FINE NEEDLE ASPIRATION CYTOLOGY IN THE MANAGEMENT OF SOLITARY THYROID NODULES – A COMPARISON WITH OTHER DIAGNOSTIC MODALITIES IN COST-EFFECTIVENESS

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ABSTRACT

This paper assesses the cost effectiveness of fine needle aspiration cytology (FNAC) as a selection criteria for surgery in solitary thyroid nodules compared to scintigraphy and ultrasonography. 98 patients who had FNAC and histological confirmation, scintigraphy and/or ultrasonography were studied. The use of combined diagnostic discriminants of positive FNAC, clinical suspicion and age above 50 years detected all malignancies and would have resulted in fewer patients being subjected to surgery – 51% (FNAC) vs 90% (Scans, U/S). This resulted in cost savings of $800 per patient seen. We conclude therefore that FNAC should be the diagnostic modality of choice and that the routine use of scintigraphy and ultrasonography is not justifiable.

Keywords: Cost-effectiveness, cytology, investigation, thyroid nodules.

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INTRODUCTION

Traditionally the patient with a solitary thyroid nodule was subjected to a diagnostic strategem which included careful physical examination, radionuclide scanning and ultrasonography to isolate patients with risk factors for malignancy. However this resulted in unnecessary surgery for the majority of benign lesions since the risk of malignancy varies from 9 to 22%.

Reports from many centres which have adopted the use of fine needle aspiration cytology as a routine diagnostic modality have proven that this tool has great sensitivity and specificity in the detection of malignancies. Many authors are now recommending FNAC as the investigation of choice and are questioning the routine application of traditional diagnostic imaging techniques. To determine if FNAC for thyroid nodules was superior to other modalities, the following questions were posed:-

1. What was the sensitivity of the various diagnostic discriminants?
2. If radionuclide scans and ultrasonography were omitted what effect had this on the subsequent management?
3. What were the cost savings that could be achieved using FNAC as the sole method of investigation?

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MATERIALS AND METHODS

From April 1987 when FNAC for thyroid nodules was introduced till July 1988, 170 patients with solitary thyroid nodules were managed. Of these, 142 had FNAC performed. 98 patients who had subsequent surgery and therefore had cytology with histological confirmation form the basis of this study. Radionuclide scanning using technetium-99m pertechnetate was done in 90 patients and ultrasonography in 91 patients. Scans and ultrasonography were often done simultaneously but were reported independently of FNAC.

To assess the effectiveness of each diagnostic modality, the following data were determined:-

1. The proportion of malignancies detected with that diagnostic modality (sensitivity) and
2. The proportion of patients who would, as a result, be subjected to surgery.

Results were considered positive for each modality as follows:-

1. Clinical suspicion of malignancy with a hard or fixed thyroid mass; palpable cervical lymph nodes; past history of neck irradiation.
2. Radionuclide Scans showing a solitary 'cold' nodule.
3. Ultrasonography depicting a solitary nodule of solid or mixed consistency.
4. FNAC being reported as malignant, suspicious for malignancy and follicular neoplasms.

If the results of each modality was negative according to the criteria above, the patient was considered as not requiring surgery. The cost of each investigation was assessed using current unsubsidised rates employed in this hospital.

RESULTS

24.5% of nodules resected were malignant with papillary carcinoma being the commonest histological subtype (Table I). Table II shows the types of lesions detected and the corresponding percentage of patients requiring surgery with the various diagnostic discriminants. Preoperative clinical suspicion detected only 29% of malignancies. Scintigraphy, ultrasonography and FNAC significantly increased the detection rate when compared to clinical suspicion but not when compared with each other ($p = 0.23, 0.36$). However using FNAC as a selective criteria would have resulted in only 31% of patients requiring operation as compared to 85% when either scintigraphy or ultrasonography was used ($p = 0.0000$).

Analysis was performed on diagnostic discriminants used in combination to maximise detection of malignancies (Table III). FNAC, clinical suspicion of malignancy and age above 50 years detected all malignancies and required only 51% of patients to be subjected to surgery. Comparatively, scintigraphy and ultrasonography did not further increase detection of carcinomas but would have required 90% of patients to be subjected to surgery ($p = 0.0000$). Using FNAC as the sole investigational modality and omitting scintigraphy or ultrasonography resulted in cost savings of approximately $800 per patient (Table IV).

