorder in central Sweden[10], and the patient had elevated ferritin. However, compound heterozygosity HFE p.C282Y/p.H63D seldom results in HH-related morbidity[11]. Comorbid factors should always be considered, and WD has previously been reported in the patient's home area[12].

The other point is the awareness of potential side effects of trientine. Although drugs for the treatment of WD were introduced in the 1960s, there is still a lack of high-quality studies. Initial treatment of patients not presenting with acute liver failure usually aims at promoting urinary copper excretion with chelating agents. Penicillamine is a drug with high incidence of adverse reactions such as hypersensitivity, gastrointestinal symptoms, proteinuria and bone marrow depression with rare cases of aplastic anemia.

Trientine is often used as a first-choice treatment because of less side-effects compared to penicillamine[3]. It is, however, not an uncomplicated drug, and besides skin reactions and neurologic worsening, cases of colitis have been described[5,6]. New compounds for the treatment of WD are under development[13,14] and may widen the available armamentarium, offering alternative therapies in case of adverse drug reactions.

Our patient developed severe hemorrhagic colitis due to trientine treatment, which may have triggered decompensation of her liver cirrhosis. Decompensated liver cirrhosis and acute liver failure are indications for liver transplantation in patients with WD. It can only be speculated if liver transplantation could have been avoided if the patient had not developed severe colitis. However, after improvement of colitis with steroid treatment, the patient could undergo liver transplantation with excellent functional status after 3 years of follow-up.

## CONCLUSION

Even if WD is a rare disorder, it is important to consider because it can present with a plethora of symptoms from childhood to an elderly age. Colitis should be recognized as a serious adverse drug reaction from trientine treatment that can result in decompensated liver disease.

## FOOTNOTES

**Author contributions:** Schult A wrote the part of the manuscript concerning transplantation, pretransplant work-up and revised the manuscript; Andersson M contributed to pretransplant clinical information; Asin-Cayuela J wrote the part concerning genetic analyses and critically revised the manuscript; Olsson KS drafted the main manuscript and critically revised the manuscript.

**Informed consent statement:** Written informed consent was obtained from the patient for publication of this case report.

**Conflict-of-interest statement:** All authors have nothing to declare.

**CARE Checklist (2016) statement:** The current case report follows the CARE checklist (2016).

**Open-Access:** This article is an open-access article that was selected by an in-house editor and fully peer-reviewed by external reviewers. It is distributed in accordance with the Creative Commons Attribution NonCommercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited and the use is non-commercial. See: <https://creativecommons.org/licenses/by-nc/4.0/>

**Country/Territory of origin:** Sweden

**ORCID number:** Andreas Schult 0000-0002-2082-8724; Matts Andersson 0000-0001-9460-4320; Jorge Asin-Cayuela 0000-0003-0609-5760; Karl Sigvard Olsson 0000-0002-7446-3572.

