MAYO CLINIC LABORATORIES

Test Definition: THEO

Theophylline, Serum

Overview

Useful For

Assessing and adjusting theophylline dosage for optimal therapeutic level

Assessing theophylline toxicity

Method Name

Kinetic Interaction of Microparticles in a Solution (KIMS)

NY State Available

Yes

Specimen

Specimen Type

Serum

Specimen Required

Supplies: Sarstedt Aliquot Tube, 5 mL (T914)
Container/Tube:
Preferred: Serum gel
Acceptable: Red top
Submission Container/Tube: Plastic vial
Specimen Volume: 0.5 mL Serum
Collection Instructions:
1. Within 2 hours of collection, centrifuge the specimen.
2. For serum gel tubes, serum may sit on gel refrigerated or aliquoted into a plastic vial.
3. For red top tubes, aliquot serum immediately into a plastic vial.

Forms

If not ordering electronically, complete, print, and send a Therapeutics Test Request (T831) with the specimen.

Specimen Minimum Volume

Serum: 0.25 mL

Reject Due To

Gross hemolysis	Reject

Specimen Stability Information

Specimen Type	Temperature	Time	Special Container
Serum	Refrigerated (preferred)	14 days	
	Ambient	72 hours	
	Frozen	28 days	

Clinical & Interpretive

Clinical Information

Theophylline and its congener, aminophylline, are used to relax smooth muscles of the bronchial airways and pulmonary blood vessels to relieve and prevent symptoms of asthma and bronchospasm.

Theophylline is typically administered orally at a dose of 400 mg/day or 6 mg/kg, whichever is lower, or intravenously as aminophylline at 0.4 mg/kg/hour. Oral dosage may be increased at 200 mg increments to a maximum of 900 mg/day, or 13 mg/kg if the steady-state blood concentration is within the therapeutic range of 8.0 to 20.0 mcg/mL.

Theophylline has a half-life of approximately 4 hours in children and adult smokers, and 8.7 hours in nonsmoking adults. The volume of distribution is approximately 0.5 L/kg, and the drug is approximately 40% protein bound. Theophylline exhibits zero-order clearance kinetics like phenytoin, small increases in dose yield disproportionately large increases in blood concentration.

Coadministration of cimetidine and erythromycin will significantly inhibit theophylline clearance, requiring dosage reduction. Other drugs such as allopurinol, ciprofloxacin, oral contraceptives, and propranolol inhibit theophylline clearance to a lesser degree.

Smoking induces CYP1A2, the antipyrine-dependent cytochrome, which significantly increases the rate of metabolism of theophylline. Drugs such as phenobarbital, phenytoin, carbamazepine, and rifampin slightly increase the rate at which the drug is cleared.

Theophylline exhibits rather severe toxicity that is proportional to blood level.

Reference Values

Therapeutic:
Bronchodilation: 8.0-20.0 mcg/mL
Neonatal apnea (< or =4 weeks old): 6.0-13.0 mcg/mL
Critical value: >20.0 mcg/mL

Interpretation

Response to theophylline is directly proportional to the serum level.

Patients usually receive the best response when the serum level is above 8.0 mcg/mL, with minimal toxicity experienced as long as the level is less than or equal to 20.0 mcg/mL.

Cautions

Many drugs affect the plasma level of this drug (as outlined in Clinical Information).

Clinical Reference

1. Milone MC, Shaw LM. Therapeutic drugs and their management. In: Rifai N, Chiu RWK, Young I, Burnham C-AD, Wittwer CT, eds. Tietz Textbook of Laboratory Medicine. 7th ed. Elsevier; 2023:420-453.e9
2. Brunton LL, Hilal-Dandan R, Knollmann BC, eds. Goodman and Gilman's: The Pharmacological Basis of Therapeutics. McGraw-Hill; 2018

Performance

Method Description

The assay is based on the kinetic interaction of microparticles in a solution. Theophylline antibody is covalently coupled to microparticles and the drug derivative is linked to a macromolecule. The kinetic interaction of microparticles in solutions is induced by binding of drug-conjugate to the antibody on the microparticles and is inhibited by the presence of theophylline in the sample. A competitive reaction takes place between the drug conjugate and theophylline in the serum sample for binding to the theophylline antibody on the microparticles. The resulting kinetic interaction of microparticles is indirectly proportional to the amount of drug present in the sample.(Package insert: THEO2. Roche Diagnostics; 01/2024)

PDF Report

No

Day(s) Performed

Monday through Saturday

Report Available

Same day/1 to 2 days

Specimen Retention Time

2 weeks

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

Test Definition: THEO

Theophylline, Serum

This test has been cleared, approved, or is exempt by the US Food and Drug Administration and is used per manufacturer's instructions. Performance characteristics were verified by Mayo Clinic in a manner consistent with CLIA requirements.

CPT Code Information

80198

LOINC® Information

Test ID	Test Order Name	Order LOINC® Value
THEO	Theophylline, S	4049-3

Result ID	Test Result Name	Result LOINC® Value
8661	Theophylline, S	4049-3