MAYO CLINIC LABORATORIES

Test Definition: PUPYU

Purines and Pyrimidines Panel, Random, Urine

Overview

Useful For

Evaluating patients with symptoms suspicious of disorders of purine and pyrimidine metabolism

Monitoring patients with disorders of purine and pyrimidine metabolism

Laboratory evaluation of primary and secondary hyperuricemias

Genetics Test Information

There are at least 35 known inherited disorders of purine and pyrimidine metabolism, which cause a variety of neurological, immunological, hematological, and renal manifestations.

Highlights

This test provides a quantitative report of abnormal levels of purines and pyrimidines in urine identified via liquid chromatography-tandem mass spectrometry.

Method Name

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

NY State Available

Yes

Specimen

Specimen Type

Urine

Ordering Guidance

This is the recommended screening test for the initial workup of a suspected disorder of purine and pyrimidine metabolism, particularly when clinical features are nonspecific, and includes measurement of purines, pyrimidines, uric acid, and S-sulfocysteine. If the clinical features are suggestive of molybdenum cofactor deficiency, isolated sulfite oxidase deficiency, or hereditary xanthinuria, order SSCTU / S-Sulfocysteine Panel, Random, Urine.

If this test is ordered with SSCTU, then SSCTU will be canceled.

Necessary Information

Patient's age is required.

Specimen Required

Supplies: Urine Tubes, 10 mL (T068)

Container/Tube: Plastic, 10-mL urine tube

Specimen Volume: 3 mL
Collection Instructions:
1. Collect a random urine specimen.
2. No preservative needed.

Forms
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

All specimens will be evaluated at Mayo Clinic Laboratories for test suitability.

Specimen Stability Information

Specimen Type	Temperature	Time	Special Container
Urine	Frozen	90 days	

Clinical & Interpretive

Clinical Information
Purines (adenine, guanine, xanthine, hypoxanthine) and pyrimidines (uracil, thymine, cytosine, orotic acid) are involved in all biological processes, providing the basis for storage, transcription, and translation of genetic information as RNA and DNA. Purines are required by all cells for growth and survival and play a role in signal transduction and translation. Purines and pyrimidines originate primarily from endogenous synthesis, with dietary sources contributing only a small amount. The end-product of purine metabolism is uric acid (2,6,8-trioxypurine), which must be excreted continuously to avoid toxic accumulation.

Disorders of purine and pyrimidine metabolism can involve all organ systems at any age. The diagnosis of the specific disorders of purine and pyrimidine metabolism is based upon the clinical presentation of the patient, determination of specific concentration patterns of purine and pyrimidine metabolites, and confirmatory enzyme assays and molecular genetic testing.

Numerous inborn errors of purine and pyrimidine metabolism have been documented. Clinical features are dependent upon the specific disorder but represent a broad spectrum of manifestations that may include immunodeficiency, developmental delay, nephropathy, and neurologic involvement. The most common disorder of purine metabolism is a deficiency of hypoxanthine-guanine phosphoribosyl transferase (HPRT), which causes 3 overlapping clinical syndromes, depending on the amount of residual enzyme activity. The majority of patients with HPRT deficiency have classic Lesch-Nyhan syndrome, a severe X-linked disorder characterized by crystals in urine, neurologic impairment, mild to severe intellectual disability, development of self-injurious behavior, and uric acid nephropathy.

Treatments for Lesch-Nyhan syndrome include allopurinol, urine alkalinization and hydration for nephropathy, and supportive management of neurologic symptoms. For milder forms of HPRT deficiency, treatment that can mitigate the

potentially devastating effects of these diseases are disorder dependent; therefore, early recognition through screening and subsequent confirmatory testing is highly desirable.

Urine S-sulfocysteine is elevated in 2 disorders with similar clinical phenotypes, molybdenum cofactor deficiency (MoCD) and isolated sulfite oxidase deficiency. Molybdenum is an important trace element that is biosynthesized into a cofactor, which is essential for the proper functioning of the enzymes, xanthine oxidase, sulfite oxidase, and aldehyde oxidase, in addition to nitrogenases and nitrate reductase. Four genes are involved in mediating the biosynthetic pathway to create molybdenum cofactor, *MOCS1*, *MOCS2*, *MOCS3*, and *GPHN* (gephyrin). The 3 clinical types of MoCD are autosomal recessive diseases resulting from 2 biallelic disease-causing variants in the respective causative gene. MoCDs result in a progressive neurodegenerative disease that manifests with seizures and brain abnormalities in the first weeks to months of life. The most common type of MoCD is MoCD A, caused by variants in *MOCS1* and resulting in neonatal or infantile onset seizures and postnatal encephalopathy with rapidly progressive neurodegeneration. Infants with MoCD B (*MOCS2* or *MOCS3*), and C (*GPHN*) have been reported but are rare. Infants with MoCD have increased S-sulfocysteine and hypoxanthine and decreased uric acid concentrations in urine. The treatment for MoCD A only is cyclic pyranopterin monophosphate infusion and is most effective when initiated early.