**S-Editor:** Zhang H

**L-Editor:** Filipodia



P-Editor: Zhang H

## REFERENCES

- 1 **Riordan SM**, Williams R. The Wilson's disease gene and phenotypic diversity. *J Hepatol* 2001; **34**: 165-171 [PMID: 11211896 DOI: 10.1016/s0168-8278(00)00028-3]
- 2 **Lucena-Valera A**, Perez-Palacios D, Muñoz-Hernandez R, Romero-Gómez M, Ampuero J. Wilson's disease: Revisiting an old friend. *World J Hepatol* 2021; **13**: 634-649 [PMID: 34239699 DOI: 10.4254/wjh.v13.i6.634]
- 3 **European Association for Study of Liver**. EASL Clinical Practice Guidelines: Wilson's disease. *J Hepatol* 2012; **56**: 671-685 [PMID: 22340672 DOI: 10.1016/j.jhep.2011.11.007]
- 4 **Isaksson A**, Walther L, Hansson T, Andersson A, Alling C. Phosphatidylethanol in blood (B-PEth): a marker for alcohol use and abuse. *Drug Test Anal* 2011; **3**: 195-200 [PMID: 21438164 DOI: 10.1002/dta.278]
- 5 **Boga S**, Jain D, Schilsky ML. Trientine induced colitis during therapy for Wilson disease: a case report and review of the literature. *BMC Pharmacol Toxicol* 2015; **16**: 30 [PMID: 26589720 DOI: 10.1186/s40360-015-0031-z]
- 6 **Dahlman T**, Hartvig P, Löfholm M, Nordlinder H, Löf L, Westermarck K. Long-term treatment of Wilson's disease with triethylene tetramine dihydrochloride (trientine). *QJM* 1995; **88**: 609-616 [PMID: 7583074]
- 7 **Coffey AJ**, Durkie M, Hague S, McLay K, Emmerson J, Lo C, Klaffke S, Joyce CJ, Dhawan A, Hadzic N, Mieli-Vergani G, Kirk R, Elizabeth Allen K, Nicholl D, Wong S, Griffiths W, Smithson S, Giffin N, Taha A, Connolly S, Gillett GT, Tanner S, Bonham J, Sharrack B, Palotie A, Rattray M, Dalton A, Bandmann O. A genetic study of Wilson's disease in the United Kingdom. *Brain* 2013; **136**: 1476-1487 [PMID: 23518715 DOI: 10.1093/brain/awt035]
- 8 **Olsson KS**, Konar J, Dufva IH, Ricksten A, Raha-Chowdhury R. Was the C282Y mutation an Irish Gaelic mutation that the Vikings helped disseminate? *Eur J Haematol* 2011; **86**: 75-82 [PMID: 20946107 DOI: 10.1111/j.1600-0609.2010.01536.x]
- 9 **Olsson S**, Raha-Chowdhury R. Letter to the editor. *Eur J Haematol* 2012; **88**: 179-180 [PMID: 21933281 DOI: 10.1111/j.1600-0609.2011.01711.x]
- 10 **Olsson KS**, Ritter B, Hansson N, Chowdhury RR. HLA haplotype map of river valley populations with hemochromatosis traced through five centuries in Central Sweden. *Eur J Haematol* 2008; **81**: 36-46 [PMID: 18363869 DOI: 10.1111/j.1600-0609.2008.01078.x]
- 11 **Gurrin LC**, Bertalli NA, Dalton GW, Osborne NJ, Constantine CC, McLaren CE, English DR, Gertig DM, Delatycki MB, Nicoll AJ, Southey MC, Hopper JL, Giles GG, Anderson GJ, Olynyk JK, Powell LW, Allen KJ; HealthIron Study Investigators. HFE C282Y/H63D compound heterozygotes are at low risk of hemochromatosis-related morbidity. *Hepatology* 2009; **50**: 94-101 [PMID: 19554541 DOI: 10.1002/hep.22972]
- 12 **Olsson KS**, Wålinder O, Kindmark A, Williams R. Common local founder effects for Wilson's disease and hereditary hemochromatosis; mutation studies of a large family. *Scand J Gastroenterol* 2012; **47**: 1014-1020 [PMID: 22774841 DOI: 10.3109/00365521.2012.703240]
- 13 Efficacy and Safety of ALXN1840 (Formerly Named WTX101) Administered for 48 Weeks Versus Standard of Care in Patients With Wilson Disease With an Extension Period of up to 60 Months. [accessed 2022 Feb 25]. In: ClinicalTrials.gov [Internet]. Bethesda (MD): U.S. National Library of Medicine. Available from: <https://ClinicalTrials.gov/show/ClinicalTrials.gov/Identifier/NCT03403205>
- 14 **Weiss KH**, Askari FK, Czlonkowska A, Ferenci P, Bronstein JM, Bega D, Ala A, Nicholl D, Flint S, Olsson L, Plitz T, Bjartmar C, Schilsky ML. Bis-choline tetrathiomolybdate in patients with Wilson's disease: an open-label, multicentre, phase 2 study. *Lancet Gastroenterol Hepatol* 2017; **2**: 869-876 [PMID: 28988934 DOI: 10.1016/S2468-1253(17)30293-5]



Published by **Baishideng Publishing Group Inc**  
7041 Koll Center Parkway, Suite 160, Pleasanton, CA 94566, USA

**Telephone:** +1-925-3991568

**E-mail:** [bpgoffice@wjgnet.com](mailto:bpgoffice@wjgnet.com)

**Help Desk:** <https://www.f6publishing.com/helpdesk>

<https://www.wjgnet.com>

