The incidence and morphological features of pyramidal lobe on thyroid ultrasound

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Abstract

The aim of this article is to document the incidence and appearances of the pyramidal lobe of the thyroid gland, and discuss the clinical relevance of this entity in sonographic practice. A prospective study was undertaken over a period of 10 months. A total of 416 consecutive patients attending head and neck ultrasound lists were scanned by a single experienced radiologist or an advanced practitioner sonographer. At the time of reporting, the presence of a pyramidal lobe was recorded. The anatomical morphology was classified into five subgroups devised for the purposes of the study. Appearances were documented in both normal and pathological glands. Of the total number of patients scanned, 90 patients were found to have pyramidal lobes, giving an overall incidence of 21%. In all, 51% were found to originate from the right of the isthmus, 46% from the left and 2% from the midline. One patient had two pyramidal lobes. A significant number of patients having routine neck ultrasounds have an incidental finding of a pyramidal lobe. Ultrasound is an effective modality for the demonstration and classification of the pyramidal lobe, as well as identification of pathology. It is important for radiologists to be aware of this normal variation, as it may be the site of primary or recurrent thyroid pathology. Radiologists should report it where relevant to ensure adequate surgical treatment of pathological glands.

Keywords: Pyramidal lobe, ultrasound, features, incidence

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Introduction

The pyramidal lobe of the thyroid gland is commonly visible as an incidental finding on ultrasound examination. The incidence of pyramidal lobes has been well described in scintigraphic, cadaveric and surgical series with a broad range of findings reported. However, there has been little published regarding the incidence and morphological features on ultrasound. Whilst a pyramidal lobe may be an entirely incidental finding, it can be affected by the same range of pathologies as the remainder of the thyroid, and hence it is important to recognise this normal variant. This has potential relevance in the pre-operative setting where knowledge of an existing pyramidal lobe may help to ensure complete resection at surgery. In addition, the pyramidal lobe may be a site of recurrent disease in individuals who have had previous thyroidectomy.

This article sets out to describe the incidence and patterns of this common variant based on a large consecutive series. Examples of clinically relevant scenarios are given.

Materials and methods

Participants

A prospective study was undertaken between 1 September 2011 and 1 July 2012. All patients attending outpatient ($n=416$) neck ultrasounds were included. These included referrals from general practitioners, head and neck surgeons and endocrinologists. There were no exclusion criteria. The presence, configuration or absence of the pyramidal lobe were recorded as a routine part of the examination; ethics approval was deemed unnecessary.

Protocol

Patients were scanned by a single experienced radiologist or an advanced practitioner sonographer. The examination was explained to the patient and consent obtained. Examinations followed departmental protocol for neck ultrasound. A brief physical examination of the neck was performed to allow correlation with the clinical information.

Figure 1 (a) to (e) Classification system of anatomical morphology of the pyramidal lobe

Table 1 The results of our study

Incidence of pyramidal lobe % (actual numbers)	Origin in relation to isthmus % (actual numbers)			Gender	
	Right	Left	Midline	Female	Male
21 (90/416)	51 (46/90)	46 (41/90)	2 (2/90)	233* 74% (67) [†]	183* 24% (22) [†]

*Total included in study.

[†]Percentage of those with pyramidal lobe (actual number).

Figure 2 (a) Transverse section. Small pyramidal lobe (measured), deep to medial lip of strap muscle (arrow). (b) Longitudinal section. Pyramidal lobe (measured) superficial to cricoid cartilage (arrow), deep to strap muscles (arrowhead). T = Trachea

Figure 3 Transverse section. Large pyramidal lobe (measured) deep to medial border of right strap muscle (arrowhead). L = Larynx

Figure 4 Longitudinal section. 'Bilobed' pyramidal lobe (arrows). L = Larynx S = Strap muscle

Patients were normally scanned with the head extended over the top of a cushion. A supine position is preferred, ensuring optimal visualisation of the internal jugular vein; a semirecumbent position was used when necessary for patient comfort.

