Test Definition: GAL1P

Galactose-1-Phosphate, Erythrocytes

Overview

Useful For

Monitoring dietary therapy of patients with galactosemia due to deficiency of galactose-1-phosphate uridyltransferase or uridine diphosphate galactose-4-epimerase

Genetics Test Information

Galactose-1-phosphate uridyltransferase (GALT) deficiency is the most common cause of galactosemia and requires lifelong restriction of dietary galactose.

Galactose-1-phosphate is elevated in patients with galactosemia due to GALT deficiency or uridine diphosphate galactose-4-epimerase deficiency, therefore is a suitable analyte for monitoring dietary compliance.

Testing Algorithm

For more information see Galactosemia Testing Algorithm.

Special Instructions

- Galactosemia Testing Algorithm
- Biochemical Genetics Patient Information
- Galactosemia-Related Test List

Method Name

Liquid Chromatography Tandem Mass Spectrometry (LC-MS/MS)

NY State Available

Yes

Specimen

Specimen Type

Whole Blood EDTA

Ordering Guidance

This test is used to monitor dietary therapy of patients with galactosemia due to deficiency of galactose-1-phosphate uridyltransferase or uridine diphosphate galactose-4-epimerase.

This test is **not appropriate** for the diagnosis of galactosemia. The preferred test to evaluate for possible diagnosis of galactosemia, routine carrier screening, and follow-up of abnormal newborn screening results is GCT / Galactosemia Reflex, Blood.

This test is **not appropriate** for the diagnosis of epimerase deficiency, the preferred test to evaluate this deficiency is

GALE / Uridine Diphosphate-Galactose 4' Epimerase, Blood.

If GAL1P / Galactose-1-Phosphate, Erythrocytes testing is needed, the test can be added to existing specimens if they were received in the testing laboratory within 72 hours of collection.

Necessary Information

Biochemical Genetics Patient Information (T602) is recommended, but not required, to be filled out and sent with the specimen to aid in the interpretation of test results.

Specimen Required

Multiple whole blood tests for galactosemia can be performed on 1 specimen. Prioritize order of testing when submitting specimens. For a list of tests that can be ordered together, see Galactosemia-Related Test List.

Patient Preparation: Specimens collected following a meal can exhibit postprandial elevations. For infants, collect a specimen immediately prior to feeding to avoid this.
Container/Tube:
Preferred: Lavender top (EDTA)
Acceptable: Green top (sodium heparin)
Specimen Volume: 3 mL

Forms

1. Biochemical Genetics Patient Information (T602) is recommended.
2. If not ordering electronically, complete, print, and send a Biochemical Genetics Test Request (T798) with the specimen.

Specimen Minimum Volume

2 mL

Reject Due To

Gross hemolysis	Reject

Specimen Stability Information

Specimen Type	Temperature	Time	Special Container
Whole Blood EDTA	Refrigerated	72 hours	

Clinical & Interpretive

Clinical Information

Galactosemia is an autosomal recessive disorder that results from a deficiency of any 1 of the 4 enzymes catalyzing the conversion of galactose to glucose: galactose-1-phosphate uridyltransferase (GALT), galactokinase (GALK), uridine diphosphate galactose-4-epimerase (GALE), and galactose mutarotase (GALM). Galactose-1-phosphate (Gal1P) accumulates in the erythrocytes of patients with galactosemia due to GALT or GALE deficiency or in neonates with GALM

deficiency. The quantitative measurement of Gal1P is useful for monitoring compliance with dietary therapy for either GALT or GALE deficiency. Gal1P is thought to be the causative factor for development of liver disease in these patients and, because of this, patients should maintain low levels and be monitored on a regular basis. The concentration of Gal1P in erythrocytes is the most sensitive index of dietary control.

GALT deficiency is the most common cause of galactosemia and is often referred to as classic galactosemia. The complete or near-complete deficiency of GALT enzyme is life-threatening if left untreated. Complications in the neonatal period include failure to thrive, liver failure, sepsis, and death.

Galactosemia due to GALT deficiency is treated by a galactose-restricted diet, which allows for rapid recovery from the acute symptoms and a generally good prognosis. Despite adequate treatment from an early age, individuals with galactosemia remain at increased risk for developmental delays, speech problems, and abnormalities of motor function. Female patients with galactosemia are at increased risk for premature ovarian failure. Based upon reports by newborn screening programs, the frequency of classic galactosemia in the United States is approximately 1 in 30,000, although literature reports range from 1 in 10,000 to 1 in 60,000 live births.

Epimerase deficiency galactosemia can be categorized into 3 types: generalized, peripheral, and intermediate. Generalized epimerase deficiency galactosemia results in profoundly decreased enzyme activity in all tissues, whereas peripheral epimerase deficiency galactosemia results in decreased enzyme activity in red and white blood cells but normal enzyme activity in all other tissues. This is compared with intermediate epimerase deficiency galactosemia, which results in decreased enzyme activity in red and white blood cells and less than 50% of normal enzyme levels in other tissues.