Isolated sulfite oxidase deficiency (ISOD) is an autosomal recessive disorder caused by deficiency of the enzyme sulfite oxidase, which results in progressive neurodegenerative disease in most cases. ISOD is the result of disease-causing variants in the *SUOX* gene. ISOD is a disease spectrum ranging from severe, early onset disease that appears in the first days of life with seizures, feeding issues, and neurologic issues causing abnormal muscle tone, to mild, later onset disease manifesting after 6 months of age with developmental delay or regression, movement issues, and ectopia lentis in some cases. Infants with ISOD have increased S-sulfocysteine and normal hypoxanthine concentrations in urine. Treatment is largely symptomatic, with medication for seizures and movement/neurologic issues. Unfortunately, no treatment for the underlying metabolic defect is currently available. Prevalence is unknown, but ISOD is likely underdiagnosed.

Hereditary xanthinuria results in kidney stones and, less commonly, muscle pain and cramping caused by accumulation of xanthine that forms crystals in the kidneys and muscle tissue. There are 2 types of hereditary xanthinuria: type I caused by deficiency of xanthine dehydrogenase resulting from disease-causing variants in the *XDH* gene, and type II caused by deficiency of molybdenum cofactor sulfurase resulting from variants in the *MOCOS* gene. Individuals with xanthinuria have increased xanthine and decreased uric acid concentrations in urine. The incidence of both types of hereditary xanthinuria is about 1 in 69,000 individuals.

Reference Values

Analyte	0-3 years	4-6 years	7-12 years	13-18 years	>18 years
Uracil	< or =50	< or =30	< or =25	< or =20	< or =20
Thymine	< or =3	< or =3	< or =3	< or =3	< or =3
Adenine	< or =3	< or =3	< or =3	< or =3	< or =3
Hypoxanthine	< or =65	< or =30	< or =30	< or =30	< or =30
Xanthine	< or =54	< or =21	< or =35	< or =15	< or =20
Orotic	< or =4	< or =4	< or =3	< or =3	< or =5
Dihydroorotic acid	< or =3	< or =3	< or =3	< or =3	< or =3
Uric Acid	350-2500	200-2000	200-1400	150-700	70-700
Deoxythymidine	< or =3	< or =3	< or =3	< or =3	< or =3

Deoxyuridine	< or =3	< or =3	< or =3	< or =3	< or =3
Thymidine	< or =3	< or =3	< or =3	< or =3	< or =3
Uridine	< or =10	< or =3	< or =3	< or =3	< or =3
Deoxyadenosine	< or =3	< or =3	< or =3	< or =3	< or =3
Deoxyinosine	< or =3	< or =3	< or =3	< or =3	< or =3
Deoxyguanosine	< or =3	< or =3	< or =3	< or =3	< or =3
Adenosine	< or =3	< or =3	< or =3	< or =3	< or =3
Inosine	< or =6	< or =3	< or =3	< or =3	< or =3
Guanosine	< or =4	< or =3	< or =3	< or =3	< or =3
5-Aminoimidazole-4-carboxamide 1-beta-D-ribofuranoside (AICAR)	< or =3	< or =3	< or =3	< or =3	< or =3
Succinyladenosine	< or =16	< or =3	< or =3	< or =3	< or =3
S-Sulfocysteine	< or =11	< or =5	< or =5	< or =5	< or =5
Dihydrouracil	< or =15	< or =6	< or =6	< or =6	< or =6
Dihydrothymine	< or =11	< or =3	< or =3	< or =3	< or =3
N-Carbamoyl-B-alanine	< or =30	< or =10	< or =10	< or =10	< or =10
N-Carbamoyl-B-aminoisobutyric acid	< or =20	< or =3	< or =3	< or =3	< or =3

All results reported as mmol/mol creatinine

Interpretation

Abnormal concentrations of measurable compounds will be reported along with an interpretation. The interpretation of an abnormal metabolite pattern includes an overview of the results and of their significance, a correlation to available clinical information, possible differential diagnosis, recommendations for additional biochemical testing and confirmatory studies (enzyme assay, molecular analysis), name and phone number of contacts who may provide these studies, and a phone number of the laboratory directors in case the referring physician has additional questions.

