KREP

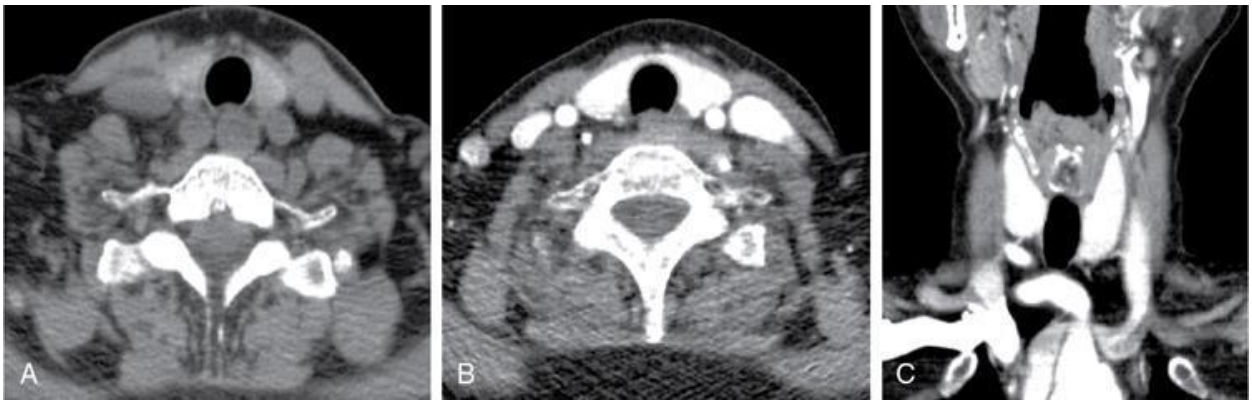
2025

KARNATAKA RADIOLOGY EDUCATION PROGRAM

Anatomy and Applied Radiology Thyroid – 2

Computed tomography (CT)

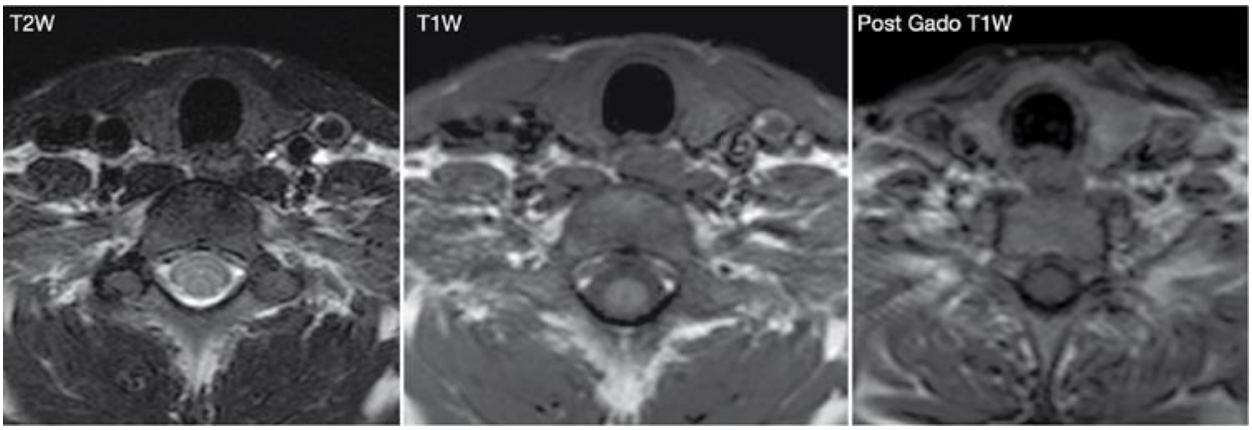
There are few and specific indications for CT in thyroid diseases. These include evaluating the degree of retrosternal extension of goitre and to provide staging information in thyroid malignancy especially the extent of extrathyroidal disease, vascular invasion and prevertebral fascial infiltration in thyroid malignancy and lymphoma. CT has no role in characterizing thyroid nodules. Since iodinated intravenous contrast used for the CT impairs the thyroid uptake of radioactive iodine for 4-8 weeks, thyroid scintigraphy and therapeutic ablation with Iodine-131 must be scheduled accordingly. However, it is worth noting that contrast enhanced CT (CECT) is no longer contraindicated in these patients. In fact, when used optimally, CECT has the potential to positively impact the oncological outcome of thyroid cancer patients due to better visualization of tumour extent and the nodes prior to surgery leading to better surgical planning and surgical clearance. In the noncontrast CT, normal thyroid gland appears homogeneously hyperdense (80-100 HU) compared to adjacent neck muscles and shows intense enhancement in the postcontrast studies.



