ORIGINAL ARTICLE

Role of TC-99m Thyroid scintigraphy in investigating Thyroid swelling: is it of any help for surgeons?

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Abstract

Objective: To assess the role of thyroid scintigraphy with technetium 99m pertechnetate in patient undergoing thyroid surgery for thyroid swelling and whether this investigation helps in decision making for surgeons regarding management strategy.

Study Design: A prospective quasi-experimental study.

Place & Duration of Study: This is a multicentric study conducted at the department of ENT, Head & Neck Surgery, Civil Hospital Karachi, Jinnah Medical College Hospital, Hamdard University Hospital, and PNS Shifa, over a period of three and half years from August 2006 to February 2010.

Patients & Methods: A total number of 110 patients were included in this study undergoing thyroid surgery for any thyroid swelling where thyroid scintigraphy with Tc-99m pertechnetate was done in all the cases with FNAC, thyroid sonography, thyroid function tests and post-operative histopathology. Data collected was analyzed for sensitivity, specificity, accuracy, positive predictive value and negative predictive value of thyroid scintigraphy for malignancy.

Results: In this study, on thyroid scintigraphy 50.9% of the cases were multinodular goiter, 48.2% were cold nodules and 0.9% was hot nodule. On post-operative histopathology 94 cases (85.4%) were benign swellings and 16 cases (14.6%) were malignant. Sensitivity, specificity, accuracy, positive predictive value and negative predictive value of thyroid scintigraphy were found to be 68.7%, 55.3%, 57.2%, 20.7% and 91.2% respectively.

Conclusion: In our view thyroid scintigraphy should not be ordered in every case of thyroid swelling because of its low predictive value for malignancy.

Key words: Thyroid scan, Tc-99m, Thyroid surgery, Hot & cold nodules

Introduction

Thyroid scintigraphy is often ordered as a routine baseline investigation in patients who present with any type of thyroid swelling. Earlier radioactive iodine I^{123} and I^{131} and later technetium 99m pertechnetate was in use for thyroid scintigraphy. Two to three decades before this was the only investigation available for assessing size, functionality and nodularity of the thyroid gland. A nodule may appear as cold, warm or hot depending upon the tracer uptake in comparison to its surrounding tissues. A hot nodule is almost always benign and does not require further diagnostic evaluation. Majority of the cold nodules are also benign with only 5-8% risk of being malignant[1]. Considering that nodules are cold in approximately 70% of the cases, this parameter has an extremely low predictive value for malignancy[2]. In addition about 70% to 90% of thyroid disorders encountered in surgical practice are benign[3].

Considering the above facts, ordering thyroid scintigraphy in every patient undergoing thyroid surgery is a shear waste of resources and time. So this study was conducted to assess the role of thyroid scintigraphy and whether it helps on decision making regarding management or type of surgery.

Subjects and Methods

This is a multicentric study conducted at the department of ENT, Head & Neck Surgery, Civil Hospital Karachi, Jinnah Medical College Hospital, Hamdard University Hospital and PNS Shifa, Karachi, over a period of three and half years from August 2006 to February 2010. Inclusion criterion included all patients of thyroid gland swelling undergoing any type of thyroid surgery. Exclusion criteria included patients undergoing revision thyroid surgery for multinodular goiter (MNG), completion thyroidectomy for malignant disease and patients lost for follow up after thyroid surgery with no final histopathological report. A total of 123 thyroid surgeries were done during the above mentioned period, among them 3 patients have revision thyroidectomy for recurrent MNG, 5 patients have completion thyroidectomy for malignant disease and5 patients were lost for follow up with no final histopathological report available. Thus a total of 110 patients were included in this study.

Detailed history and clinical examination was done in all the cases along with relevant investigations like thyroid function tests, ultrasound thyroid gland and pre-operative fine needle aspiration cytology. Thyroid scintigraphy with Tc-99m pertechnetate was specifically done in all the cases. Surgery was planned after the report of these investigations and thyroid surgery ranging from isthmectomy to total thyroidectomy was done accordingly. Post-operatively all the specimens were sent for histopathology. All the data was recorded on a proforma and later saved and analyzed on SPSS version 11.

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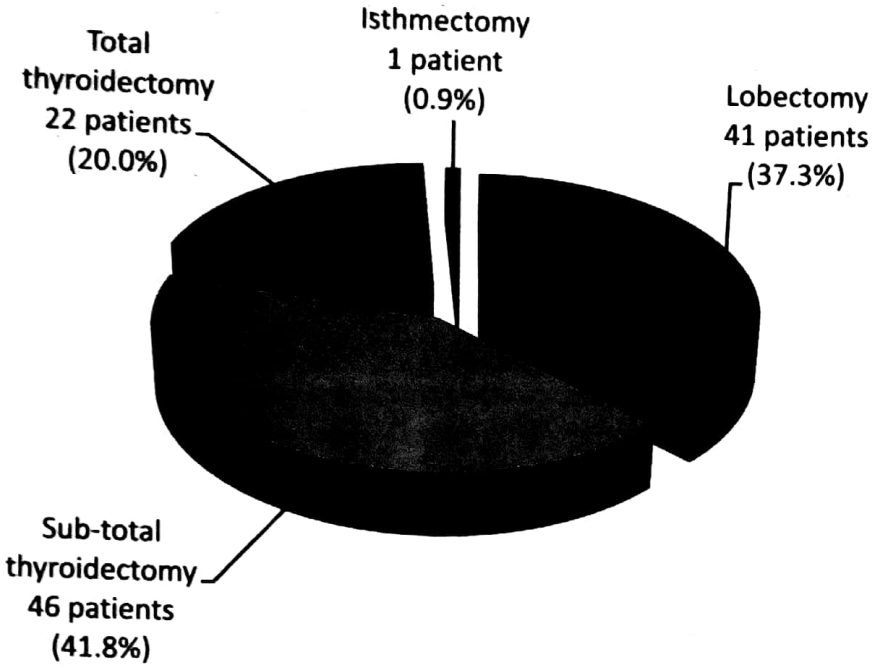