Clinically, infants with generalized epimerase deficiency galactosemia develop symptoms such as liver and kidney dysfunction and mild cataracts when on a normal milk diet, while infants with peripheral or intermediate epimerase deficiency galactosemia do not develop any symptoms. Generalized epimerase deficiency galactosemia is treated by a galactose- and lactose-restricted diet, which can improve or prevent the symptoms of kidney and liver dysfunction and mild cataracts. Despite adequate treatment from an early age, individuals with generalized epimerase deficiency galactosemia remain at increased risk for developmental delay and intellectual disability. Unlike patients with classic galactosemia resulting from a GALT deficiency, female patients with generalized epimerase deficiency galactosemia experience normal puberty and are not at increased risk for premature ovarian failure. Based upon reports by newborn screening programs, the frequency of epimerase deficiency galactosemia in the United States ranges from approximately 1 in 6700 African American infants to 1 in 70,000 infants of European ancestry.

GALM deficiency is a rare form of galactosemia that is due to a deficiency of galactose mutarotase, which may manifest clinically with bilateral cataracts. Infants with GALM deficiency have increased blood galactose concentrations with levels of galactose 1-phosphate ranging from 0.3 to 10.8 mg/dL.(1) Neonates with GALM deficiency have elevated galactose-1-phosphate, but Gal1P decreases rapidly in early infancy. To date, only pediatric patients have been described in the literature, and so the long-term, adult consequences of GALM deficiency remain unknown.

The incidence of GALM deficiency has been reported as 1 in 10,000 in African populations and close to 1 in 80,000 in the Japanese population, with an overall estimation of about 1:228,411 in all populations.(2)

For more information see Galactosemia Testing Algorithm.

Reference Values

Reference interval (normal range): < or =0.9 mg/dL
Therapeutic range: < or =4.9 mg/dL

Interpretation

The concentration of galactose-1-phosphate (Gal1P) is provided along with reference values for patients with galactosemia and normal controls. The recommended Gal1P goal for patients with galactosemia is 4.9 mg/dL or less.

Cautions

Patients should wait 3 to 4 months after blood transfusion before collection of whole blood for galactose-1-phosphate testing.

Clinical Reference

1. Wada Y, Kikuchi A, Arai-Ichinoi N, et al. Biallelic GALM pathogenic variants cause a novel type of galactosemia. Genet Med. 2019;21(6):1286-1294. doi:10.1038/s41436-018-0340-x
2. Iwasawa S, Kikuchi A, Wada Y, et al. The prevalence of GALM mutations that cause galactosemia: A database of functionally evaluated variants. Mol Genet Metab. 2019;126(4):362-367. doi:10.1016/j.ymgme.2019.01.018
3. Berry GT. Classic galactosemia and clinical variant galactosemia. In: Adam MP, Feldman J, Mirzaa GM, et al. eds. GeneReviews [Internet]. University of Washington, Seattle; 2000. Updated March 11, 2021. Accessed September 12, 2024. Available at www.ncbi.nlm.nih.gov/books/NBK1518/
4. Walter JH, Fridovich-Keil JL. Galactosemia. In: Valle D, Antonarakis S, Ballabio A, Beaudet AL, Mitchell GA, eds. The Online Metabolic and Molecular Bases of Inherited Disease. McGraw-Hill; 2019. Accessed July 26, 2024. Available at https://ommbid.mhmedical.com/content.aspx?bookid=2709&sectionid=%20225081023
5. Timson DJ. Type IV galactosemia. Genet Med. 2019;21(6):1283-1285. doi:10.1038/s41436-018-0359-z
6. Fridovich-Keil J, Bean L, He M, et al. Epimerase deficiency galactosemia. In: Adam MP, Feldman J, Mirzaa GM, et al. eds. GeneReviews [Internet]. University of Washington, Seattle; 1993-2024. Updated March 4, 2021. Accessed September 12, 2024. Available at www.ncbi.nlm.nih.gov/books/NBK51671/

Performance

Method Description

Packed red blood cells are diluted with cold water and vortexed to lyse the cells, creating a hemolysate. The hemolysate is extracted with acetonitrile/methanol containing internal standard and then is centrifuged prior to injection onto a liquid chromatography tandem mass spectrometry (LC-MS/MS) system. The ratio of the extracted peak area of galactose-1-phosphate (Gal-1-P) to its internal standard (13)C2-Gal-1-P as determined by LC-MS/MS is used to calculate the concentration of analyte, in mg/dL, in the sample.(Unpublished Mayo method)

PDF Report

No

Day(s) Performed

Thursday

Report Available

4 to 10 days

Specimen Retention Time

1 month

Performing Laboratory Location

Mayo Clinic Laboratories - Rochester Main Campus

Fees & Codes

Fees

- Authorized users can sign in to Test Prices for detailed fee information.
- Clients without access to Test Prices can contact Customer Service 24 hours a day, seven days a week.
- Prospective clients should contact their account representative. For assistance, contact Customer Service.

Test Classification

This test was developed and its performance characteristics determined by Mayo Clinic in a manner consistent with CLIA requirements. It has not been cleared or approved by the US Food and Drug Administration.

CPT Code Information

84378

LOINC® Information

Test ID	Test Order Name	Order LOINC® Value
GAL1P	Galactose-1-Phosphate, RBC	2312-7

Result ID	Test Result Name	Result LOINC® Value
24101	Galactose-1-Phosphate, RBC	2312-7