(A–C): Non-contrast axial CT images (A) shows a normal hyperdense thyroid gland relative to the adjacent skeletal muscles. Contrast axial (B) and coronal (C) images shows intense enhancement of the thyroid gland.

Magnetic resonance imaging (MRI)

MRI may sometime be indicated for better evaluation of the locoregional extent of thyroid cancer. Multiplanar thin section (3-mm) images are obtained in axial, coronal and sagittal planes. The useful sequences include T1, T2, fluid sensitive sequences, postgadolinium T1-weighted images and diffusion-weighted imaging. The normal thyroid gland appears isointense to slightly hyperintense on T2-weighted images; appears slightly hyperintense on T1-weighted images compared to the adjacent neck muscles and enhances intensely following contrast (Fig. 3.35.7). Thyroid nodules incidentally detected on MRI must be evaluated with ultrasound for better characterization. Though MR spectroscopy may have a role in differentiating thyroid carcinoma from benign follicular lesion, it is not used for practical reasons. Prior studies have shown high choline peak in almost all carcinomas and the choline/creatine ratio ranged from 1.6 in well-differentiated carcinoma to 9.4 in anaplastic carcinoma. On the other hand, the normal thyroid gland and benign follicular lesions showed no choline peak.



Normal thyroid gland appears isointense to mildly hyperintense to neck muscles on T2-weighted (T2W) images and T1-weighted (T1W) images and enhances following gadolinium contrast injection

Thyroid scintigraphy, also known as a thyroid scan, is a nuclear medicine imaging procedure that uses a radioactive tracer to assess the structure and function of the thyroid gland, helping diagnose and monitor thyroid conditions.

Procedure:
A radioactive tracer (like iodine-123 or technetium-99m) is administered intravenously or orally.
The tracer is absorbed by the thyroid cells, and a gamma camera detects the radiation emitted by the tracer.
The camera creates images of the thyroid gland, showing the size, shape, and function of the gland.

"Hot" areas indicate high tracer uptake (often suggesting overactive thyroid tissue), while "cold" areas indicate low uptake (potentially suggesting a nodule or other abnormality).

