Test Definition: TIWB

Titanium, Blood

Overview

Useful For

Detecting and monitoring titanium exposure and potential implant status in patients with orthopedic implants

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

Whole blood

Specimen Required

This specimen container cannot be opened or used for any other testing before shipping.

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 EDTA 3 mL Tube (T989)

-Metal Free B-D Tube (EDTA), 6 mL (T183)

Collection Container/Tube:

Preferred: Royal blue-top BD vacutainer with EDTA blood collection tube (3 mL) (BD catalog no. 367777)

Acceptable: Royal blue-top BD Vacutainer Plus with EDTA blood collection tube (6 mL) (BD catalog no. 368381)

Specimen Volume: 0.55 mL

Collection Instructions:

1. See Metals Analysis Specimen Collection and Transport for complete instructions.
2. Send whole blood specimen in original collection tube. **Do not aliquot.**

Specimen Minimum Volume

0.35 mL

Reject Due To

Gross	OK

hemolysis	
Gross lipemia	OK
Gross icterus	OK

Specimen Stability Information

Specimen Type	Temperature	Time	Special Container
Whole blood	Refrigerated (preferred)	28 days	
	Ambient	28 days	
	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 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 the majority of 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, 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 are useful in determining whether implant breakdown is occurring. Blood 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

0-17 years: Not established
> or =18 years: <2 ng/mL

Interpretation

Clinically, this test is used to detect and monitor titanium exposure and potential implant status in patients with orthopedic implants. Increased concentrations in blood have been proposed as a marker of component wear.

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):90-96
3. Sarmiento-Gonzalez A, Marchante-Gayon JM, Tejerina-Lobo JM, Paz-Jimenez J, Sanz-Medel A. 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 prosthesis. Anal Bioanal Chem. 2008;391(7):2583-2589
4. 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
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. Krachler M, Domej W, Irgolic KJ. Concentrations of trace elements in osteoarthritic knee-joint effusions. Biol Trace Elem Res. 2000;75:253-263
8. Swiatkowska I, Martin N, Hart AJ. Blood titanium level as a biomarker of orthopaedic implant wear. J Trace Elem Med Biol. 2019;53:120-128. doi:10.1016/j.jtemb.2019.02.013
9. Yao JJ, Lewallen EA, Thaler R, et al. Challenges in the measurement and interpretation of serum titanium concentrations. Biol Trace Elem Res. 2020;196(1):20-26. doi:10.1007/s12011-019-01891-4
10. Swiatkowska I, Martin NG, Henckel J, Apthorp H, Hamshere J, Hart AJ. Blood and plasma titanium levels associated with well-functioning hip implants. J Trace Elem Med Biol. 2020;57:9-17. doi:10.1016/j.jtemb.2019.09.005
11. 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
12. 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:chap39

Performance

Method Description

The metal of interest is analyzed by triple-quadrupole 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
TIWB	Titanium, B	59753-4

Result ID	Test Result Name	Result LOINC® Value
614612	Titanium, B	59753-4