Figure -1 Types of surgeries performed

Results

A total number of 110 patients were included in this study. Among them 103 patients (93.6%) were female and 7 (6.3%) were male. Age ranges from minimum of 14 years to maximum of 61 years with mean age incidence of 32.8 years (± 1.28 years). Clinically out of these 110 patients, 38 (34.5%) have single nodule and 72 (65.4%) have multinodular goiter. On thyroid function tests, 93 patients (84.5%) were euthyroid, 10 patients (9.1%) were hypothyroid and 7 patients (6.3%) were hyperthyroid. Fine needle aspiration cytology (FNAC) was done in all the cases and showed benign lesion in 93 (84.5%) cases, malignant in 2 (1.8%) cases and inconclusive or doubtful malignancy in15 (13.6%) cases.

Figure 1 shows the extent of thyroid surgery done in these patients where sub-total thyroidectomy was done in majority of the cases (41.8%). On thyroid scintigraphy out of total 110 patients, 56 showed multinodular goiter (50.9%), cold nodule in 53 cases (48.2%) and hot nodule in 1 case (0.9%) (table 1).

Final histopathological report after surgery showed that 94 cases (85.4%) were benign whereas 16 cases (14.6%) were malignant (table 1). Among the malignant tumors, 10 cases were papillary carcinoma 4 cases were follicular carcinoma, 1 case of undifferentiated carcinoma and 1 case of lymphoma (fig. 2). Table 1 also shows correlation of thyroid scintigraphy with final histopathological findings, where out of 56 multinodular goiter 51 were benign and 5 were malignant, out of 53 cold nodule cases 42

Table - 1 Correlation of thyroid scan finding with final histopathological findings

Thyroid scan finding	Total cases	Final Histopathology	
		Benign	Malignant
Multinodular	56	51	5
Cold nodule	53	42	11
Hot nodule	1	1	0
Total	110	94	16

Table-2 True negative (TN), True positive (TP), False negative (FN) and False positive (FP) values for thyroid scintigraphy

		Histopathology	
		Benign	**Malignant**
Thyroid scan	Benign (multinodular + hot)	52 True negative (TN)	5 False negative (FN)
	Malignant (cold nodule)	42 False positive (FP)	11 True positive (TP)

were benign and 11 were malignant whereas 1 case of hot nodule was found to be benign. Table 2 shows that true positive cases in this study were 11 (cold nodule on scintigraphy and malignant on H/P), true negative cases were 52 (multinodular + hot nodule on scintigraphy and benign on H/P), false positive cases were 42 cases (cold nodule on scintigraphy and benign on H/P) and false negative cases were 5 cases(multinodular on scintigraphy and malignant on H/P). Sensitivity of thyroid scintigraphy in our study was found to be 68.7%, specificity was 55.3%, accuracy was 57.2%, positive predictive value was 20.7% and negative predictive value was 91.2% (table 3).