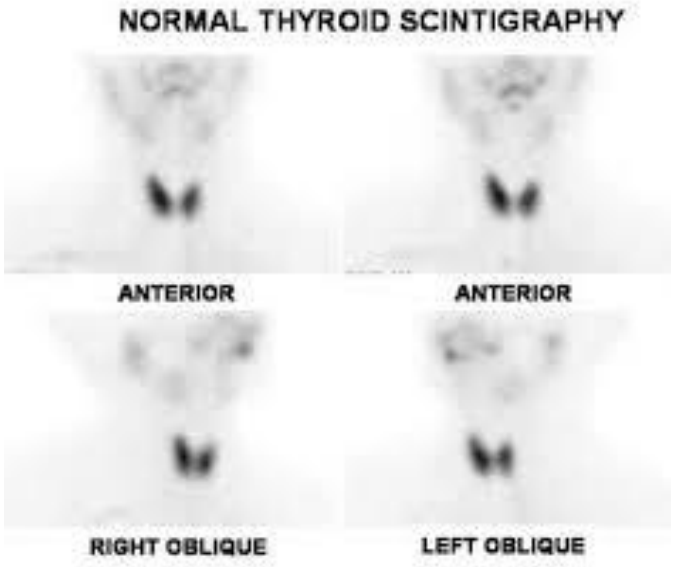
Technique

- **patient preparation : fast for 4 hours prior to exam**
- **radiopharmaceutical : Tc-99m pertechnetate**
- **dose and route of administration : 111-185 MBq (3-5 mCi) IV**
- **time of imaging : 20 minutes after Tc-99m pertechnetate administration**

- **equipment**
  - **camera: gamma camera**
  - **collimator: pinhole**
  - **window: 20% energy window centered at 140 KeV**
- **procedure**
  - **obtain anterior, LAO, and RAO views**
  - **mark chin, suprasternal notch, palpable nodules, and surgical scars**

Interpretation

Radiotracer uptake on the thyroid scan needs to be interpreted with biochemical thyroid function tests and thyroid antibodies (e.g. antithyroglobulin, antimicrosomal, thyrotropin receptor). The combination of these results can usually distinguish between the causes of thyroid dysfunction.



A thyroid biopsy is a procedure that removes a small sample of cells and fluid from your thyroid gland. Healthcare providers use it to help diagnose certain thyroid conditions.

Thyroid biopsy procedures in done in one of three ways:

Fine-needle aspiration (FNA). Nearly all thyroid nodule biopsies use the FNA method. During this minimally invasive procedure, a provider uses a long, thin needle (22-gauge diameter or smaller) to draw cells and fluid from one or more thyroid nodules. They use ultrasound imaging to guide the needle directly into the nodule.

Core-needle biopsy (CNB). This procedure is like FNA, but the needle has a larger diameter (14- to 20-gauge). A provider might opt for this method if they need larger, more intact tissue samples.

Surgical thyroid biopsy. Rarely, a healthcare provider may need to do a surgical biopsy. This involves making a small incision in your neck to access your thyroid gland.

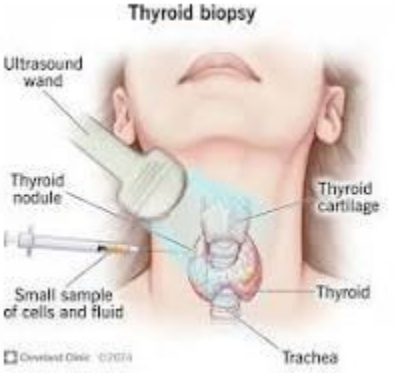
Thyroid needle biopsy (FNA or CNB)

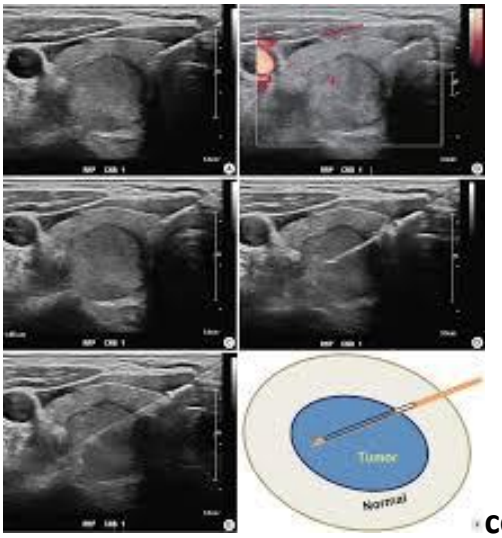
These are typically outpatient procedures, meaning you'll go home the same day. Your provider will:

- **Give local anesthesia to numb part of neck.**
- **Place a handheld device called an ultrasound transducer on your neck. This allows them to see your thyroid and locate the nodules.**
- **Gently insert a long, thin needle through your skin and into the thyroid nodule.**
- **Carefully draw out a fluid and tissue sample. You'll need to remain very still during this part.**
- **Remove the needle and place a bandage over the injection site.**
- **Send your sample to a cytologist for testing.**
- **Your provider might repeat this process if you have more than one nodule. The procedure takes about 10 to 20 minutes to complete.**

