MAYO CLINIC LABORATORIES

Test Definition: TIS

Titanium, Serum

Overview

Useful For
Monitoring metallic prosthetic implant wear

Special Instructions
- Metals Analysis Specimen Collection and Transport

Method Name
Triple-Quadrupole Inductively Coupled Plasma-Mass Spectrometry (ICP-MS/MS)

NY State Available
Yes

Specimen

Specimen Type
Serum

Specimen Required
Patient Preparation: High concentrations of gadolinium and iodine are known to potentially interfere with most inductively coupled plasma mass spectrometry-based metal tests. If either gadolinium- or iodine-containing contrast media has been administered, **a specimen should not be collected for 96 hours**.

Supplies:
-Metal Free Specimen Vial (T173)
-Metal Free B-D Tube (No Additive), 6 mL (T184)

Collection Container/Tube: Plain, royal blue-top Vacutainer plastic trace element blood collection tube

Submission Container/Tube: 7-mL Metal-free, screw-capped, polypropylene vial

Specimen Volume: 0.55 mL Serum

Collection Instructions:
1. Allow specimen to clot for 30 minutes; then centrifuge the specimen to separate serum from the cellular fraction.
2. Remove the stopper. Carefully pour specimen into a metal-free, polypropylene vial, avoiding transfer of the cellular components of blood. **Do not** insert a pipet into the serum to accomplish transfer, and **do not** ream the specimen with a wooden stick to assist with serum transfer.
3. See Metals Analysis Specimen Collection and Transport for complete instructions.

Specimen Minimum Volume
Serum: 0.35 mL

Reject Due To

Gross hemolysis	OK
Gross lipemia	OK
Gross icterus	OK

Specimen Stability Information

Specimen Type	Temperature	Time	Special Container
Serum	Refrigerated (preferred)	28 days	METAL FREE
	Ambient	7 days	METAL FREE
	Frozen	28 days	METAL FREE

Clinical & Interpretive

Clinical Information

Titanium is the ninth most abundant element in the earth's crust. Multiple oxidation states between 2+ and 4+ allow formation of a variety of compounds. There is no evidence 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 foodstuffs. 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 non-fibrogenic 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, to date, 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 serum titanium. While titanium concentrations are not a measure of toxicity, they are useful in determining whether implant breakdown is occurring. Serum titanium concentrations are likely to be increased above the reference range in patients with metallic joint prosthesis. Prosthetic devices produced by Zimmer Company and Johnson and Johnson typically are made of aluminum, vanadium, and titanium. This list of products is incomplete, and these products change occasionally; see prosthesis product information for each device for composition details.

Reference Values

<2 ng/mL

Interpretation

Prosthesis wear is known to result in increased circulating concentration of metal ions. In the absence of an implant, circulating titanium is below 1 ng/mL. Modest increase (1.0-3.0 ng/mL) in serum titanium concentration is evident with a prosthetic device in good condition. Serum concentrations above 10 ng/mL in a patient with titanium-based implant suggest prosthesis wear.

Increased serum titanium concentration in the absence of corroborating clinical information does not independently predict prosthesis wear or failure.

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. 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
3. 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
4. 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;185:253-262
5. Krachler M, Domj W, Irgolic KJ. Concentrations of trace elements in osteoarthritic knee-joint effusions. Biol Trace Elem Res. 2000;75(1-3):253-263
6. Sodi R. Vitamins and trace elements. In: Rifai N, Chiu RWK, Young I, Burnham CAD, Wittwer CT, eds. Tietz Textbook of Laboratory Medicine. 7th ed. Elsevier; 2023:chap 39

Performance

Method Description

The metal of interest is analyzed by inductively coupled plasma mass spectrometry.(Unpublished Mayo method)

PDF Report

No

Day(s) Performed

Wednesday

Report Available

2 to 8 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

83018

LOINC® Information

Test ID	Test Order Name	Order LOINC® Value
TIS	Titanium, S	8244-6

Result ID	Test Result Name	Result LOINC® Value
89367	Titanium, S	8244-6