

Chapter 2

History and Examination for Thyroid Nodules

Alan A. Parsa and Hossein Gharib

Introduction

The name thyroid gland, in English, is derived from the Latin *glandula thyreoidea*, meaning shield-shaped gland, named by Thomas Warton in 1656 [1]. As the first endocrine gland to develop embryologically [2], it possesses important functions from fetal development until death.

Embryologically, the development of the thyroid gland begins in the fourth week of development as a depression and epithelial thickening of the floor of the primitive pharynx. Beginning at the base of the foramen caecum, the thyroid primordium descends into the underlying mesenchyme and travels through the neck as a bilobed diverticulum. The gland arrives at its final resting place in front of the trachea in the seventh week [2, 3]. During the descending process, the thyroid gland remains connected to the tongue surface by a thyroglossal duct from which it will eventually detach. The thyroglossal duct typically regresses and disappears; however, in around 50% of the population, the distal portion of the thyroglossal duct persists as a pyramidal lobe of the thyroid (Fig. 2.1) [5]. A thyroglossal duct cyst, the most common congenital neck mass, seen in around 7% of the population, is a remnant dilation of the thyroglossal duct between the foramen caecum and the thyroid gland which did not fully regress [4, 6].

Postpartum: The thyroid gland's final anatomical location is anterior to the trachea and caudal to the thyroid cartilage. The adult thyroid gland consists of a right

A.A. Parsa, MD, FACE (✉)

Department of Medicine, University of Hawaii, John A. Burns School of Medicine,
Honolulu, HI, USA

e-mail: aparsa@hawaii.edu

H. Gharib, MD, MACP, MACE

Division of Endocrinology, Diabetes, Metabolism and Nutrition,
Mayo Clinic College of Medicine, Rochester, MN, USA

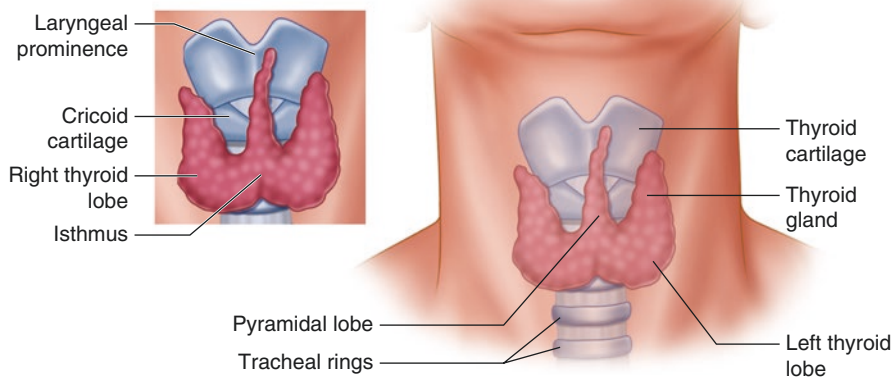


Fig. 2.1 The thyroid gland is inferior to the thyroid cartilage anterior to the tracheal rings. A pyramidal lobe is seen in approximately 50% of the population [5]

and left lobe, bridged together by a thin and often impalpable strip of thyroid tissue called the isthmus.

Thyroid nodules are common in the general population and have a reported prevalence of 70% by imaging studies [7, 8] and 7% by palpation [9–12]. Thyroid nodules are typically nonfunctional, frequently discovered incidentally, with environmental and genetic conditions predisposing them to malignancy. To properly identify malignancy risks, work-up should include a thorough history, a physical exam, and thyroid imaging.

History: Since most thyroid nodules are detected incidentally by exam or imaging and most nodules are benign, directed questions can assist in determining malignancy risk and aggressiveness of follow-up and therapy. For instance, an adult patient with palpitations, heat intolerance, tremor, anxiety, diarrhea, and a thyroid mass is suspect of a toxic nodular thyroid, a benign process. The same findings in a 13-year-old should raise concern of malignancy due to a 26% malignancy risk in those under the age of 17 regardless of the functionality of the nodule [13, 14]. Other risk factors for malignancy in a patient's history include a personal history of head and neck irradiation, family history of thyroid cancer, age of puberty, and history of thyroid disease [15, 16].

A review of systems may also give important information of the aggressiveness of a tumor and the need for immediate surgical, radiotherapy, or chemotherapeutic intervention. For instance, symptoms of dysphagia, odynophagia, hoarseness, or aspiration of liquids are suggestive of recurrent laryngeal nerve involvement [17], while cough, dyspnea, hemoptysis, and stridor are suggestive of tracheal invasion [18]. Though very aggressive thyroid malignancy is rare, it is important to identify these patients as their prognosis is typically poor [19, 20].

