MAYO CLINIC LABORATORIES

Test Definition: TIUCR

Titanium/Creatinine Ratio, Random, Urine

Overview

Useful For

Monitoring exposure and elimination of titanium

Profile Information

Test Id	Reporting Name	Available Separately	Always Performed
TICU	Titanium/Creat Ratio, U	No	Yes
CRTFR	Creatinine, Random, U	No	Yes

Special Instructions

- Metals Analysis Specimen Collection and Transport

Method Name

TICU: Triple-Quadrupole Inductively Coupled Plasma-Mass Spectrometry (ICP-MS/MS)
CRTFR: Enzymatic Colorimetric Assay

NY State Available

Yes

Specimen

Specimen Type

Urine

Shipping Instructions

Ship specimen on ice

Specimen Required

Patient Preparation: High concentrations of gadolinium and iodine are known to interfere with most metal tests. If either gadolinium- or iodine-containing contrast media has been administered, **the specimen should not be collected for at least 96 hours**.
Supplies: Urine Tubes, 10 mL (T068)
Collection Container/Tube: Clean, plastic urine collection container
Submission Container/Tube: Plastic, 10-mL urine tube or a clean, plastic aliquot container with no metal cap or glued insert
Specimen Volume: 7 mL
Collection Instructions:
1. Collect a random urine specimen.
2. See Metals Analysis Specimen Collection and Transport for complete instructions.

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	28 days	

Clinical & Interpretive

Clinical Information
Titanium is the ninth most abundant element in the earth's crust. Its light weight and high strength are useful in alloys for diverse applications. There is no evidence to date that titanium is an essential element. Due in part to titanium's oxide formation propensity, the element is considered to be nontoxic. Soils, drinking water, and air all contain trace amounts of titanium. The food processing industry uses large quantities of titanium as a food additive; processed foods contain higher levels than are found in most produce and organic food products. The average daily oral intake through food consumption is 0.1 to 1 mg/day, which accounts for more than 99% of exposure. Gastrointestinal absorption of titanium is low (approximately 3%), and most of the ingested titanium is rapidly excreted in the urine and stool. The total body burden of titanium is usually in the range of 9 to 15 mg, a significant portion of which is contained in the lungs. Titanium dust entering the respiratory tract is nonirritating and is almost completely nonfibrogenic in humans.

Titanium-containing alloys are used in some artificial joints, prosthetic devices, and implants. Titanium dioxide allows osseointegration between an artificial medical implant and bone. Despite their wide use, exposure to these materials has not been linked to toxicity. In one study, patients monitored up to 36 months following joint replacement with titanium-containing joints showed a statistically significant increase in detectable titanium. While titanium concentrations are not a measure of toxicity, they can be useful in determining whether implant breakdown is occurring.

Reference Values
TITANIUM
0-17 years: Not established
> or =18 years: <0.4 mcg/g creatinine

CREATININE
> or =18 years old: 16-326 mg/dL
Reference values have not been established for patients who are less than 18 years of age.

Interpretation
Elevated concentrations of urinary titanium have been reported after documented exposures.

Cautions

Titanium is a trace metal commonly used in alloys and readily present in the environment. Thus, contamination of the collection site and of the specimen must be avoided. Failure to use metal-free collection procedures and devices may cause falsely increased results. See Specimen Required for collection and processing information.

Clinical Reference

1. Rifai N, Horvath AR, Wittwer, CT, eds. Tietz Textbook of Clinical Chemistry and Molecular Diagnostics 6th ed. Elsevier; 2018
2. Barry J, Lavigne M, Vendittoli PA. Evaluation of the method for analyzing chromium, cobalt and titanium ion levels in the blood following hip replacement with a metal-on-metal prosthesis. J Anal Toxicol. 2013;37(2):90-6
3. Sarmiento-Gonzalez, A, et al. High resolution ICP-MS determination of Ti, V, Cr, Co, Ni, and Mo in human blood and urine of patients implanted with a hip or knee prothesis. Anal Bioanal Chem. 2008;391(7):2583-9
4. Kim KT, Eo MY, Nguyen TTH, Kim SM. General review of titanium toxicity. Int J Implant Dent. 2019;5(1):10. Published 2019 Mar 11. doi:10.1186/s40729-019-0162-x
5. Jacobs JJ, Skipor AK, Patterson LM, et al: Metal release in patients who have had a primary total hip arthroplasty. A prospective, controlled, longitudinal study. J Bone Joint Surg Am. 1998;80(10):1447-1458
6. Liu TK, Liu SH, Chang CH, Yang RS. Concentration of metal elements in the blood and urine in the patients with cementless total knee arthroplasty. Tohoku J Exp Med. 1998;185(4):253-262
7. Jin T, M Berlin: Titanium. G Nordberg B Fowler M Nordberg et al. Handbook on the toxicology of metals. 3rd ed 2007 Academic Press Amsterdam 861-870
8. Chao EY, Frassica F, Prichard DJ, Moyer TP. Metal ion release in patients with porous coated megaprostheses. 41st Annual Meeting of the Orthopaedic Research Society, Orlando, Florida, 1995 Feb 13-16

Performance

Method Description

Titanium:
Titanium in urine is analyzed by inductively coupled plasma triple-quadrupole mass spectrometry in mass shift mode using ammonia as a reaction gas, gallium as an internal standard, and a salt matrix calibration.(Unpublished Mayo method)

Creatinine:
The enzymatic method is based on the determination of sarcosine from creatinine with the aid of creatininase, creatinase, and sarcosine oxidase. The liberated hydrogen peroxide is measured via a modified Trinder reaction using a colorimetric indicator. Optimization of the buffer system and the colorimetric indicator enables the creatinine concentration to be quantified both precisely and specifically. (Package insert: Creatinine plus ver 2. Roche Diagnostics; V15.0, 03/2019)

PDF Report

No

Day(s) Performed

Wednesday

Report Available

1 to 7 days

Specimen Retention Time

14 days

Performing Laboratory Location

Mayo Clinic Laboratories - Rochester Superior Drive

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

82570
83018

LOINC® Information

Test ID	Test Order Name	Order LOINC® Value
TIUCR	Titanium/Creat Ratio, Random, U	104656-4

Result ID	Test Result Name	Result LOINC® Value
CRTFR	Creatinine, Random, U	2161-8
614615	Titanium/Creat Ratio, U	104656-4