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Title:

Correlation of pre-operative Fine Needle Aspiration cytology and post-operative histological findings of solitary thyroid nodules at the Kenyatta National Hospital.

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Declaration

I hereby certify that this thesis is my original work and has not been submitted in any other institution.

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Date 2nd November 2001

This thesis has been submitted with my approval as the supervisor.

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Dedication

This work is dedicated to my late father Samuel Lesan, who instilled the principles of hard work in me as 1 grew up.

Acknowledgements

Special acknowledgment to my supervisor Prof. John Adwok without whose guidance this work would not have been completed on time.

To Dr. Lucy Muchiri who assisted me greatly on the cytopathological aspects of this study. And also gave guidance into the whole work.

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To all those others who in one way or another contributed to the completion of this work and the program in general I'm truly grateful.

Abbreviations

ACTH	Adrenocorticotrophic hormone
CTsean	Computerised Tomographic Scanning.
FNAC	Fine Needle Aspiration Cytology.
KNH	Kenyatta National Hospital
MEN	Multiple Endocrine Neoplasm
MRI	Magnetic Resonance Imaging
STN	Solitary Thyroid Nodule
TFT	Thyroid Function Test
T3	Tri-iodothyroxine
T_4	Thyroxine
USA	United States of America.

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Introduction

Solitary thyroid nodule is a commonly encountered endocrine disorder in surgical practice. It affects both females and males of all ages. Majority of the nodules are asymptomatic and benign, 5-10% are malignant[12].

The need to identify malignant solitary nodules is the most challenging aspect in the management of solitary thyroid nodules. It affects 4-7% of the general population with a reported incidence of 30-60 new cases per one million people per year and accounting for an annual death rate of 25 persons per one million people*[3].

Clinically it is not an easy task to predict malignancy. On the basis of history and physical examination alone a definitive diagnosis of a malignant solitary thyroid nodule is not possible. Malignancy can only be suspected in the presence of suggestive symptoms like cervical lymphadenopathy. Several investigative procedures are currently in use to attempt and separate out the minority malignant lesions from the benign lesions and these include ultrasonography, thyroid function test, Radionucleiod scanning and Fine Needle Aspiration Cytology (FNAC).

FNAC in the management of solitary thyroid nodule is a well established procedure. It has been extensively employed in assessment of solitary thyroid nodule, but the services of an experienced cytopathologist are usually required for accurate interpretation. The procedure is considered the "Gold" standard in preoperative evaluation of solitary thyroid nodule[4].

In this study the aim is to evaluate the predictive value of preoperative FNAC in surgical decision making by evaluating the final cytopathological diagnosis and comparing it with preoperative diagnosis.

To achieve this goal, 184 patients were recruited in a retrospective study covering a 5-year period from June 1996 to May 2001 at Kenyatta National Hospital. All patients had a preoperative FNAC done.

Summary

This is a retrospective study carried out at Kenyatta National Hospital over a 5-year period from June 1996 to May 2001. The main objective is to correlate preoperative Fine Needle Aspiration Cytology and post-operative histological findings.

The study involved a total of 184 patients with solitary thyroid nodule, 164 females and 20 males (Female: Male ratio 9:1) with a mean age of 38.5 years (range 4.5 yr-75yrs). Of the 184 patients, 184 had FNAC, 179 Thyroid function tests, 168 ultrasonography, 29 Radionucleiod Scan and 1 CT scan. The investigations done depended on clinicians attending to the patients, however all underwent lobectomy and had the excised tissues analysed histologically. On ultrasonography 74% were solid, 23% cystic and the rest were of mixed consistency and on radionucleiod scanning 93% were cold nodules versus 7% that were hot. FNAC reported 84.2% as diagnostic, 12% suspicious and in 3.8% inadequate samples were obtained. Post operatively the commonest finding was adenoma. Malignancy rate was 5.4%.

