THE PYRAMIDAL LOBE IN THYROID IMAGING

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The incidence of the pyramidal lobe of the thyroid gland is quoted in surgical and anatomical texts as varying from 43% to 80% (*1–3*) in operated or cadaver specimens. The reported experience of individuals performing thyroid scans has not been this high. McAllister (*4*) and his group state "an occasional pyramidal lobe is found." Atkins and Richards (*5*) recently quoted an incidence of 9% with an increased incidence in thyroidectomized patients. Dische and Berg (*6*) found pyramidal lobes in 22 of 66 (33%) patients with thyroid disease. In a group of 27 normal controls, they found eight (30%) pyramidal lobes. In eight postoperative thyroidectomy patients there were five pyramidal lobes (62%). Beierwaltes (*7*) states that pyramidal lobes are found in 1–4% of scans performed in patients who have had thyroid surgery. This low incidence may have been due to the technical limitation of the early scanning equipment.

During the clinical evaluation of the Spintharicon for thyroid imaging, our attention was called to what appeared to be an unusual number of pyramidal lobes appearing in the ^{125}I spark images. To evaluate this observation, all of the ^{125}I spark images performed from April 1 through December 15, 1967, which had comparative ^{125}I rectilinear scans were evaluated for the presence or absence of a pyramidal lobe.

A series of 130 patients was available consisting of 107 females ranging in age from 9 to 76 years and 23 males ranging in age from 12 to 60 years. The spark image was compared to the rectilinear scan, and note was made of the absence or presence of a pyramidal lobe. A pyramidal lobe was considered present if from the isthmus a cephalad finger-like projection of activity occurred in or near the midline (Fig. 1) or if activity was present above the superior-most tips of either lateral lobe, in or near the midline. In this latter event, this activity was usually connected to a point at or near the superior tip of either lateral lobe, often the left (Fig. 2). The scan or image was classed as doubtful if in the area where a pyramidal lobe might be expected there was a suggestion of activity, even though there was an insufficient amount to present a definite pattern.

TECHNICAL FACTORS

The application of the Spintharicon to thyroid imaging has been previously described (*8,9*). The spark camera images most efficiently with low-energy radioisotopes; hence the use of ^{125}I in this study. The patient is placed in the supine position with his neck hyperextended. The 5-in.-dia chamber is placed in contact with the neck. In patients with short necks, the chamber is necessarily spaced away from the neck up to a distance of 3 cm. A high-resolution collimator with a hole diameter of 2 mm, septal thickness of 0.5 mm and length of 15 mm was used in all cases. This collimator results in relatively low counting rates with the usual 100 μCi dose of ^{125}I. Therefore almost all patients received 200 μCi of ^{125}I to permit imaging in a reasonable time. The spark content of the images in this series ranged from 8,000 to 20,000 sparks depending on gland size. The imaging time ranged from 4 to 25 min depending on the total activity in the gland.

A commercial 3-in. crystal scanner was used for the rectilinear scans. Patients were placed in the supine position and after the landmarks were determined the detector was placed over the area of maximum activity. The photo-tube voltage was set at this particular counting rate. The count-per-minute range differential varied from 70 to 100%. The density setting was 25. The high-energy 31-hole focused collimator was used initially. Later a low-energy 73-hole focused collimator was obtained. Depending on the collimator and the activity in the patient's gland, speeds varied from 18 to 60 cm/min. Line spacing was 2 mm. Scanning was usually started