Cautions

Additional confirmatory testing via enzyme assays and molecular genetic testing is required for follow-up of abnormal results.

Clinical Reference

1. Jinnah HA, Friedmann T. Lesch-Nyhan disease and its variants. 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 February 12, 2026. Available at https://ommbid.mhmedical.com/content.aspx?sectionid=225089443

2. Nyhan WL, Hoffmann GF, Al-Aqeel AI, Barshop BA. Introduction to the disorders of purine and pyrimidine metabolism. Atlas of Inherited Metabolic Diseases. 4th ed. CRC Press; 2020:495-495

3. Balasubramaniam S, Duley JA, Christodoulou J. Inborn errors of purine metabolism: clinical update and therapies. J Inherit Metab Dis. 2014;37(5):669-686

4.. Balasubramaniam S, Duley JA, Christodoulou J. Inborn errors of pyrimidine metabolism: clinical update and therapy. J Inherit Metab Dis. 2014;37(5):687-698

5. Misko AL, Liang Y, Kohl JB, Eichler F. Delineating the phenotypic spectrum of sulfite oxidase and molybdenum cofactor

deficiency. Neurol Genet. 2020;6(4):e486

Performance

Method Description

Diluted, filtered urine is mixed with an internal standard mixture and analyzed for uracil, thymine, adenine, hypoxanthine, xanthine, orotic, dihydroorotic, deoxythymidine, deoxyuridine, thymidine, uridine deoxyadenosine, deoxyinosine, deoxyguanosine, adenosine, inosine, guanosine, 5-aminoimidazole-4-carboxamide 1-beta-D-ribofuranoside, succinyladensoine, S-sulfocysteine, dihydrouracil, dihydrothymine, n-carbamoyl-beta-alanine, and N-carbamoyl-beta-aminoisobutyric acid by liquid chromatography-tandem mass spectrometry. The ratios of the extracted peak areas of the purine and pyrimidine analytes to the added internal standards are used to calculate the concentration of purines and pyrimidines present in the sample.(la Marca G, Casetta B, Malvagia S, et al. Implementing tandem mass spectrometry as a routine tool for characterizing the complete purine and pyrimidine metabolic profile in urine samples. J Mass Spectrom. 2006;41[11]:1442-1452; Monostori P, Klinke G, Hauke J, et al. Extended diagnosis of purine and pyrimidine disorders from urine: LC MS/MS assay development and clinical validation. PLoS One. 2019;14[2]:e0212458. doi:10.1371/journal.pone.0212458)

PDF Report

No

Day(s) Performed

Tuesday, Thursday

Report Available

3 to 7 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

82542

LOINC® Information

Test ID	Test Order Name	Order LOINC® Value
PUPYU	Purines and Pyrimidines Panel, U	79673-0

Result ID	Test Result Name	Result LOINC® Value
42201	Interpretation (PUPYU)	79677-1
41978	Uracil	25140-5
38249	Thymine	48157-2
38239	Adenine	59203-0
41980	Hypoxanthine	38366-1
41981	Xanthine	38371-1
38246	Orotic Acid	17869-9
38251	Dihydroorotic	78694-7
41979	Uric Acid	34385-5
38252	Deoxythymidine	59215-4
38253	Deoxyuridine	59193-3
38248	Thymidine	59215-4
38250	Uridine	59216-2
38241	Deoxyadenosine	59199-0
38243	Deoxyinosine	59202-2
38242	Deoxyguanosine	59201-4
38245	Inosine	59210-5
38244	Guanosine	78691-3
38254	AICAR	75151-1
38247	Succinyladenosine	59214-7
38255	Dihydrouracil	79685-4
38256	Dihydrothymine	78693-9
38257	N-carbamoyl-beta-alanine	59251-9
38258	N-carbamoyl-beta-aminoisobutyric Acid	79647-4
42200	Reviewed By	18771-6
38240	Adenosine	75160-2
606745	S-Sulfocysteine	33876-4