The thyroid gland was systematically evaluated with typical views as follows:

- Transverse section of the isthmus
- Transverse images of the upper/mid/lower lobes on each side
- Longitudinal views of both left and right lobes
- Evaluation of pyramidal lobe if present
- Detailed assessment of any abnormality with appropriate measurements and colour Doppler assessment.

On completion of the scan, the neck was cleaned, and an explanation of findings given to the patient where appropriate.

Imaging for data collection was performed using one of two Aplio XG™ Ultrasound units (Toshiba Medical Systems Co., Crawley), either employing a linear 12–18 MHz probe or a linear 12–18 MHz matrix probe, both giving comparable images.

At the time of reporting, the presence of a pyramidal lobe was recorded as part of a data set. The anatomical morphology was classified into five subgroups devised as a simple classification by the authors for the purposes of this study. These were named P0–P4 with classification criteria as follows (see Figure 1(a) to (e))

- P0 – No pyramidal lobe
- P1 – Pyramidal lobe, wide base, narrow apex
- P2 – Pyramidal lobe, base size same as top size (parallel strip of tissue)
- P3 – Pyramidal lobe, thin base with a bulbous upper portion
- P4 – Pyramidal lobe completely separated from the thyroid (i.e. ectopic thyroid tissue above thyroid gland in pre-laryngeal location)

Figure 5 (a) Axial section. Pre-laryngeal nodule (measured), deep to medial border of left strap muscle (arrowhead). (b) Longitudinal section confirms multinodular goitre with a nodule (arrow) within the pyramidal lobe (measured)

Figure 6 Longitudinal section. Pyramidal lobe (arrow) with cystic nodule (arrowhead)

Figure 7 Longitudinal section. Coarsened echotexture within the pyramidal lobe (arrow) in a patient with Hashimoto's disease

The origin of the pyramidal lobe was documented as arising from the right, left or midline of the isthmus. Measurements were recorded in longitudinal, antero-posterior (AP) and transverse sections. The presence of pathology within the pyramidal lobe was also documented. The classification was determined at the time of scanning, as retrospective classification based on static images can be inaccurate. The findings were tabulated along with the patient age, gender and date of scan.

Results (see Table 1)

A total of 416 patients were included in the study, 233 females and 183 males. Pyramidal lobes were present

in 90 patients (one patient was found to have two pyramidal lobes), yielding an overall incidence of 21%. The frequency of the subtypes was as follows: P1 – 28%, P2 – 32%, P3 – 12% and P4 – 20%. The patient ages ranged from 17 to 89 (median 48). Forty-one (46%) pyramidal lobes were found to arise from the isthmus to the left of the midline and 46 (51%) from the isthmus to the right of the midline; 2 (2%) arose from the midline. Size was recorded in longitudinal, transverse and AP dimensions. The longitudinal measurements ranged from 9 mm to 39 mm (mean 19 mm), the transverse measurement from 4 mm to 27 mm (mean 9 mm) and the AP from 1 mm to 12 mm (mean 3 mm).

Discussion

Anatomy and embryology

The thyroid gland is the largest endocrine gland in the human body, situated anteriorly in the lower neck at the level of C5 to T1 vertebrae.¹

The thyroid gland is the first endocrine gland to develop. The initial precursor, the thyroid primordium, appears by the third week of gestation, starting as a simple midline thickening in the foramen caecum of the primitive pharynx, where the anterior 2/3 and posterior 1/3 of the tongue will meet. This graduates to form a thyroid diverticulum, which enlarges to become a bi-lobed entity, joined by an isthmus. Descent of the primitive thyroid gland is complete by the seventh gestational week, during which time it remains connected to the base of the tongue by the thyroglossal duct. In most cases, this tubular duct solidifies by week 10 and is completely obliterated. If, however, the duct remains patent, the inferior aspect of the thyroglossal duct may persist, with the formation of a pyramidal lobe. This explains why pyramidal lobes may be attached to the hyoid bone, or incorporated into a thyroglossal duct cyst.²

The typical location of the pyramidal lobe is deep into the medial border of the strap muscles overlying laryngeal cartilage. In our study, the pyramidal lobes varied in size and shape, including one which was found to be 'bilobed'.