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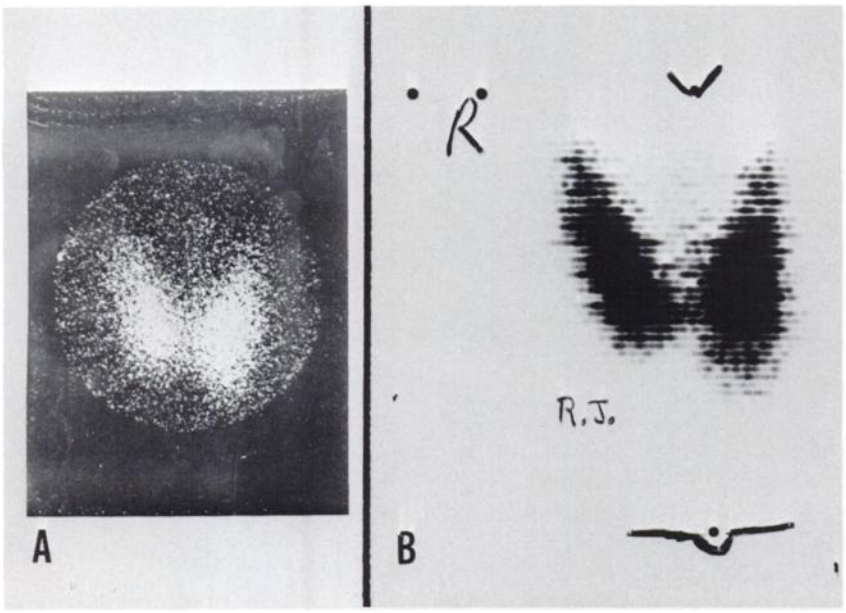

FIG. 1. Demonstration of pyramidal lobe arising from isthmus. Lobe is faintly but definitely apparent in both spark image (A) and rectilinear scan (B). Both images with ^{125}I.

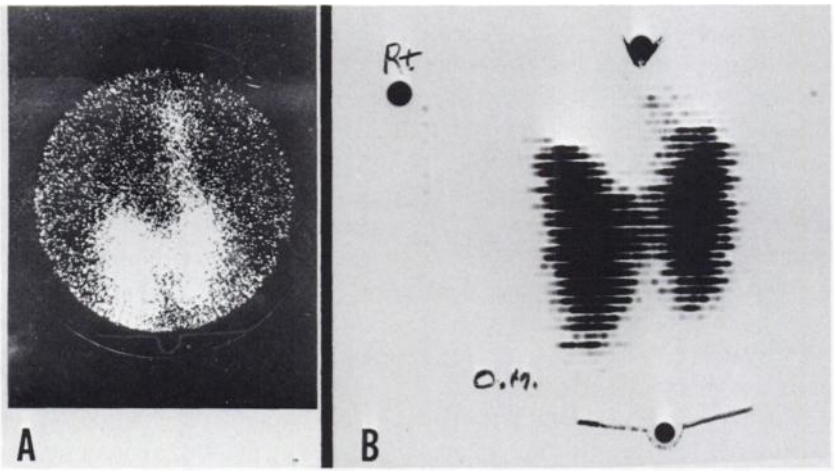

FIG. 2. Pyramidal lobe connected to tip of left lobe. Extent of pyramidal lobe is entirely visible in spark image (A). Scan was not started high enough to completely show pyramidal lobe (B). Iodine-125 used for both images.

from above the obvious area of activity in the gland and proceeded caudad for a distance of approximately 1 cm beyond the area of obvious activity as seen on the teledeltos paper. At times the scan was started too low. If this had been a prospective study, scanning should have started from below and proceeded cephalad to detect the pyramidal lobe. In an occasional instance, too much suppression was used on the teledeltos record or photoscan, and no activity was visible in the pyramidal lobe area. In contrast, a pyramidal lobe was seen in the spark image because the camera collects information simultaneously from a field larger than the target area.

