MAYO CLINIC LABORATORIES

Test Definition: MP9W

Mucopolysaccharidoses, Nine-Enzyme Panel, Leukocytes

Overview

Useful For

Supporting the biochemical diagnosis of mucopolysaccharidoses types II, IIIA, IIIB, IIIC, IIID, IVA, IVB, VI, and VII, and of multiple sulfatase deficiency

This test is **not useful for** carrier detection.

Genetics Test Information

This test is a screening panel for individuals with clinical signs and symptoms suspicious for one of several mucopolysaccharidoses (MPS types II, IIIA, IIIB, IIIC, IIID, IVA, IVB, VI, or VII) or for multiple sulfatase deficiency. If an enzyme deficiency is detected by this screening test, additional biochemical or molecular testing is required to confirm a diagnosis.

Special Instructions

- Informed Consent for Genetic Testing
- Biochemical Genetics Patient Information
- Informed Consent for Genetic Testing (Spanish)

Method Name

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

NY State Available

Yes

Specimen

Specimen Type

Whole Blood ACD

Ordering Guidance

To evaluate newborn patients in follow-up to an abnormal newborn screen for MPS I, the recommended tests are IDUAW / Alpha-L-Iduronidase, Leukocytes and MPSBS / Mucopolysaccharidosis, Blood Spot, MPSWB / Mucopolysaccharidosis, Blood), MPSER / Mucopolysaccharides Quantitative, Serum or MPSQU / Mucopolysaccharides Quantitative, Random, Urine.

To evaluate newborn patients in follow-up to an abnormal newborn screen for MPS II, the recommended tests are I2SB / Iduronate-2-Sulfatase, Blood Spot or I2SWB / Iduronate-2-Sulfatase, Leukocytes and MPSBS / Mucopolysaccharidosis, Blood Spot, MPSWB / Mucopolysaccharidosis, Blood, MPSER / Mucopolysaccharides Quantitative, Serum or MPSQU / Mucopolysaccharides Quantitative, Random, Urine.

Shipping Instructions

For optimal isolation of leukocytes, it is recommended the specimen arrive refrigerated within 6 days of collection to be stabilized. Collect specimen Monday through Thursday only and not the day before a holiday. Specimen should be collected and packaged as close to shipping time as possible.

Necessary Information

1. Patient's age is required.

2. Reason for testing is required.

Specimen Required

Container/Tube:

Preferred: Yellow top (ACD solution B)

Acceptable: Yellow top (ACD solution A) or lavender top (EDTA)

Specimen Volume: 6 mL

Collection Instructions: Send whole blood specimen in original tube. **Do not aliquot**.

Forms

New York Clients-Informed consent is required. Document on the request form or electronic order that a copy is on file. The following documents are available:

-Informed Consent for Genetic Testing (T576)

-Informed Consent for Genetic Testing-Spanish (T826)

Specimen Minimum Volume

5 mL

Reject Due To

Gross hemolysis	Reject

Specimen Stability Information

Specimen Type	Temperature	Time	Special Container
Whole Blood ACD	Refrigerated (preferred)	6 days	
	Ambient	6 days	

Clinical & Interpretive

Clinical Information

The mucopolysaccharidoses (MPS) are a group of disorders caused by a deficiency of any of the enzymes involved in the stepwise degradation of dermatan sulfate, heparan sulfate, keratan sulfate, or chondroitin sulfate, also known as glycosaminoglycans (GAG). Accumulation of GAG in lysosomes interferes with normal functioning of cells, tissues, and organs. There are 11 known disorders that involve the accumulation of GAG which affects multiple organ systems. These

disorders have a broad clinical spectrum and can present with coarse facial features, cardiac abnormalities, organomegaly, intellectual disabilities, short stature, and skeletal abnormalities. This assay detects 9 of the 11 known MPS, including MPSII, MPSIIIA, MPSIIIB, MPSIIIC, MPSIIID, MPSIVA, MPSIVB, MPSVI, and MPSVII.

Multiple sulfatase deficiency (MSD) is a rare autosomal recessive lysosomal disorder caused by mutations in the sulfatase-modifying factor 1 (SUMF1) gene. SUMF1 encodes for a formylglycine-generating enzyme that performs a critical posttranslational modification necessary for activation of all human sulfatases, including arylsulfatase A and B. The clinical features of MSD resemble symptoms of every single sulfatase deficiency, including metachromatic leukodystrophy, the mucopolysaccharidoses, X-linked ichthyosis, and chondrodysplasia punctata type I. Individuals with MSD typically demonstrate reduced activity of several sulfatase enzymes including those on this panel (iduronate-2-sulfatase, heparan sulfate sulfatase, galactosamine-6-sulfate sulfatase, N-acetylglucosamine-6-sulfatase, and arylsulfatase B).

Mucolipidosis II (MLII), also known as I-cell disease, is a rare autosomal recessive disorder with features of both mucopolysaccharidoses and sphingolipidoses. I-cell disease is a progressive disorder characterized by congenital or early infantile manifestations including coarse facial features, short stature, skeletal anomalies, cardio- and hepatomegaly, and developmental delays. While not intended for I-cell disease, a pattern of reduced activity of several enzymes may indicate MLII.