Literature Review

Anatomy

Site and structure

Thyroid gland is anatomically located in the neck anteriorly. The gland has two lateral lobes interconnected by an isthmus. Each lobe measures approximately 5cmx3cmx 1.5cm and is usually larger in females. It weighs about 20 grams. It may have a pyramidal lobe of Laloutte of variable size. The apex of the lateral lobe reaches the junction of middle and lower 1/3 of the thyroid cartilage. The base is at the level of the 5^{th} or 6^{th} tracheal rings.[29]

The lateral surface is convex, and is covered by skin, superficial and deep fascia, sternocleidomastoid muscle, superior belly of the omohyoid muscle, sternothyroid and sternohyoid muscle and the visceral (pretracheal) fascia from out to within.

The deep fascia sends septae into the gland's substance dividing it into lobules each consisting of 30-40 follicles that contain colloid and form the main secretory and storage elements. Each follicle is lined by columnar/cuboidal epithelium.

A string indurations of vascular connective tissue known as suspensory ligament of Berry binds the gland to each side of cricoid cartilage and it is the ligament and pretracheal fascia which splits to invest the gland and makes the gland move up and down during swallowing.

Relations

Medially the gland is related to the tracheal, inferior pharyngeal constrictor, posterior part of the cricothyroid muscle, oesophagus, superior and inferior thyroid arteries and the recurrent laryngeal nerve.

Posteriorly it is related to the common carotid artery and the parathyroid glands. The isthmus connects the lower 1/3 of the lateral lobes at the level of 2^{nd} and 3^{rd} tracheal rings.

Anteriorly, it is covered by skin, fascia and sternothyroid muscle. The inferior thyroid veins are its lower border and the communicating artery between right and left thyroid lobes superiorly.

Arterial blood Supply

- Superior thyroid arteries (2)
- Inferior thyroid arteries (2)
- Thyroidea ima artery

Venous drainage

- Superior/middle thyroid veins
- Inferior thyroid which drains to the brachiocephalic vein

Lymphatic drainage

The thyroid has a rich network of lymphatic channels. Lymph drains primarily into mediastinal nodes inferiorly, tracheo-oesophageal nodes laterally and midline Delphian nodes superiorly.

Studies performed following injection of a dye suggest that majority of lymph from the thyroid gland return to thoracic duct without passing through deep cervical lymph nodes chains or the nodes of posterior triangle of the neck. Secondary drainage zone may open up in malignancy. These include occipital nodes, superficial lateral, supraclavicular and deep cervical nodes.[29]

Development of the thyroid

It develops from two distinct sources;

- The branchial arch and
- The neural crest.

The median pharyngeal down growth migrates between 1st and 2nd arch components of the branchial arch at the tongue and descends in caudal direction from the foramen caecum, at the back of the tongue to its anatomical position passing ventrally to the hyoid bone. The track usually obliterates but parts may persist as thyroglossal cyst or fistula. The descent may fail leading to ectopic thyroid. When there is over descent the primary mediastinal or retrosternal thyroid results. It may fail to divide into two and appear as one unilateral lobe. When this happens the left is usually absent.

Parafollicular or C-cells which are of neural crest origin, first migrate to ultimobrachial bodies of the 4th and 5th branchial pouches then to the thyroid[29,30,31].
The cells may transform into calcitonin-producing in medullary carcinoma of the thyroid.

Solitary thyroid nodule

Solitary nodule in the thyroid usually raises concern because of the possibility of malignancy. Studies show that 4-7% of USA population have palpable thyroid nodule, but clinical evidence of cancers of the thyroid are rare[1,2,6,7]. Annual incidence of thyroid cancer in USA is approximately 25-35 per million accounting for about 0.4% of cancer deaths[3].

Prevalence of nodule in children is reported between 0.22-1.5% and increases annually at an annual rate of 0.08%[2 J]. The thyroid nodule prevalence increases five times in persons exposed to ionizing radiation.

It follows that of palpable nodules 1-2 per 1000 are cancers. Surgical clinical report 20-30% of solitary thyroid nodules is malignant. The general conclusion is that thyroid nodules are common but thyroid cancer is very rare[4,6,7,8].