A family history identifies genetic conditions linked to thyroid malignancy. These include conditions such as familial nonmedullary thyroid cancer (FNMTC)

Table 2.1 Familial conditions which are associated with thyroid malignancy and the associated risk of malignancy

Condition	Risk of thyroid malignancy	Predominant thyroid cancer type
MEN2 [23]	90%	Medullary
Cowden syndrome [24]	38%	Follicular
FNMTC [21, 22]	3–15%	FCD
FAP [26, 27]	0.4–12%	Papillary
Gardner syndrome [25]	2% (predominantly women)	Papillary

MEN2 multiple endocrine neoplasia type 2, *FNMTC* familial nonmedullary thyroid carcinoma, *FCD* follicular cell derived, *FAP* familial adenomatous polyposis. Risk of developing thyroid cancer and type based on familial syndromes

[21, 22], multiple endocrine neoplasia 2 (MEN2) [23], Cowden syndrome (PTEN hamartoma tumor syndrome) [24], Gardner syndrome [25], and familial adenomatous polyposis (FAP) [26, 27]. The detail of questioning should be determined by the patient’s risk factors. For instance, if the patient does not possess a family history of thyroid malignancy, questions related to MEN2 or FNMTC may be excessive. On the other hand, a patient with a family history of colon polyps should be questioned about Gardner syndrome or FAP, due to the increased risk of thyroid malignancy as noted in Table 2.1.

Physical Examination

To our knowledge, studies comparing the efficacy of different palpation techniques to identify thyroid structural disease have not been done. Palpation techniques typically develop through reading or from previous training. Regardless of which method is used, there are three key features of the physical exam: knowledge of neck anatomy, the examiner’s training, and the experience and comfort with his/her approach to the exam.

Anatomy: The normal adult thyroid gland is located inferior to the thyroid cartilage and anterior to the second and fourth tracheal rings. The gland is posterior the sternohyoid and sternothyroid muscles (also known as the strap muscles) and medial to the internal jugular vein and carotid artery bound by the pretracheal fascia (Fig. 2.2). Included within the pretracheal fascia is the thyroid gland, trachea, and esophagus. The gland is highly vascularized permitting direct hormone secretion into circulation. The recurrent laryngeal nerve and external branch of the superior laryngeal nerves innervate the vocal cords and are a source of morbidity during surgical thyroidectomy [28]. The four parathyroid glands, typically found posterior to the thyroid gland, are also a source of morbidity during thyroidectomies [29].

The thyroid has two lobes connected in the midline by an isthmus. The average anterior to posterior thickness of each lobe is <20 mm with a superior to inferior length of about 40–60 mm. The average weight of the thyroid gland is between 15 and 30 g in adult males and slightly heavier in females due to enlargement associated

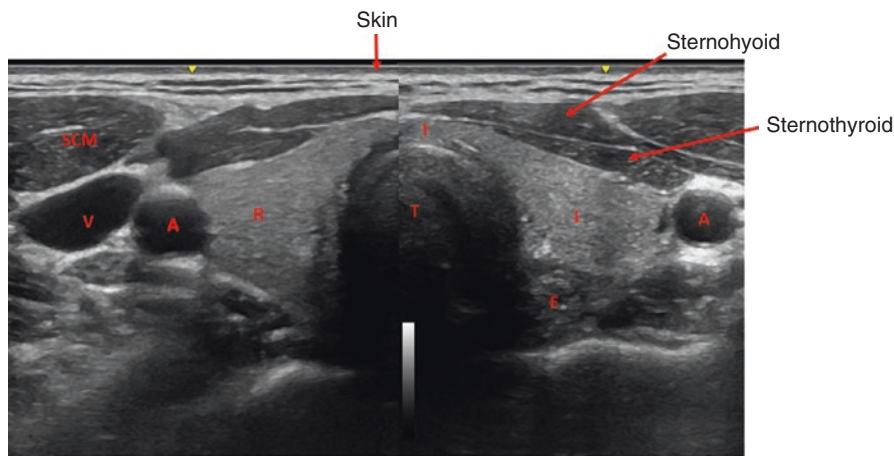


Fig. 2.2 Ultrasound image of the thyroid gland. *T* trachea, *R* right thyroid lobe, *L* left thyroid lobe, *I* thyroid isthmus, *A* carotid artery, *SCM* sternocleidomastoid muscle, *E* esophagus, *V* jugular vein

with menstruation and pregnancy. Thyromegaly is defined when the anterior/posterior or transverse lengths exceed 20 mm or when the parenchyma extends anterior to the carotid arteries.

