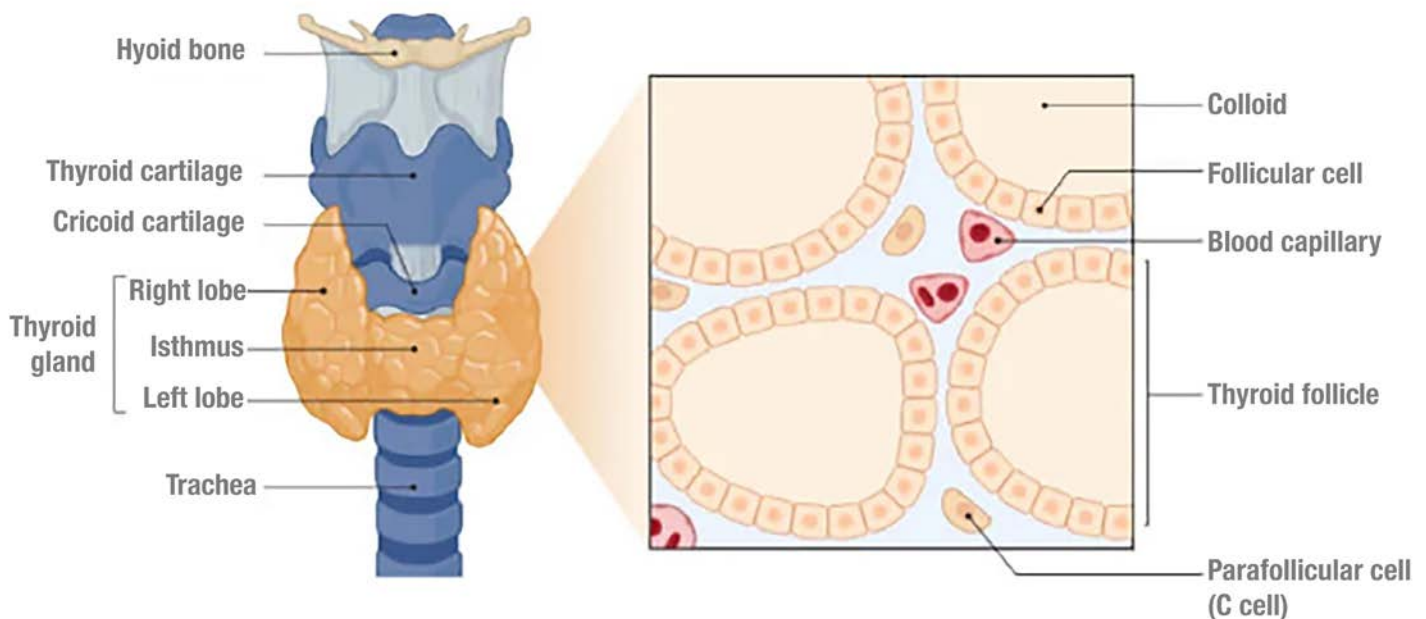


# LABORATORY TESTS RELATED TO THYROID DISEASES AND CANCER

## WHAT IS THE THYROID?

The thyroid is a small butterfly shaped gland that is located in the front of the neck below the larynx. It is wrapped around the trachea (windpipe). The thyroid produces hormones that control the body's metabolism, which are chemical reactions in the body that change food into energy.



## THYROID DISEASES

Thyroid diseases affect the size and the function of the thyroid gland. There are various types of thyroid diseases that range from non-threatening, such as goiter, to life-threatening, such as thyroid cancer.

### GOITER

Goiter is a condition where the thyroid gland is enlarged. There are many causes of goiter including an overactive thyroid, an underactive thyroid, an inflamed thyroid, hormonal changes, certain medications, and benign or malignant tumors. Because goiter is only a sign of many possible diseases, it should be thoroughly evaluated by your clinician with several tests. One of the more common causes of goiter is lack of iodine in the diet. Signs and symptoms of goiter include a swelling on the neck, coughing, difficulty swallowing, difficulty breathing and a tight feeling in the throat.

### HASHIMOTO'S THYROIDITIS

Hashimoto's Thyroiditis is an autoimmune condition where the thyroid gland is inflamed because the immune system is attacking the thyroid tissue. This condition leads to the thyroid gland not functioning to its full capacity resulting in hypothyroidism (see below). Signs and symptoms of Hashimoto's Thyroiditis include constipation, fatigue and sluggishness, enlargement of the tongue, muscle aches, tenderness and stiffness.

### HYPERTHYROIDISM

Hyperthyroidism is a condition where the thyroid gland produces high levels of thyroid hormones and releases excess thyroid hormones in the body. Some causes for hyperthyroidism include Grave's disease, consuming too much iodine and the inflammation of the thyroid. Signs and symptoms include an elevated heartbeat, weight loss, goiter, muscle weakness and a significantly increased appetite.

### HYPOTHYROIDISM

Hypothyroidism is a condition where the thyroid gland does not produce an adequate amount of thyroid hormones. The inflammation of the thyroid due to autoimmune conditions, such as Hashimoto's thyroiditis, contribute to the development of hypothyroidism. Signs and symptoms include increased sensitivity to the cold, weight gain, goiter, dry skin, muscle weakness, slowed heart rate and fatigue.