Careful individual assessment to pick out the minority with cancers is important. Short of histological studies there are no certain methods of differentiating benign from malignant neoplasms. About 50% of apparent solitary thyroid nodules prove to be dominant nodules of multinodular goitre. On pathological examination of the true solitary nodules 70-80% are adenomas, 10-20% are cancers and the rest are cysts, foci of thyroiditis or areas of fibrosis[4,15-31]. Current diagnostic approaches vary with varied reliability.

Pathology of the thyroid can be divided into;

- Benign

- Malignant

Benign thyroid nodules

Adenoma

Virtually all adenomas present as solitary discrete small nodules less than 4 cm in diameter.

Classification of adenomas remains unsettled. However, on histological grounds a variety of patterns are seen that resemble embryogenesis stages hence are classified as:

- Foetal
- Embryonal
- Simple
- Colloid[2731]

However, all contain follicles in variable proportions and sizes hence at times referred to as follicular adenomas, (micro or macrofollicular). Uncommon variants have branching papillary protruding into microcystic spaces, such lesions being referred to as papillary cystadenomas. Another lesion is the so-called Hurthle cell adenoma. The large cells usually arranged in trabecular pattern. Thus histologically six types are recognized and classified as:

- Simple
- Colloid (macrofollicular)
- Microfollicular
- Trabecular
- Hurthle cell
- Atypical

Principal importance of adenomas is its clinical differentiation from cancers. Adenomas may;

- Increase in size and cause pressure symptoms
- Achieve a certain size and plateau
- Enlarge suddenly and become painful secondary to intra-lesional haemorrhage but rarely hyperfunction. Most adenomas are cold nodules. Tendency to transform to malignant lesions is doubtful.

Other benign tumors

These include;

- Degenerative cyst
- Dermoid cyst lipomas
- Haemangiomas
- Teratomas

Thyroid malignancy

Classification of thyroid malignancy:

- Papillary carcinoma 60-70%
- Follicular carcinoma 20-25%
- Medullary carcinoma 5-10%
- Undifferentiated carcinoma i o%

Epidermal carcinoma	< 1 %
Others	< 1 %

Papillary carcinoma

Accounts for between 60 and 70% of thyroid cancers. Previously referred to as papillary adenoma. More than half contain a mixture of follicular elements. Majority of papillary carcinomas are indolent with good prognosis.

It is the most common thyroid cancer and accounts for 80% of malignancies in persons under 40 years[27].

The tumor usually presents as a painless, incidental lump in the neck and rarely large enough to cause pressure symptoms. Most remain occult and the first sign of disease is metastatic enlargement of a cervical lymphnode[22, 23]. The tumor may also metastasise hematogenously to bone and lungs. Others may progressively enlarge and rarely give disfiguring masses, dysphagia, dysphonia or dyspnoea.

In one series, Tocholl-Ducommun et al[22] while analyzing a large series found;

- 40% of lesions had spread beyond the capsule at the time of diagnosis
- 40% had metastasized to cervical lymph nodes
- 10% had metastasized widely to the lungs.

In another study, Tubiana M et al found that 20% of children had pulmonary metastasis at diagnosis[23].

Overall, 70-80% of patients survive at least 10 years. However, the prognosis is dependent upon;

- Extra thyroid extension
- Degree of differentiation
- Male gender over 45years
- Duration of tumor (highly malignant tumors arise from previously low-grade lesions)

Relapses tend to occur 20-40 years after initial management of children with papillary carcinoma[27].

Follicular carcinoma

This accounts for 25% of thyroid cancer. It is the more aggressive cancer. Histological differences from papillary carcinoma include the absence of ground-glass nuclei, well-formed papillae and psammoma bodies[j1].

Follicular cancer occurs more often in females than males and peaks in the 5th and 6,n decades. It carries a mortality rate of up to 70% at 5 years[12].

Clinically, follicular carcinoma presents either as a solitary enlarging thyroid nodule or more often an irregular, firm nodular thyroid enlargement. The mass enlarges more rapidly than papillary carcinoma though at a slower pace.

Metastasis is hematogenous to the lungs, bones and other distant sites[15,24].