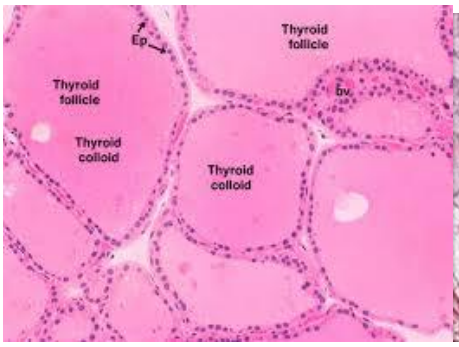
Surgical thyroid biopsy

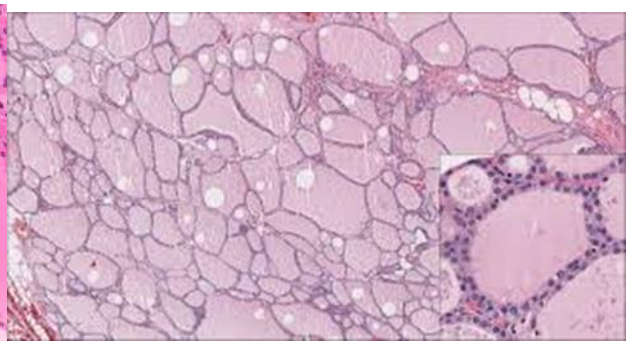
- **This approach is very rare. But a provider may need to do a surgical biopsy if results from your FNA or CNB aren't clear, or if they need additional information.**
- **The procedure involves removing nodules and/or tissue samples directly from your thyroid gland and sending them to a lab for testing.**





core biopsy





What are the side effects of a thyroid biopsy?

Common thyroid biopsy side effects include soreness and bruising at the injection site. You can manage any discomfort with over-the-counter (OTC) pain relievers like acetaminophen (Tylenol®) or ibuprofen (Motrin®).

Complications are rare. But they can include: Bleeding, Infection,Cyst formation.

Thyroid laboratory *tests*

TSH measures your thyroid-stimulating hormone. This is usually the first test most providers recommend. Your pituitary gland (part of your brain) makes TSH. It travels to your thyroid gland, stimulating it to produce thyroid hormones, T3 and T4.

Infants up to 5 days old: 0.7–15.2 mIU/L
Children 1–6 years old: 0.7–5.97 mIU/L
Children 7–11 years old: 0.6–4.84 mIU/L
People 12–20 years old: 0.51–4.3 mIU/L
Adults 21–99 years old: 0.27–4.2 mIU/L

T3 (or free T3) measures the amount of triiodothyronine in your blood. This hormone is one of two main hormones that your thyroid makes.

Total T3:
This measures both the bound and unbound (free) T3 in the blood. Normal range: 80 to 200 ng/dL.
Free T3:This measures only the active, unbound T3, which is the form that the body uses.
Normal range: 2.3 to 4.1 pg/mL.

T4 (or free T4) measures the amount of thyroxine in your blood. Thyroxine is the other main type of hormone that your thyroid makes.

For adults, a normal total T4 range is typically 5.0 to 12.0 micrograms per deciliter (mcg/dL), while the normal range for free T4 is 0.8 to 1.8 nanograms per deciliter (ng/dL).

Thyroid antibody tests tell your provider whether or not there are thyroid antibodies in your blood. The presence of thyroid antibodies might mean you have an autoimmune disorder like Graves' disease or Hashimoto's disease.

For thyroid antibody tests, normal ranges typically vary depending on the specific antibody being measured, but generally, levels below 34 IU/mL for thyroid peroxidase antibodies (TPOAb) and below 115 IU/mL for thyroglobulin antibodies (TgAb) are considered normal.

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