Ultrasound appearances

The normal pyramidal lobe is characterised by homogenous soft tissue of similar echogenicity and texture to the thyroid glandular tissue. It is situated superficial to the larynx, deep into the medial lips of the strap muscles, which are comparatively hypoechoic (see Figures 2(a) and (b) and 3).

Table 2 Studies determining incidence of pyramidal lobes using different modalities

Study	Incidence of pyramidal lobe % (actual numbers)	Origin (%)		Gender			Modality
		Right	Left	Midline	Both lobes	Female	Male
Ryu et al. ^{5*}	58.1 (79/135)	22	34	13	2	Not specified	Not specified
	56.3 (76/135)	18	35	18	2	Not specified	Not specified
	60% (81/135)	28	38	14	1	106 [†]	29 [‡]
						62 [‡]	52 [‡]
Kim et al. ^{6*}	56.8% (75/132)	23	29	11	1	115 [†]	17 [†]
						50 [‡]	41 [‡]
	59.8% (79/132)	23	29	12	0	115 [†]	17 [†]
						60 [‡]	59 [‡]
Kim et al. ⁷	50.6% (82/160)	25	34	22	1	Not specified	Ultrasound
Kim et al. ⁸	59.3% (96/160)	27	40	27	2	CT	CT
	44.6% (981/2200)	L > R (varied with slice thickness)				1389 [†]	811 [†]
						50 [‡]	36 [‡]
Su et al. ⁹	14% (208/1500)	Not measured				Not measured	Ultrasound
Tanriover et al. ¹⁰	57.8% (52/90)	Not measured				15 [†]	75 [†]
						Not measured [‡]	Not measured [‡]
Begum et al. ¹¹	27% (16/60)	5	15	6.6	0	Not measured	Cadaveric dissection
Sultana et al. ¹²	50% (30/60)	L > R (observational)		56.6	0	12 [†]	48 [†]
						41.7 [‡]	52.1 [‡]
Ranade et al. ¹³	58% (61/88)	Not measured				17 [†]	88 [†]
						+58	
Harjeet et al. ⁴	28.9% (total 570)	35	67	57	6	160 [†]	410 [†]
						Not specified [‡]	Not specified [‡]
Izenstark et al. ¹⁴	30% (39/130)	Not measured				107 [†]	23 [†]
						35 [‡]	35 [‡]
Siraj et al. ¹⁵	41% (Total 207)	34	38	27	0	91 [†]	70 [†]
						44 [‡]	34 [‡]
Levy et al. ¹⁶	18% (Total 431)	Not specified	63% of normal scans	Not specified	Not specified	332 [†]	99 [†]
						18 [‡]	20 [‡]
Zivic et al. ¹⁷	61% (61/100)	36	15	49	Not specified	92 [†]	8 [†]
						62 [‡]	50 [‡]
Geraci et al. ¹⁸	12% (74/604)	4	96	Not specified	Not specified	32 [†]	42 [†]
						Not specified [‡]	Not specified [‡]
Sturniolo et al. ³	25.5% (358/1405)	Not available	Not available	Not available	Not available	Not available	Not available
Blumberg et al. ¹⁹	59 (41/70)	7	93	0	Not specified	60 [†]	10 [†]
						Not specified [‡]	Not specified [‡]

*Figures for origin and gender are based on the true-positive cases.

[†]Total included.[‡]Percentage pyramidal.