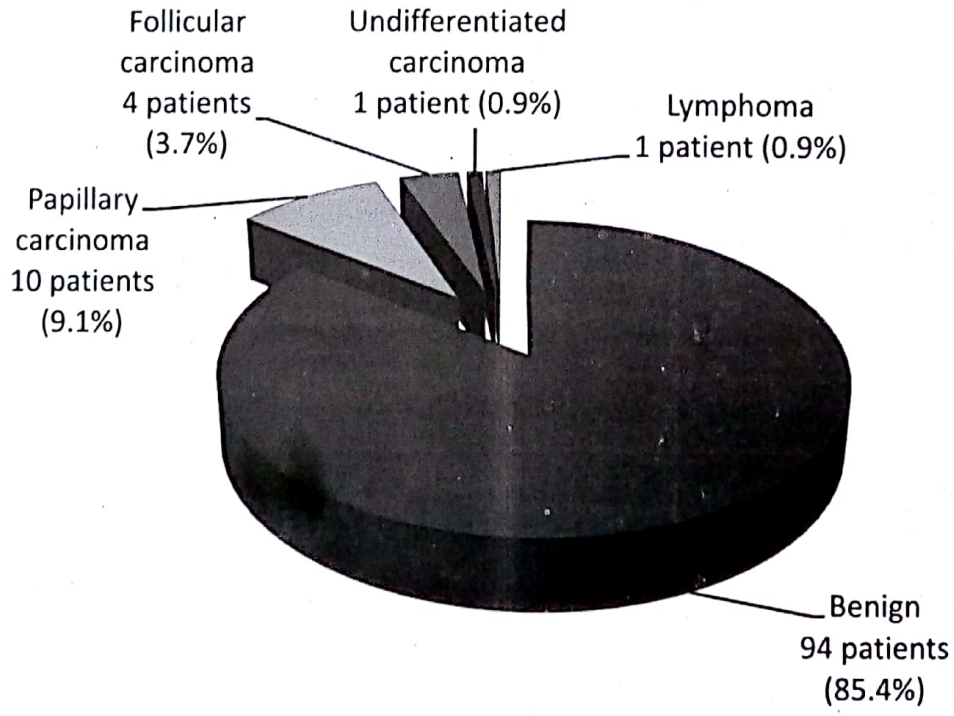

Figure - 2 Histopathology findings of specimen after surgery

Table- 3 Sensitivity, specificity, accuracy, positive predictive value and negative predictive value of thyroid scintigraphy

	Formula		Result
Sensitivity	TP/TP+FN	11/11+5	68.7%
Specificity	TN/TN+FP	52/52+42	55.3%
Accuracy	TP+TN/TP+TN+FP+FN	11+52/11+52+42+5	57.2%
Positive predictive value	TP/TP+FP	11/11+42	20.7%
Negative predictive value	TN/TN+FN	52/52+5	91.2%

Discussion

Radionuclide imaging has been the mainstay in the evaluation of thyroid nodule since 1939 when Hamilton and Soley demonstrated that malignant thyroid tissue concentrates less radioactive iodine than normal thyroid tissue[4]. Surveys by the American Thyroid Association and European Thyroid Association showed that 23% and 66% of practitioners respectively still routinely employ thyroid scan in the evaluation of a solitary nodule[5,6]. The most commonly used radioisotopes are technetium (Tc-99m) and I^{123}. As both these isotopes gives similar information, choice of radioisotopes is dependent of preference of the clinician and radiologist[7]. Tc-99m quickly washes out of the thyroid gland before being organified inside the gland, allows a shorter scanning time (20 – 30 minutes) and can be performed immediately after administration of radioisotope. I^{123} imaging needs to be performed 24 hours after administration and the scanning time can run 4 to 6 hours in length. Imaging resolution is also much better with Tc-99m than radioactive iodine. Nodules that are smaller than 1 cm cannot be detected reliably by either scan, as they are below the discriminating power of scintigraphic devices.

A useful investigations is one in which the results will alter the management or add confidence to clinical diagnosis[8]. Thyroid scintigraphy has lost its importance in the recent years as fine needle aspiration cytology and thyroid ultrasound are providing more reliable information. Thyroid scintigraphy is mostly done to assess size of the thyroid gland, nodularity within the thyroid gland or functionality of the thyroid nodules. About two to three decades ago thyroid scintigraphy was the only method for studying thyroid size, marker uptake (functionality) and presence of nodules. Now with thyroid ultrasound, assessment of thyroid gland size and nodularity can be made more accurately. In addition ultrasound has the advantage of being readily available, safe, non-invasive, relatively inexpensive and very efficacious for evaluation of the thyroid gland architecture[9]. Functionality or marker uptake was used to assess its malignant potential i.e. hot nodule is almost always benign and cold nodule could be malignant. Again fine needle aspiration cytology is considered to be more valuable in assessing malignant potential.

In our study all the parameters showed very low values i.e. sensitivity was 68.7%, specificity was 55.3%, accuracy was 57.2%, positive predictive value was 20.7% while the negative predictive value was high i.e. 91.2%. Thus it is concluded that thyroid scintigraphy is not a good investigation for predicting thyroid malignancy. In contrast most studies shows that FNAC plays a significant role in pre-operative diagnosis of thyroid swellings with high sensitivity, specificity and accuracy[10,11,12]. Similarly other studies conducted for thyroid scintigraphy also shows that it is not of much help for surgeons in every case[13,14]. A study conducted by Lumachi et al also shows similar results for thyroid scintigraphy, where sensitivity was 95.8%, specificity was 21.1%, accuracy was 35.7%, positive predictive value was 22.6% and negative predictive value was 95.5%[15]. In another study by Kountakis et al shows sensitivity as 91%, specificity as 19% and accuracy as 38%[16]. Extent of thyroid surgery performed in our series was also not dependent upon the findings of thyroid scintigraphy.

The role of thyroid scintigraphy is now limited to only few thyroid diseases like in ectopic thyroid gland, retrosternal goiter, nodule with low TSH value and metastasis cases. Despite new molecular genetics insights into congenital hypothyroidism, the thyroid scan remains the most accurate tests for the detection of ectopic thyroid tissue[17].

Conclusion

In our view thyroid scintigraphy should not be ordered in every case of thyroid swelling undergoing surgery. This should be used only in selective cases like for ectopic thyroid, retrosternal goiter and thyroid nodule with low TSH level.

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