Overview

Useful For
Follow-up of patients with differentiated thyroid cancers after thyroidectomy and radioactive iodine ablation

Testing Algorithm
All specimens are screened for the presence of autoantibodies to thyroglobulin.

Method Name
Immunoenzymatic Assay

NY State Available
Yes

Specimen

Specimen Type
Serum Red

Advisory Information
Refer to TGMS / Thyroglobulin Mass Spectrometry, Serum for accurate sample analysis of patients who are known to be thyroglobulin antibody positive.

Specimen Required
Patient Preparation: For 12 hours before specimen collection do not take multivitamins or dietary supplements containing biotin (vitamin B7), which is commonly found in hair, skin, and nail supplements and multivitamins.

Collection Container/Tube: Red top (serum gel tubes are not acceptable)
Submission Container/Tube: Plastic vial

Specimen Volume: 1 mL

Forms
If not ordering electronically, complete, print, and send 1 of the following forms with the specimen:
- General Request (T239)
- Oncology Test Request (T729)

Specimen Minimum Volume
0.5 mL

Reject Due To

<table>
<thead>
<tr>
<th>Gross hemolysis</th>
<th>Reject</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gross lipemia</td>
<td>OK</td>
</tr>
</tbody>
</table>

Specimen Stability Information
Test Definition: HTG2
Thyroglobulin, Tumor Marker

<table>
<thead>
<tr>
<th>Specimen Type</th>
<th>Temperature</th>
<th>Time</th>
<th>Special Container</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serum Red</td>
<td>Refrigerated (preferred)</td>
<td>7 days</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Frozen</td>
<td>30 days</td>
<td></td>
</tr>
</tbody>
</table>

Clinical and Interpretive

Clinical Information

Thyroglobulin (Tg) is a thyroid-specific glycoprotein (approximately 660 KDa) that serves as the source for thyroxine (T4) and triiodothyronine (T3) production within the lumen of thyroid follicles. For T4 and T3 release, Tg is reabsorbed into thyrocytes and proteolytically degraded, liberating T4 and T3 for secretion.

Small amounts of intact Tg are secreted alongside T4 and T3 and are detectable in the serum of healthy individuals, with levels roughly paralleling thyroid size (0.5-1.0 ng/mL Tg per gram thyroid tissue, depending on thyroid-stimulating hormone: TSH level). In situations of disordered thyroid growth (eg, goiter), increased thyroid activity (eg, Graves disease), or glandular destruction (eg, thyroiditis) larger amounts of Tg may be released into the circulation.

Clinically, the main use of serum Tg measurements is in the follow-up of differentiated follicular cell-derived thyroid carcinoma. Because Tg is thyroid-specific, serum Tg concentrations should be undetectable, or very low, after the thyroid gland is removed during treatment for thyroid cancer.

Current clinical guidelines consider a serum Tg of more than 1 ng/mL in an athyrotic individual as suspicious of possible residual or recurrent disease. To improve diagnostic accuracy, it is recommended that at least initially this measurement is obtained after TSH stimulation, either following thyroid hormone withdrawal, or after injection of recombinant human TSH. Most patients will have a relatively low risk of recurrence, and will thereafter only require unstimulated Tg measurement. If unstimulated (on thyroxine) serum Tg measurements are less than 0.1 to 0.2 ng/mL, the risk of disease is below 1%. Patients with higher Tg levels, who have no demonstrable remnant of thyroid tissue, might require additional testing, such as further stimulated Tg measurements, neck ultrasound, or isotope imaging. A stimulated Tg above 2 ng/mL is considered suspicious. The presence of antithyroglobulin autoantibodies (TgAb), which occur in 15% to 30% of thyroid cancer patients, could lead to misleading Tg results. In immunometric assays, the presence of TgAb can lead to false-low results; whereas it might lead to false-high results in competitive assays.

Traditionally, there have been no reliable means to obtain accurate Tg measurements in patients with TgAb. However, recently trypsin digestion of serum proteins, which cuts both antibodies and Tg into predictable fragments, has allowed accurate quantification of Tg in samples with antibody interferences through measurement of Tg by mass spectrometry. Refer to TGMS / Thyroglobulin Mass Spectrometry, Serum for accurate sample analysis of patients who are known to be TgAb positive. If TgAb status is unknown, refer to HTGR / Thyroglobulin, Tumor Marker Reflex to LC-MS/MS or Immunoassay. When HTGR is ordered, TgAb testing is performed first. If TgAb is negative (<1.8 IU/mL), Tg is assayed by immunoassay (sensitive down to 0.1 ng/mL). If TgAb is positive, Tg is assayed by mass spectrometry (sensitive down to 0.5 ng/mL).