The pyramidal lobe may be continuous with the thyroid gland itself, arising from right, left or centre of the isthmus. It may also be bilobed (see Figure 4). Ectopic thyroid tissue is located along the thyroglossal duct in the pre-laryngeal region, above the thyroid gland. The pyramidal lobe may be affected by the same pathologies as those seen in the thyroid gland; therefore, cystic change, nodularity, calcification and altered echotexture may be present.

In our study, a range of appearances was demonstrated, most of which were also present in the thyroid gland. In one patient, a pre-laryngeal nodule was identified in transverse section, whose longitudinal views confirmed to be a nodule located in a pyramidal lobe in the presence of multinodular goitre (see Figure 5(a) and (b)). In a single patient, a cystic nodule was found in a similar location (see Figure 6). In a patient with Hashimoto's thyroiditis, the pyramidal lobe showed a coarsened patchy echotexture, in keeping with concomitant autoimmune disease (see Figure 7). No cases of thyroid malignancy were found in this cohort of patients.

Surgical and pathological studies

There is a wide range in the incidence of pyramidal lobes recorded within the existing literature (see Table 2). The largest intra-operative study carried out by Sturniolo et al.,³ which sampled 1405 patients undergoing thyroidectomy, showed the presence of a pyramidal lobe in 25.5%. This finding compares favourably with the present study, which shows an overall incidence of 21%. The largest cadaveric study by Harjeet et al.⁴ found an incidence of 28.9%, again comparable to this study. There is significant variation, however, in the remainder of the studies, with incidences ranging from 12% to 61%. Our study did not reveal a significant difference in the site of pyramidal lobe origin, with roughly equal numbers originating from the right (51%) and left (46%) side of the isthmus, and 2% arising from the midline. There is an overall predominance of left of midline origin in published observations.

Ultrasound

Kim et al. have favourably compared sonographic prevalence rates of the thyroid pyramidal lobe with those found at surgery and computed tomography (CT) of the neck in 135 patients undergoing thyroidectomy. In one study, the incidence of pyramidal lobes as diagnosed by thyroid ultrasound, neck CT and surgery was 58.5%, 56.3% and 60%, respectively.⁵ Whilst their studies confirm the accuracy of ultrasound for detecting the pyramidal lobe, Kim et al. attribute the unusually high incidence they have found with selection bias. Su et al.⁹ found an overall incidence of 14%. In the present study, a pyramidal lobe was found in 21% of patients, an incidence compatible with the much of the published literature. Whilst the incidental finding of a pyramidal lobe on ultrasound is not routinely reported at our institution, its presence may become significant in patients with suspected or diagnosed thyroid pathology. In cases of thyroidectomy, any remaining ectopic thyroid tissue including a pyramidal lobe may undergo change. This may be hypertrophic in response to the action of thyroid stimulating hormone, or indeed pathological, with

malignant recurrence being a concern. Residual tissue may also interfere with post-surgical radioiodine treatment, by absorbing most, if not all of the radioactive agent, thus nullifying the anticipated effects on nodal disease. If the surgeon is aware of the presence of a pyramidal lobe at the time of surgery, the possibility of complete excision is optimised.¹⁴

Conclusion

Our study suggests that pyramidal lobes are common normal variants, and can be accurately detected using ultrasound. It is important to remember that incomplete resection of the pyramidal lobe may result in post-operative hyperplasia of the gland itself, or recurrence of the primary pathology. It is therefore important that radiologists and sonographers are aware of the pyramidal lobe and its sonographic appearances. On the basis of this study, the authors recommend reporting the finding of a pyramidal lobe to ensure that the surgeon may be aware of its presence at the time of surgery, thus enabling complete resection.

DECLARATIONS

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Contributorship: EL was responsible for the study concept and design. CM researched the literature and carried out statistical analysis. EL and HL performed the clinical studies. CM and HL carried out experimental studies and data analysis. The manuscript was prepared by CM and EL and edited by EL.

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