TABLE 1. COMPARISON BETWEEN SCANNER AND SPARK CAMERA IN DETECTING PYRAMIDAL LOBE

	Positive	Doubtful	Total
Scan and spark image interpreted the same	21	4	25
Pyramidal lobe in scan image only	9		9
Pyramidal lobe in spark image only	8	3	11
Scan considered positive; spark doubtful	1		1
Total pyramidal lobes	39	7	46
Summation			
Scan images	31	4	35
Spark images	29	8	37

RESULTS

Of the 130 patients, there were 39 patients (30%) in whom a pyramidal lobe was definitely demonstrable by scan or spark imaging. The presence of a pyramidal lobe was considered doubtful in seven patients (Table 1). The doubtful cases were considered to be due to two factors. First, concentration of radioactivity within the small mass of pyramidal lobe was near the threshold of detectability of both imaging devices. Second, the tech-

TABLE 2. DISTRIBUTION OF PYRAMIDAL LOBES BY CLINICAL DIAGNOSIS

	Total in series	Pyramidal lobe
Euthyroid	98	31
No significant thyroid findings		24
Multinodular goiter		3
Solitary nonfunctioning nodule		1
Functioning adenoma		1
Adrenal hyperplasia		1
Unilateral lobe		1
Hyperthyroid	13	6
Posttherapy		
Surgery*	12	5
RAI	3	2
Thyroiditis	4	2
	130	46 (35%)

* 1 patient had recurrent hyperthyroidism.

nical factors of the imaging systems may not have been optimally selected. Such causes as patient movement, swallowing, insufficient activity in the lobe and over suppression may tend to smear or obliterate the pyramidal lobe image if one is present. Therefore, for purposes of this paper, the seven doubtful cases are added to the positive cases to make a total of 46 pyramidal lobes recorded (35%).

The scan and spark images agreed in 25 cases. In nine cases a pyramidal lobe was apparent on the scan but was not observed in the spark image. In eleven cases the spark image showed a pyramidal lobe while the scan did not. One case was recorded as a definite pyramidal lobe in the scan but doubtful in the spark image. The rectilinear scans showed 31 pyramidal lobes and four doubtful, while the spark images indicated 29 definite pyramidal lobes and eight doubtful (Table 1 summation). Thus each instrument discovered a pyramidal lobe in approximately 27–28% of the patients.

The incidence of the pyramidal lobe is the same for both sexes since 38 females and 8 males or 35% for each sex were shown to have pyramidal lobes. These 46 individuals with pyramidal lobes ranged in age from 14 to 67 years. There was no apparent predilection for any age group.

Significantly, the appearance of the pyramidal lobe correlated with the degree of uptake which usually, but not necessarily, reflected the size of the thyroid gland. The uptake was categorized as low (0–9%), normal (10–40%) and elevated (41% and above). There were no pyramidal lobes observed in the seven patients with low uptake. In 100 patients with normal uptake, there were 34 pyramidal lobes (34%). In the 20 patients with elevated uptake, there were 11 pyramidal lobes (55%). Three patients did not have a thyroid uptake.

Table 2 lists the number of observed pyramidal lobes according to diagnosis. The pyramidal lobe