Reference Values

THYROGLOBULIN, TUMOR MARKER

Athyrotic: <0.1 ng/mL

Intact thyroid < or =33 ng/mL
THYROGLOBULIN ANTIBODY

<1.8 IU/mL

Reference values apply to all ages.

**Interpretation**

Current guidelines recommend measurement of thyroglobulin (Tg) with a sensitive immunoassay (limit of quantification <1.0 ng/mL); for measurements of unstimulated Tg, the detection limit should be in the 0.1 to 0.2 ng/mL range.

In all cases, serum thyroglobulin autoantibodies (TgAb) should also be measured, preferably with a method that allows detection of low concentrations of TgAb. If TgAb are detected, the laboratory report should alert the ordering provider to the possibility of false-low Tg results if using an immunometric assay. If the apparent Tg concentration is <1.0 ng/mL, the sample should be remeasured by mass spectrometry. This will allow accurate detection of Tg, in the presence of TgAb, down to 0.5 ng/mL (risk of residual/recurrent disease <1%-3%).

Samples from patients with Tg concentrations >1.0 ng/mL might not require Tg measurement by mass spectrometry, because current guidelines suggest further workup might be necessary above this threshold. However the positive predictive value for residual/recurrent disease is modest when Tg is just above this threshold (3%-25%) in athyrotic patients. Above 10 ng/mL, the risk of residual/recurrent disease is at least 25%, with many studies showing 60% to >90% risks. In selected patients, therefore, it might also be useful to test TgAb positive samples by mass spectrometry, even if the Tg concentration is >1.0 ng/mL, but not above the 10 ng/mL threshold. These considerations are even more relevant in patients with a known thyroid remnant of a few grams, who may always have serum Tg concentrations of 1.0 to 10 ng/mL, owing to remnant Tg secretion, regardless of the presence or absence of residual/recurrent cancer.

It has been determined that the presence of antithyroglobulin autoantibodies (TgAb) in serum can lead to underestimation of Tg concentration by immunometric methods. When TgAb are present in samples with detectable Tg, the Tg values may be underestimated by up to 60% in immunoassays. In addition, approximately 20% of specimens containing TgAb, which are negative for Tg by immunoassay, tested positive by liquid chromatography-tandem mass spectrometry (LC-MS/MS). Therefore, measuring of Tg by mass spectrometry is the preferred method in TgAb positive patients.

The decision levels listed below, are for thyroid cancer follow up of athyrotic patients and apply to unstimulated and stimulated thyroglobulin measurements. Decision levels are based on best practice guidelines and the literature, which includes Mayo Clinic studies.

Decision levels for thyroid cancer patients, who are not completely athyrotic (ie, patient has some remnant normal thyroid tissue), have not been established, but are likely to be somewhat higher: remnant normal thyroid tissue contributes to serum Tg concentrations 0.5 to 1.0 ng/mL per gram of remnant tissue, depending on the thyroid-stimulating hormone (TSH) level.

Tg <0.1 ng/mL: Tg levels must be interpreted in the context of TSH levels, serial Tg measurements and radioiodine ablation status. Tg levels <0.1 ng/mL in athyrotic individuals on suppressive therapy indicate a minimal risk (<1-2%) of clinically detectable recurrent papillary/follicular thyroid cancer.

Tg > or =0.1 to 2.0 ng/mL: Tg levels must be interpreted in the context of TSH levels, serial Tg measurements and radioiodine ablation status. Tg levels 0.1 to 2.0 ng/mL in athyrotic individuals on suppressive therapy indicate a low risk of clinically detectable recurrent papillary/follicular thyroid cancer.

Tg 2.1 to 9.9 ng/mL: Tg levels must be interpreted in the context of TSH levels, serial Tg measurements and
Test Definition: HTG2
Thyroglobulin, Tumor Marker

radiiodine ablation status. Tg levels 2.1 to 9.9 ng/mL in athyrotic individuals on suppressive therapy indicate an increased risk of clinically detectable recurrent papillary/follicular thyroid cancer.

Tg > or =10 ng/mL: Tg levels must be interpreted in the context of TSH levels, serial Tg measurements and radiiodine ablation status. Tg levels > or =10 ng/mL in athyrotic individuals on suppressive therapy indicate a significant risk (>25%) of clinically detectable recurrent papillary/follicular thyroid cancer.