Inspection: Inspection is typically more useful with large glands. The subject is told to tilt the head slightly upward which will better expose the neck and possible substernal glands. Thyroid size, shape, texture, mobility, and presence of visible nodularity should be observed and documented. A scar superior to the sternal notch, known as a necklace scar, indicates prior thyroid or parathyroid surgery. The gland should be viewed from the front and side of the patient. Shadows cast by light manipulation can exaggerate thyroid borders and texture. Sips of water by the subject cause a cephalad movement of the gland confirming its structure.

Palpation: Two different palpation techniques include thyroid examination facing the patient or from behind the patient. The subject should be warned prior to the procedure that a choking sensation may be felt, while the thyroid gland is palpated. If unable to tolerate, ultrasonography is an alternative to the physical exam.

With the palmar aspect of the fingers, the thyroid isthmus should first be located even though it is frequently impalpable unless enlarged. This is done by initially identifying the laryngeal prominence (the so-called Adam's apple) of the thyroid cartilage. Fingers should slide inferiorly to find the cricoid cartilage, marking the typical location of the superior border of the thyroid isthmus. A sip of water will cause the isthmus to move cephalically under the fingers confirming the structure. If not felt, the thyroid may be further inferior or the isthmus may not be palpable. Once identified, fingers should slide laterally along the isthmus toward the sternocleidomastoid muscle (SCM) along the contour of the trachea wedging the dorsum of the fingers posterior to the SCM. The thyroid gland should now be trapped between the palmar aspect of the fingers and the trachea. A sip of water will cause the thyroid gland to move upward passing under the fingers confirming that the

structure being felt is the thyroid gland. If the structure being felt does not move, it may represent a lymph node, a fixed thyroid malignancy, a prominent neck muscle, or some other neck structure. Asymmetry, size, and any discrete masses should be noted and documented for both lobes. Some thyroid glands are not palpable due to atrophy from levothyroxine therapy, surgical resection, substernal location, or a naturally small gland.

Once the thyroid gland has been examined and findings recorded, the neck should be palpated for lymphadenopathy along the cervical chain with a midline examination for a possible persistent thyroglossal duct, seen in approximately 7% of the general population [4].

Conclusion

A complete thyroid examination includes a careful history, thyroid palpation, appropriate imaging, and lab tests. Thyroid imaging with an ultrasound machine, described elsewhere in this book, is very useful, complements thyroid palpation, and provides information of malignancy risks. Understanding of thyroid anatomy and adjacent neck structures is also critical for a good exam. While different techniques for thyroid palpation are described, no studies have been done to compare accuracy or efficacy of these. We recommend adopting a technique with which the examiner is comfortable and has experience.

References

1. Lydiatt DD, Bucher GS. Historical vignettes of the thyroid gland. *Clin Anat*. 2011;24(1):1–9.
2. Kratzsch J, Pulzer F. Thyroid gland development and defects. *Best Pract Res Clin Endocrinol Metab*. 2008;22(1):57–75.
3. Trueba SS, Augé J, Mattei G, Etchevers H, Martinovic J, Czernichow P, Vekemans M, Polak M, Attié-Bitach T. PAX8, TITF1, and FOXE1 gene expression patterns during human development: new insights into human thyroid development and thyroid dysgenesis-associated malformations. *J Clin Endocrinol Metab*. 2005;90(1):455–62.
4. Kurt A, Ortug C, Aydar Y, Ortug G. An incidence study on thyroglossal duct cysts in adults. *Saudi Med J*. 2007;28(4):593–7.
5. Kim DW, Jung SL, Baek JH, Kim J, Ryu JH, Na DG, Park SW, Kim JH, Sung JY, Lee Y, Rho MH. The prevalence and features of thyroid pyramidal lobe, accessory thyroid, and ectopic thyroid as assessed by computed tomography: a multicenter study. *Thyroid*. 2013;23(1):84–91.
6. Ewing CA, Kornblut A, Greeley C, Manz H. Presentations of thyroglossal duct cysts in adults. *Eur Arch Otorhinolaryngol*. 1999;256(3):136–8.
7. Bartolotta TV, Midiri M, Runza G, Galia M, Taibbi A, Damiani L, Paalermo-Patera G, Lagalla R. Incidentally discovered thyroid nodules: incidence, and greyscale and colour Doppler pattern in an adult population screened by real-time compound spatial sonography. *Radiol Med*. 2006;111(7):989–98.
8. Russ G, Leboulleux S, Leenhardt L, Hegedus L. Thyroid incidentalomas: epidemiology, risk stratification with ultrasound and workup. *Eur Thyroid J*. 2014;3(3):154–63.