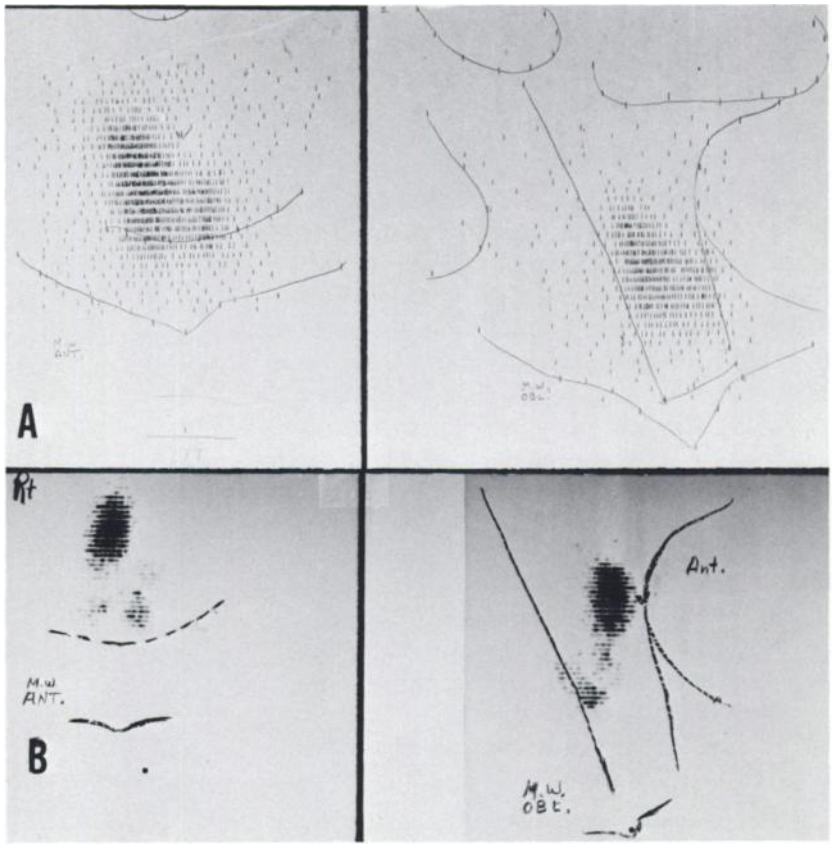

FIG. 3. 43-year-old female who had a thyroidectomy in 1949 for hyperthyroidism. In 1961 she was seen for clinically palpable multiple nodules not evident on scan (A) obtained with ^{131}I. A "total" thyroidectomy with removal of parathyroids was performed. In 1967 photoscan (B) was performed with ^{125}I for reevaluation of her thyroid status. Note appearance of pyramidal lobe. (ANT) Anterior view. (OBL) Oblique view.

was observed in five of 12 postoperative patients (41%) and in two of three postradioiodine treated patients. One of the postoperative patients had recurrent hyperthyroidism in which the pyramidal lobe was enlarged and actively functioning. The pyramidal lobe was present in six of 13 hyperthyroid patients.

SIGNIFICANCE OF THE PYRAMIDAL LOBE

The pyramidal lobe is an embryologic remnant of the caudal end of the thyroglossal tract. It may present as a midline neck mass and be of concern to physicians and patients. In postoperative patients (Fig. 3), apparently the lobe hypertrophies from the action of thyroid-stimulating hormone (TSH). Since only a small amount of thyroid tissue remains, that which is present undergoes hypertrophy and/or hyperplasia to supply the body's thyroid requirements. This is apparently the explanation for the higher incidence of pyramidal lobes in postsurgical and postradioiodine treated patients. Posttherapy patients may require thyroid medication to suppress TSH production. Recognition of this physiology in these patients can avoid unnecessary worry and surgery, as is shown in the following case (Fig. 4).

A 51-year-old female was referred by a general surgeon for thyroid scanning in February 1967 for the complaint of a "knot" in her throat of 2-years duration. This had progressively enlarged and at times caused her difficulty in swallowing. The past history revealed a thyroidectomy in 1958 for "nonmalignant goiter." Clinically, the patient appeared to be euthyroid. She was on no medication. The uptake at the time of the scan was 23%, and the PBI 10.2 μg%. No explanation of the discrepancy between the uptake and the PBI was available. The physician suspected a thyroglossal cyst and had indeed suggested surgery to the patient. The ^{131}I scan,* particularly the oblique view, was correlated with the mass by palpation while the patient was beneath the probe. The pyramidal lobe and the remnants of the lateral lobes were considered to be hypertrophied structures. The scan was used to reassure the patient that the tissue was an enlargement of the remnants of the thyroid. However, because of the high PBI and the palpable neck mass, the patient was given methimazole by her surgeon, and she was operated on in May 1967. The operative report states: "There was a mass in the midline just inferior to the cricoid cartilage approximately 4 × 6 cm in size. Dissection shows a projection of this mass extending to the foramen cecum." The pathology report describes the tissues as follows: "Portion of thyroid gland showing colloid storage and changes consistent with involuted hyperplasia with rather marked colloid storage in a somewhat multinodular fashion." Postoperatively the patient gained weight markedly, her eyes became puffy and she developed swelling (myxedema) in her legs. She was placed on thyroid medication. In June 1968 she was doing well, had lost considerable weight and had no complaints.