Table I
HISTOLOGY OF RESECTED NODULES

Histology		No.	%
Non neoplastic goitre		39	
Multinodular goitre		9	
Follicular Adenoma		11	
Thyroiditis		2	
BENIGN	SUBTOTAL	74	75.5
Papillary carcinoma		16	
Follicular carcinoma		3	
Medullary carcinoma		2	
Lymphoma		2	
Hurthle cell carcinoma		1	
MALIGNANT	SUBTOTAL	24	24.5
	TOTAL	98	100

DISCUSSION

Traditional criteria used in selecting patients with solitary thyroid nodules for surgery relied on the presence of factors supposedly placing the patient at a higher risk of harbouring a malignancy. Such clinical features included patients at extremes of age, males, a history of previous irradiation to the neck or a rapidly expanding mass; signs suggestive of malignancy as in hard fixed masses with cervical lymph nodes or a lack of response to suppression therapy. Scintigraphy depicting a solitary cold nodule and ultrasonography showing solitary nodules of solid or mixed consistency were also risk factors commonly employed. These criteria however lacked sensitivity and /or specificity and resulted in unwarranted surgery for the majority of benign lesions. Clinical suspicion of carcinoma detects only about a quarter of all tumours(1-3). Some authors have suggested using lack of response to thyroxine suppression to identify cancers and as a selective criteria for surgery (4). However considerable controversy still exists regarding the efficacy of thyrotropin suppression in reducing the size of nodules and at least one well controlled prospective randomised trial recently has shown no significant reduction after six months of levothyroxine therapy (5). The basis of using scintigraphy, rested on the premise that the incidence of malignancy in 'warm' or 'hot' nodules was negligible. This premise has been challenged by some who have reported 22% to 44% of tumours being 'warm' on scintigraphy (6-8). This has been attributed to a suffi-

Table II
DIAGNOSTIC DISCRIMINANTS IN THE SELECTION OF PATIENTS FOR SURGERY

Parameter	% of malignancy detected			% of patients requiring surgery	
	*MFC included n = 24	MFC excluded n = 18	p@	n = 98	p#
Clinical Suspicion	29%	39%		8%	
Scan (n = 90)	85.7%	86.7%	.0002	84.4%	.0000
Ultrasound (n = 91)	86.3%	87.5%	.0003	85.7%	.0000
FNAC	71%	94%	.0009	31%	.0002

*MFC — microscopic foci of papillary carcinoma.
p@ — Detection of malignancies with each modality compared to clinical suspicion.
P values between scan/ultrasound and FNAC were not significant: Scan vs FNAC — 0.23; U/S FNAC — 0.36.
p# — % of patients requiring surgery with each modality compared to when clinical suspicion is used.
P values for FNAC vs scan or U/S — 0.0000.

Table III
DIAGNOSTIC DISCRIMINANTS USED IN COMBINATION

Parameters	% of malignancy detected		% of patients requiring surgery	
	MFC included n = 24	MFC excluded n = 18	n = 98	p#
CS̄, 50 YRS	50%	55.5%	36.7%	
FNAC, CS̄	75%	94%	31%	
FNAC, CS̄ and >50 yrs	83%	100%	51%	
Scan, CS̄ (n = 90)	90% (n = 21)	86.7% (n = 15)	90%	.0000
Ultrasound, CS̄ (n = 91)	91% (n = 22)	94% (n = 16)	89%	.0000

p# — % of patients requiring surgery using FNAC, CS and >50 yrs vs Scan, Cs and Ultrasound, CS.