Cautions
The test is most sensitive for detection of thyroid cancer recurrence when patients are off thyroid replacement long enough to have an elevated thyroid-stimulating hormone (TSH) prior to drawing the specimen. This test also can be used to follow patients with normal TSH; however, thyroglobulin (Tg) values from specimens with high TSH should not be compared with values with normal TSH, because TSH stimulation changes the baseline determinations.

Thyroglobulin autoantibodies (TgAb) may interfere with the measurement of Tg. All specimens are prescreened for TgAb and a comment appended to the report if they are present. Undetectable levels of Tg should be interpreted with caution if TgAb are present. A Tg antibody result of <4 IU/mL is unlikely to cause clinically significant Tg assay interference. It is recommended that the Tg result be reviewed for concordance with clinical presentation.

Specimens with Tg concentrations greater than 250,000 ng/mL may "hook" and appear to have markedly lower levels.

Tg and TgAb values determined by different methodologies might vary significantly and cannot be directly compared with one another. Some patients might be antibody-positive by some methods and antibody-negative by others. Comparing values from different methods might lead to erroneous clinical interpretation.

Clinical Reference

Performance

Method Description
The Beckman Coulter Unicel DxI 800 is used for both thyroglobulin tumor marker and thyroglobulin antibody testing.

The Access Thyroglobulin (Tg) assay is a simultaneous 1-step immunoenzymatic (sandwich) assay. A sample is added to a reaction vessel, along with a biotinylated mixture of 4 monoclonal anti-Tg antibodies, streptavidin-coated paramagnetic particles, and monoclonal anti-Tg antibody alkaline phosphatase conjugate. The biotinylated
antibodies and the serum Tg binds to the solid phase, while the conjugate antibody reacts with a different antigenic site on the Tg molecule. After incubation in a reaction vessel, materials bound to the solid phase are held in a magnetic field while unbound materials are washed away. Then, the chemiluminescent substrate Lumi-Phos 530 is added to the vessel and light generated by the reaction is measured with a luminometer. The light production is directly proportional to the concentration of Tg in the sample. (Instruction manual: Beckman Coulter Assay Manual, 2010)

The Access Thyroglobulin Antibody II assay (TgAb) is a sequential 2-step immunoenzymatic (sandwich) assay. A sample is added to a reaction vessel with paramagnetic particles coated with the thyroglobulin protein. The serum TgAb binds to the thyroglobulin. After incubation in a reaction vessel, materials bound to the solid phase are held in place by a magnetic field, while unbound materials are washed away. The thyroglobulin-alkaline phosphatase conjugate is added and binds to the TgAb. After the second incubation, materials bound to the solid phase are held in place by a magnetic field, while unbound materials are washed away. Then, the chemiluminescent substrate, Lumi-Phos 530 is added to the reaction vessel and light generated by the reaction is measured with a luminometer. The light production is directly proportional to the concentration of thyroglobulin antibody in the sample. (Instruction manual: Thyroglobulin Antibody II Assay, Beckman Coulter, Inc., Fullerton, CA 2011)

PDF Report

No

Day(s) and Time(s) Test Performed

Monday through Friday; 6 a.m.-12 a.m.

Saturday; 6 a.m.-6 p.m.

Analytic Time

Same day/1 day

Maximum Laboratory Time

3 days

Specimen Retention Time

12 months

Performing Laboratory Location

Rochester

Fees and 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 Regional Manager. For assistance, contact Customer Service.

Test Classification

This test has been cleared or approved by the U.S. 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

84432-Thyroglobulin, tumor marker
86800-Thyroglobulin antibody screen

**LOINC® Information**

<table>
<thead>
<tr>
<th>Test ID</th>
<th>Test Order Name</th>
<th>Order LOINC Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>HTG2</td>
<td>Thyroglobulin, Tumor Marker</td>
<td>57780-9</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Result ID</th>
<th>Test Result Name</th>
<th>Result LOINC Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>TGAB2</td>
<td>Thyroglobulin Antibody, S</td>
<td>56536-6</td>
</tr>
<tr>
<td>HTGN2</td>
<td>Thyroglobulin, Tumor Marker, S</td>
<td>3013-0</td>
</tr>
<tr>
<td>HTG2I</td>
<td>Thyroglobulin Interpretation</td>
<td>69053-7</td>
</tr>
</tbody>
</table>