The second surgery in this patient might have been avoided if the patient had been treated with thyroid hormone after her first operation in 1958. In sufficient doses, thyroid hormone would have suppressed TSH and removed the stimulus for the enlargement of the pyramidal lobe and the remnants of the lateral lobes.

Knowledge of the presence of a pyramidal lobe is important in patients with suspected or diagnosed

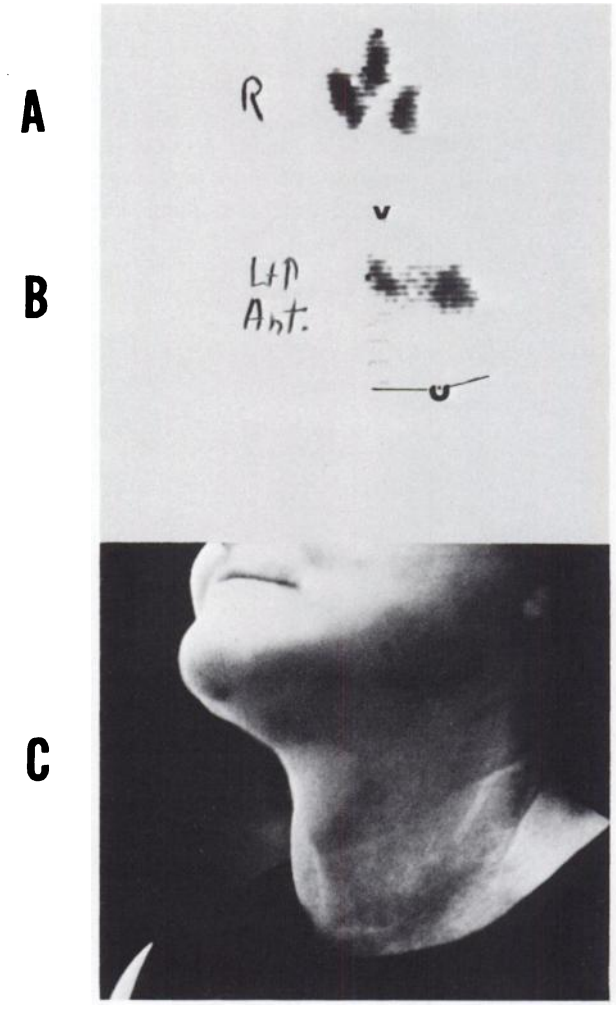

FIG. 4. Pyramidal lobe in 51-year-old female who had subtotal thyroidectomy in 1958. Note midline position of lobe in anterior view (A) and anterior position of pyramidal lobe in oblique view (B). Enlarged lobe can readily be seen as prominent longitudinal neck mass in lower illustration (C). Iodine-131 was used for patient who is not included in series reviewed.

* This patient is not included in the series reviewed.