Table IV
COST SAVINGS WITH FNAC (per 100 patients seen)

	Cost (per 100 pts)
Scheme A	
Scan, Operative and Hospital Fees (4 days) – assuming 90% operated	$196,120
Scheme B	
Ultrasound, Operative and Hospital fees (4 days) – assuming 89% operated	$190,620
Scheme C	
FNAC, Operative and Hospital Fees (4 days) – assuming 51% operated	$112,468
Cost savings : Scheme A — C	$ 83,652
: Scheme B — C	$ 78,152

Cost schedule: Scan-$100; U/S-$45; FNAC-$70; Operative fees-$1300; Hospital stay per day-$192

ciently thick blanket of normal tissue overlying or surrounding the malignant lesion. In parallel fashion, ultrasonography was previously thought to be able to identify cystic lesions which were less likely to be malignant. However, Hammer et al showed convincingly that the cystic nature of a thyroid nodule did not rule out malignancy, being distributed equally among benign (27%) and malignant (33%) lesions. 17% of their cystic nodules were malignant (9). Additionally, the inaccuracy of sonogram in differentiating cysts and solid nodule has been commented upon by various authors who report an error incidence of 25% to 32% (9,10).

In contrast, FNAC has been shown to have a high sensitivity and specificity in the assessment of thyroid nodules. Our data in Table III reveal that the use of diagnostic discriminants of FNAC, clinical suspicion of malignancy and age above 50 years detected all tumours. Using these three selective parameters in combination required only 51% of patients to be operated in contrast to the 90% when either scintigraphy or ultrasonography were employed. This translated to cost savings of $800 per patient seen. We have intentionally analysed the detection of malignancies after exclusion of microscopic foci of papillary carcinoma that were detected on resected nodule. The clinical significance of these small or microscopic carcinomas is debatable since studies from necropsies report an incidence ranging from 8% to 36% (11-14). Some authors even question whether these represent true malignant growths (15).

In conclusion, FNAC used with other clinical criteria in selecting patients for surgery is safe and cost effective. Scintigraphy and ultrasonography in the assessment of the patients with a thyroid nodule should be used judiciously as routine use is not justifiable.

REFERENCES

1. Woolner LB, Beahrs OH, Black BM, McConahey WM, Keating R Jr: Classification and prognosis of thyroid carcinoma. A study of 885 cases observed in a 30 year period. AM J Surg 1961; 102:354-87.
2. Anderson JB, Webb AJ: Fine needle aspiration biopsy and the diagnosis of thyroid cancer. Br J Surg 1987; 74:292-6.
3. Ng EH, Nambiar R: Thyroid carcinoma – Problems in management. Ann Acad Med Singapore 1988; 17:9-14.
4. Blum M, Rothschild M: Improved nonoperative diagnosis of the solitary thyroid nodule; surgical selection based on risk factors and three months of suppression. JAMA 1980; 243:242-5.
5. Gharib H, James EM, Charboneau JW, Naessens JM, Offord KP, Gorman CA: Suppressive therapy with Levothyroxine for solitary thyroid nodules: A Double-Blind Controlled Clinical Study. N Engl J Med 1987; 317:70-5.
6. Evans DM: Diagnostic discriminants of thyroid cancer. Am J Surg 1987; 153:569-70.
7. Hoffman GL, Thompson NW, Heffron C: The solitary thyroid nodule. Arch Surg 1972; 105:379-85.
8. Saxe AW: Thyroid scans and the diagnosis of carcinomas of the thyroid. Surg Gynecol Obstet 1979; 149:729-30.
9. Hammer M, Wortsman J, Folse R: Cancer in cystic lesions of the thyroid. Arch surg 1982; 117:1020-3.
10. Rosens IB, Provias JP, Walfish PG: Pathologic nature of cystic thyroid nodules selected for surgery by needle aspiration biopsy. Surgery 1986; 100:606-12.
11. Bondeson L, Ljungberg O: Occult thyroid carcinoma at autopsy in Malmo, Sweden. Cancer 1981; 47:319-23.
12. Harach HR, Franssila KO, Wasenius V: Occult papillary carcinoma of the thyroid: a "normal" finding in Finland, A systematic autopsy study. Cancer 1985; 56:531-8.
13. Fukunaga FH, Yatani R: Geographic pathology of occult thyroid carcinomas. Cancer 1975; 36:1095-9.
14. Hubert JP, Kierman PD, Beahrs OH, McConahey WM, Woolner LB: Occult papillary carcinoma of the thyroid. Arch Surg 1980; 115:394-8.
15. Lowhagen T, Willems JS, Lundell G, Sundblad, Granberg PO: Aspiration biopsy cytology in diagnosis of thyroid cancer. World J Surg 1981; 5:61-73.