## THYROID CANCER

Thyroid cancer develops in the thyroid gland. In the early stages, thyroid cancer may not present any signs and symptoms. The types of thyroid cancer depend on the cells that the malignant growth originates in. The main types of thyroid cancer are:

### ANAPLASTIC THYROID CARCINOMA

is a very rare and aggressive type of malignant growth in the thyroid gland. The cancer often begins in the thyroid as a thyroid nodule which is a lump of abnormal thyroid cells and quickly spreads outside the thyroid tissue. Anaplastic carcinoma contributes to about 2% of thyroid cancers.

### FOLLICULAR THYROID CARCINOMA

is a type of thyroid cancer that develops in the follicular cells of the thyroid. This type of cancer may not present symptoms during the early stages (stage 1 and 2). Follicular thyroid carcinoma is the second most common type of thyroid cancer, contributing to about 15% of the cases.

### HÜRTHLE CELL CARCINOMA

is a rare aggressive type of cancer that begins in the Hürthle cells in the thyroid tissue. There are usually no symptoms during the early stages (stages 1 and 2) of Hürthle cell carcinoma. Common signs and symptoms in the later stages (stages 3 and 4) include a higher level of thyroglobulin (see below) and a lump in the thyroid gland. Hürthle cells carcinoma is rare and accounts for about 3% of thyroid cancers.

### MEDULLARY THYROID CARCINOMA

is a rare cancer that begins in the C cells of the thyroid. C cells produce the hormone calcitonin that controls the level of calcium in the blood. The two types of medullary thyroid carcinoma are sporadic medullary thyroid carcinoma (non-hereditary) and familial medullary thyroid carcinoma (hereditary). Similar to other types of thyroid cancers, there are rarely any symptoms during the early stages (stages 1 and 2). During the advanced stages (stages 3 and 4), symptoms include a painful lump in the neck, trouble swallowing, shortness of breath and diarrhea. Both types of medullary thyroid carcinoma contribute to about 4% of thyroid cancers.

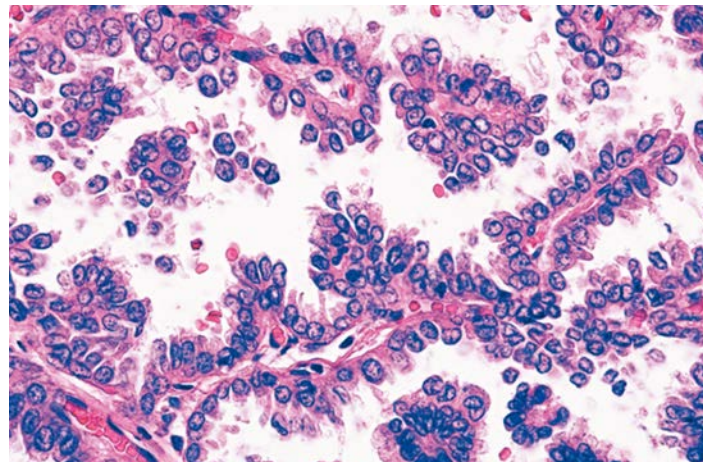
### PAPILLARY THYROID CARCINOMA

is a malignant growth that also begins in the follicular cells. The growth is often difficult to detect and it grows slowly. This type of cancer does not often present symptoms but a growing and usually painless lump in the thyroid nodule can be a sign of the cancer. Papillary thyroid carcinoma is the most common type of thyroid cancer and it contributes to about 80% of thyroid cancers.

# STAGES OF THYROID CANCER

The stages of thyroid cancer determine how far the cancer has spread and what parts of the body it has spread to. Treatment plans and prognosis (course of the disease) will depend on the staging portion of your diagnosis. Below is a short description of each stage:

- STAGE I:** The size of the tumor is less than 2cm and the cancer has not spread beyond the thyroid.
- STAGE II:** The size of the tumor is between 2cm-4cm and the cancer has not spread outside of the thyroid. For medullary thyroid cancer only: The size of the tumor is more 4cm or it has started to spread beyond the thyroid but not to nearby lymph nodes.
- STAGE III:** One of the following criteria is true:
- The tumor is of variable size or has spread outside of the thyroid to lymph nodes in the neck.
  - Papillary thyroid carcinoma and follicular thyroid carcinoma only: The size of the tumor is more than 4cm or it has started to spread beyond the thyroid but not to nearby lymph nodes.
- STAGE IV:** The cancer has spread beyond the thyroid gland or to the lymph nodes in the neck and upper chest.
- STAGE IVA:** The cancer has spread beyond the thyroid gland or to the lymph nodes in the neck and upper chest.
- STAGE IVB:** The tumor has spread to nearby blood vessels or the spine. The cancer may have spread to lymph nodes.
- STAGE IVC:** The cancer has spread to other parts of the body (metastasized).
- STAGE IV:** Anaplastic Thyroid Carcinoma only
- STAGE IVA:** The tumor has not spread outside of the thyroid gland and may or may not have spread to the lymph nodes.
- STAGE IVB:** The tumor has spread outside of the thyroid gland and may or may not have spread to the lymph nodes.
- STAGE IVC:** The cancer has spread to other parts of the body (metastasized).