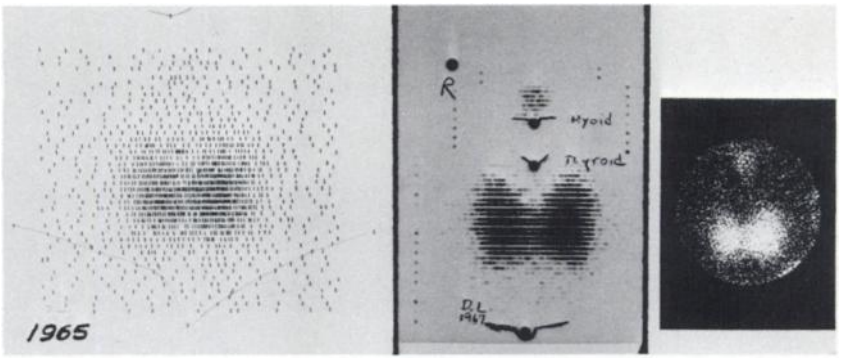

FIG. 5. Comparison of spark image with rectilinear scan. Forty-two-year-old female evaluated in 1965 for excessive obesity had scan performed with ^{131}I on 2-in. crystal scanner with paper record. Scan was not carried high enough to detect aberrant tissue. In 1967 patient was reevaluated using ^{125}I, and photoscan from 3-in. detector. Aberrant tissue was found above thyroid and considered to be lingual thyroid. Spark image, however, shows activity to extend as thin line from medial tip of left lobe superiorly into broadened mass above hyoid.

cancer of the thyroid. In the event that a total thyroidectomy is planned by the surgeon, he should be aware of the existence of a pyramidal lobe in the patient. If dissection is easily possible, the surgeon should remove the pyramidal lobe with the rest of the gland to avoid possible involvement of the lobe by tumor as well as subsequent hyperplasia of the lobe and its possible interference with postsurgical radioiodine treatment. Otherwise, the lobe can be ablated postsurgically with ^{131}I.

DISCUSSION

As shown in Figs. 3 and 4, the pyramidal lobe appears in the scan very close to the surface of the neck in the oblique view and anterior to the main mass of thyroid tissue. Recognition of these findings as well as its midline position will aid in differentiating the pyramidal lobe from other thyroid tissue.

Each instrument independently was capable of visualizing a pyramidal lobe in approximately 27–28% of the patients. The devices did not detect all of the pyramidal lobes in the same patients. However, it is concluded that the spark camera and the scanner have about the same potential for detecting the pyramidal lobe. The spark camera is easier to position over the patient, and fewer technical controls enable a quality image to be obtained on the first attempt. In some spark images there appeared to be more detail of the pyramidal lobe than in the scans, with the connection of the pyramidal lobe to the lateral lobe clearly more evident (Fig. 5).

Familiarity with the technical principles of the scanner is required to obtain a high-quality rectilinear scan. Background erase should not be used since some areas of the gland may be near background levels of activity. Such areas will not be visualized if high-contrast photorecording is used when the region of maximum counting rate is taken as the reference for maximum film density. Repeat scans should be performed whenever unusual or interesting detail is suggested in the image. Areas of low activity can be better defined in repeat scans by peaking the photorecord voltage when the probe is centered over the area of low activity; or, increased activity in the gland can be achieved by repeating the scan with ^{99m}Tc-pertechnetate (*10*).

Iodine-125 has been shown to produce images of better resolution than ^{131}I (*11,12*). Furthermore, the higher concentration of ^{125}I in the thyroid glands (200-μCi doses) of the patients reviewed in this series may explain the higher incidence of pyramidal lobes in this series. The 35% incidence of pyramidal lobes obtained resulted from the addition of the two instruments used in the study. This incidence is similar to that of Dische and Berg's experience (*6*) but less than that quoted in surgical and anatomical texts. With improved imaging devices, radioisotopes that can be administered in higher activities and more awareness on the part of the technicians and physicians, it is possible that a higher incidence of pyramidal lobes in scans may be seen in the future.

CONCLUSIONS

With careful techniques and adequate radioactivity, the pyramidal lobe of the thyroid gland is visualized in approximately 35% of all patients presenting for thyroid scans. Postoperative and post ^{131}I-treated patients, hyperthyroid patients and patients with large glands show a higher incidence of pyramidal lobes, approaching 50–60%. The pyramidal lobe may present as a hypertrophied-hyperplastic structure in posttherapy patients. Its recognition and proper management may spare the patient anxiety and surgery. Oblique views can help to define the pyramidal lobe since the lobe presents anterior to the main thyroid gland and is very close to the outline of the neck. Any palpable masses should be correlated with the image while the patient is under the scanner. Using the technical parameters described in this study, no significant difference was found between the Spintharicon and the rectilinear scanner in detecting pyramidal lobes.

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