9. Vander JB, Gaston EA, Dawber TR. The significance of nontoxic thyroid nodules: final report of a 15-year study of the incidence of thyroid malignancy. *Ann Intern Med.* 1968;69:537–40.
10. Tunbridge WM, Evered DC, Hall R, Appleton D, Brewis M, Clark F, et al. The spectrum of thyroid disease in a community: the Whickham survey. *Clin Endocrinol.* 1977;7(6):481–93.
11. Ezzat S, Sarti DA, Cain DR, Braunstein GD. Thyroid incidentalomas. Prevalence by palpation and ultrasonography. *Arch Int Med.* 1994;154(16):1838–40.
12. Hegedus L. Clinical practice: the thyroid nodule. *N Engl J Med.* 2004;351(17):1764–71.
13. Rallison ML, Dobyns BM, Keating FR, Rall JE, Tyler FH. Thyroid nodularity in children. *JAMA.* 1975;233:1060–72.
14. Niedziela M. Pathogenesis, diagnosis and management of thyroid nodules in children. *Endocr Relat Cancer.* 2006;13:427–53.
15. Smith-Bindman R, Lebda P, Feldstein VA, Sellami D, Goldstein RB, Brasic N, Jin C, Kornak J. Risk of thyroid cancer based on thyroid ultrasound imaging characteristics: results of a population based study. *JAMA Intern Med.* 2013;173(19):1788–96.
16. Campanella P, Ianni F, Rota CA, Corsello SM, Pontecorvi A. Quantification of cancer risk of each clinical and ultrasonographic suspicious feature of thyroid nodules: a systematic review and meta-analysis. *Eur J Endocrinol.* 2014;170(5):R203–11.
17. Kay-Rivest E, Mitmaker E, Payne RJ, Hier MP, Mlynarek AM, Young J, Forest VI. Preoperative vocal cord paralysis and its association with malignant thyroid disease and other pathological features. *J Otolaryngol Head Neck Surg.* 2015;44(1):35.
18. Avenia N, Vannucci J, Monacelli M, Lucchini R, Polistena A, Santoprete S, Potenza R, Andolfi M, Puma F. Thyroid cancer invading the airway: diagnosis and management. *Int J Surg.* 2016;28(Suppl 1):S75–8.
19. Chiacchio S, Lorenzoni A, Boni G, Rubello D, Elisei R, Mariani G. Anaplastic thyroid cancer: prevalence, diagnosis and treatment. *Minerva Endocrinol.* 2008;33(4):341–57.
20. Cabanillas ME, McFadden DG, Durante C. Thyroid cancer. *Lancet.* 2016;388(10061):2783–95.
21. Fallah M, Pukkala E, Tryggvadottir L, et al. Risk of thyroid cancer in first-degree relatives of patients with nonmedullary thyroid cancer by histology type and age at diagnosis: a joint study from five Nordic countries. *J Med Genet.* 2013;50:373–82.
22. Mazeh H, Sippel RS. Familial nonmedullary thyroid carcinoma. *Thyroid.* 2013;23:1049–56.
23. BAJ P, Ponder MA, Coffey R, et al. Risk estimation and screening in families of patients with medullary thyroid carcinoma. *Lancet.* 1988;1:397–401.
24. Bubien V, Bonnet F, Brouste V, et al. High cumulative risks of cancer in patients with PTEN hamartoma tumour syndrome. *J Med Genet.* 2013;50:255–63.
25. Half E, Bercovich D, Rozen P. Familial adenomatous polyposis. *Orphanet J Rare Dis.* 2009;4:22.
26. Steinhagen E, Guillem JG, Chang G, et al. The prevalence of thyroid cancer and benign disease in patients with familial adenomatous polyposis may be higher than previously recognized. *Clin Colorectal Cancer.* 2012;11:304–8.
27. Herraiz M, Barbesino G, Faquin W, et al. Prevalence of thyroid cancer in familial adenomatous polyposis syndrome and the role of screening ultrasound examinations. *Clin Gastroenterol Hepatol.* 2007;5:367–73.
28. Sari S, Erbil Y, Sümer A, Agcaoglu O, Bayraktar A, Issever H, Ozarmagan S. Evaluation of recurrent laryngeal nerve monitoring in thyroid surgery. *Int J Surg.* 2010;8(6):474–8.
29. Hone RW, Tikka T, Kaleva AI, Hoey A, Alexander V, Balfour A, Nixon IJ. Analysis of the incidence and factors predictive of inadvertent parathyroidectomy during thyroid surgery. *J Laryngol Otol.* 2016;130(7):669–73.

Thyroid Nodules

Diagnosis and Management

Gharib, H. (Ed.)

2018, XVIII, 231 p. 83 illus., 52 illus. in color., Hardcover

ISBN: 978-3-319-59473-6

A product of Humana Press