## UNDER THE MICROSCOPE

*A pathology slide of papillary thyroid carcinoma showing dark blue, crowded cells creating protrusions or projections into the clear spaces (called tufts or fronds).*

## LAB TESTS RELATED TO THYROID DISEASES

*\*Please note that reference ranges are set by individual laboratories for their specific populations so reference ranges might differ slightly.*

### DIAGNOSIS

**Fine Needle Aspiration biopsy (FNA):** This is a procedure where a small sample of tissue is removed from the thyroid gland using a hollow needle. The sample is examined under a microscope to identify whether the cells from the sample are benign or malignant. The FNA also helps determine the type of cancer.

**Thyroid Antibody Tests:** These tests measure the level of thyroid autoantibodies in the blood. These tests are important because they identify the antibodies that attack the thyroid gland leading to inflammation. High levels of thyroid antibodies are a sign of thyroid not functioning properly. These tests help differentiate between the thyroid diseases.

Type of Thyroid Antibody	Thyroid Disease	Typical Reference Range*
Thyroid peroxidase antibody	Hashimoto thyroiditis, hypothyroidism	Less than 9 IU/mL
Thyroglobulin antibody	Thyroid Cancer, Hashimoto thyroiditis	Less than 4 IU/mL
Thyroid stimulating Immunoglobulin	Hyperthyroidism	Less than 1.3 TSI Index

**Thyroid-stimulating hormone (TSH):** This test measures if the thyroid is performing optimally. This test is important because it can indicate whether your thyroid is under or over performing. Typical reference ranges\* for adults are between 0.4-4.0 mIU/L.

**Thyroid Panel:** This test measures the levels of free thyroxine (T4) and free or total triiodothyronine (T3) in the blood. This test is important because the levels of free or total T3 and free T4 hormones indicate whether the thyroid gland is functioning properly. The typical reference range\* for adults for free T4 is between 0.8-1.5 ng/dL and total T4 is between 75-195 ng/dL.

## LAB TESTS RELATED TO THYROID CANCER MONITORING

**Calcitonin:** This test measures the level of the hormone calcitonin in the blood. This test is important because calcitonin is produced by the C cells in the thyroid at low levels and high levels of calcitonin may indicate that the treatment is not effective. The typical reference range\* for men is less than 14.3 pg/mL and for women is less than 7.6 pg/mL.

**Carcinoembryonic antigen (CEA):** This test measures the level of the protein CEA in the blood. This test is important because CEA is a type of tumor marker that is correlated with a particular type of thyroid cancer called medullary thyroid carcinoma. High levels of CEA during treatment are a sign that the treatment may not be effective or recurrence. The typical reference range\* for adults is 0 – 2.5 ng/mL.

**Thyroglobulin:** This test measures the level of the protein, thyroglobulin in the blood. This test is important because low levels of thyroglobulin indicate that the treatment is working. The typical reference ranges\* for men are between 1.40 – 29.2 ng/mL and for women between 1.50-38.5 ng/mL.

## ASK YOUR DOCTOR

- What are all my treatment options?
- Why do you recommend this particular treatment?
- What are the follow-up tests and what are we looking for?
- What is the course of action based on my lab results?
- How will we know that the treatment is working? What should I watch for?
- Do I need to make changes to my diet?
- How often do I need to get tested for the tumor markers?

## MEET CARLY AND ERIN

### CARLY

*"If I don't have labs done, I don't know if my body is responding properly to treatment."*



Carly thought that her fatigue was a result of her busy schedule as a graduate student and working full-time but a routine physical check-up revealed a more serious diagnosis. At the age of 27, after a doctor discovered a small lump in her throat, she was diagnosed with Stage 1 Papillary Thyroid Cancer. While navigating her cancer diagnosis was a challenging journey, she was determined to do everything in her power to manage her cancer. Today, Carly is cancer free and utilizes the lab to manage her follow-up care.



### ERIN

*"The whole course of my cancer treatment was dictated by all of my test results. The test results revealed information that really tailored the way that my treatment program was conducted and the way that I will manage my cancer in the future. Without that team of people, I wouldn't be where I am today."*

Eight years after her initial papillary thyroid cancer diagnosis, Erin's cancer returned. While dealing with her first diagnosis as a senior in college was challenging, she was pregnant with her son when the cancer returned. Throughout her pregnancy, her hormone levels were being monitored at a high-risk clinic and an ultrasound revealed three suspicious lymph nodes which were later diagnosed as recurrent papillary thyroid carcinoma. While Erin underwent surgery to get the two cancerous lymph nodes removed, there is a possibility of recurrence because of the BRAF mutation (a mutation that increases the growth of the cancer) present on the carcinoma. In order to manage the growth of her cancer, Erin undergoes a combination of blood tests and scans every 6 months.


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