Reference Values

Iduronate-2-sulfatase: >2.20 nmol/hour/mg protein

Heparan-N-sulfatase: >0.13 nmol/hour/mg protein

N-acetyl-alpha-D-glucosaminidase: >0.09 nmol/hour/mg protein

Heparan-alpha-glucosaminide N-acetyltransferase: >0.24 nmol/hou/mg protein

N-acetylglucosamine-6-sulfatase: >0.03 nmol/hour/mg protein

N-acetylgalactosamine-6-sulfatase: >1.60 nmol/hour/mg protein

Beta-galactosidase: >0.28 nmol/hour/mg protein

Arylsulfatase B: >0.34 nmol/hour/mg protein

Beta-glucuronidase: >3.50 nmol/hour/mg protein

An interpretive report will be provided.

Interpretation

Abnormal results are not sufficient to establish a diagnosis of a particular disease. To verify a preliminary diagnosis based on this assay, additional biochemical or molecular genetic analyses are required.

When abnormal results are detected, a detailed interpretation is given, including an overview of the results and of their significance, a correlation to available clinical information, elements of differential diagnosis, recommendations for additional biochemical testing, and in vitro, confirmatory studies (enzyme assay, molecular analysis), and a phone number to reach one of the laboratory directors in case the referring physician has additional questions.

Cautions

Beta-galactosidase is reduced in patients with galactosialidosis. Those patients will also demonstrate deficient activity of neuraminidase which is not evaluated on this panel. If there is clinical suspicion of galactosialidosis, order test OLIGU / Oligosaccharide Screen, Random, Urine.

Mucolipidosis II (MLII, I-cell disease) may not be detectable by this assay. If there is clinical suspicion of MLII, please order test LSDS / Lysosomal Storage Disorders Screen, Random, Urine, NAGS / Hexosaminidase A and Total Hexosaminidase, Serum, and/or molecular genetic analysis of the GNPTAB gene, test CGPH / Custom Gene Panel, Hereditary, Next-Generation Sequencing, Varies, Gene List ID: IEMCP-L5VNMC)

Individuals with pseudodeficiency alleles can show reduced enzyme activity.

Carrier status (heterozygosity) for these conditions cannot be reliably detected.

Enzyme levels may be normal in individuals receiving enzyme replacement therapy or who have undergone hematopoietic stem cell transplant.

Clinical Reference

1. Neufeld EF, Muenzer J. The mucopolysaccharidoses. In: Valle DL, Antonarakis S, Ballabio A, Beaudet AL, Mitchell GA. eds. The Online Metabolic and Molecular Bases of Inherited Disease. McGraw-Hill; Accessed July 17, 2023. Available at https://ommbid.mhmedical.com/content.aspx?bookid=2709&sectionid=225544161
2. Hopwood JJ, Ballabio A. Multiple sulfatase deficiency and the nature of the sulfatase family. In: Valle DL, Antonarakis S, Ballabio A, Beaudet AL, Mitchell GA. eds. The Online Metabolic and Molecular Bases of Inherited Disease. McGraw-Hill; Accessed July 17, 2023. Available at https://ommbid.mhmedical.com/content.aspx?bookid=2709&sectionid=225546905

Performance

Method Description

Leukocytes are incubated with four cocktail mixes 1) substrate and internal standard (IS) for iduronate 2-sulfatase, heparan N-sulfatase, alpha-N-acetylglucosaminidase, N-acetylgalactosamine-sulfate, beta-galactosidase, arylsulfatase B, beta-glucuronidase, and tripeptidyl peptidase 1; 2) substrate and IS for acetyl-CoA:alpha-glucosaminide N-acetyltransferase; 3) substrate and IS for N-acetylglucosamine-6-sulfatase; and 4) substrate and IS for palmitoyl-protein thioesterase 1 in 96-well plates. Following overnight incubation, the plates are combined and purified by liquid-liquid extraction. The extracts are evaporated, reconstituted with mobile phase, and analyzed by tandem mass spectrometry.(Unpublished Mayo method)

PDF Report

No

Day(s) Performed

Preanalytical processing: Monday through Saturday
Testing performed: Tuesday

Report Available

8 to 15 days

Specimen Retention Time

WBC homogenate: 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

82657

LOINC® Information

Test ID	Test Order Name	Order LOINC® Value
MP9W	MPS (Nine) Panel, WBC	104072-4

Result ID	Test Result Name	Result LOINC® Value
BG759	Reason for Referral	42349-1
618439	Iduronate-2-sulfatase	24089-5
618440	Heparan-N-sulfatase	24086-1
618441	N-acetyl-alpha-D-glucosaminidase	24092-9
618442	Heparan-alpha-glucosaminide N-acetyltransferase	24044-0
618443	N-acetylglucosamine-6-sulfatase	24098-6
618444	N-acetylgalactosamine-6-sulfatase	24096-0

618445	Beta-galactosidase	24061-4
618446	Arylsulfatase B	24094-5
618447	Beta-glucuronidase	24065-5
618448	Interpretation	59462-2
618438	Reviewed By	18771-6