Prognosis is heavily dependent on stage of neoplasm at diagnosis and response to thyroid suppression hormone therapy.

Medullary carcinoma

This accounts for 5-10% of thyroid cancer. Derived from parafollicular C cells (cells of neurocrest origin) within the thyroid gland. Its outstanding features are;

- Elaboration of calcitonin and other peptides
- Genetic association
- Amyloid stroma[25,30]

10-15% encountered in children have a genetic association and are transmitted by autosomal dominant pattern. Chromosome number 10 has highly been implicated[25]. 80-90% of medullary carcinoma secretes calcitonin and this can be used as a screening test. Other peptides that may be secreted include somatostatin, gastrin releasing peptide (GRP), histamine, prostaglandins, serotonin and ACTH, which may present a variety of clinical pictures[25,31].

Undifferentiated carcinoma

This accounts for 10-15% of thyroid cancers and usually occurs beyond the 7th decade. They are notoriously aggressive[31]. At presentation they have usually invaded large areas of the thyroid. Histologically, they fall into two main groups;

- Small cell carcinoma
- Giant cell carcinoma

The small cell carcinoma is thought to be a variant of a lymphoma[19,21,34,35] whereas the giant cell carcinoma is an anaplastic highly invasive carcinoma.

Other tumors

Lymphoma may involve the thyroid gland as a primary or secondary tumor. The mean age of involvement is 60-70 years and the female to male ratio is 3:1. Hashimoto's thyroiditis may precede the development of thyroid lymphoma in some cases[5].

Other more rare tumors include;

- Fibrosarcoma
- Haemangiosarcoma
- Osteogenic sarcoma
- Squamous cell carcinoma

Since 1935, the overall incidence of thyroid cancer has tripled[1 3]. Irradiation during childhood has incurred the greatest risk[7, 13]. 4-9% of individuals have a history of childhood irradiation developed thyroid cancer after a mean latent period of 20 years. High risk is particularly secondary to high doses of radiation at young age[4].

80% of children who develop thyroid cancers have had exposure to radiation. Among the Japanese, 6.7% of individuals who survived the exposure to the atomic bomb have developed cancer of the thyroid[3, 19,20]. More recent nuclear accidents e.g. Chernobyl, Mile island and North seas raises concern[21 •31]. The only dubious comfort stems from the fact that most tumors are papillary or follicular and not anaplastic. There is no current evidence to incriminate cancer development in radio iodine or scintiscans used in management of thyroid conditions.

Clinical staging of thyroid cancer

Stage I Intra thyroidal lesion

Stage II Lacks fixation to surrounding structures but with movable cervical metastasis

Stage III With local fixation or fixed to cervical nodes

Stage IV Cancer with distant metastasis.

Whereas staging is important in order to estimate prognosis, the histological type is of much greater significance. Types in order of worsening prognosis are;

- Papillary carcinoma
- Follicular carcinoma
- Medullary carcinoma
- Anaplastic carcinoma.

Evaluation of the thyroid nodule

Factors to be considered in determining the need for further workup include sex, age, and family history of patient, history of lesion, history of neck irradiation, physical characteristics of the gland, local symptoms and laboratory evaluation.

Conditions to consider

- Adenoma
- Cyst
- Cancer
- Multinodular goitre
- Subacute thyroiditis

Effects of prior operation or iodine-131 treatment

- Metastasis
- Thyroid hemiagenesis
- Parathyroid cyst or adenoma
- Thyroglossal cyst
- Non-thyroid lesions

Inflammatory or neoplastic nodes

- Cystic hygroma
- Aneurysm
- Bronchocele laryngocele

Clinical history of nodule

Age/Sex

It is an important consideration since the ratio of malignant: benign nodules is higher in youth[1]. Men carry a higher risk of malignancy[1, 3,6]. Nodules are less frequent in

men but higher percentage of them is malignant. Patients with MEN II syndrome have phaechromocytoma, medullary thyroid carcinomas, hyperparathyroidism and mucosal neoplasm.

Irradiation

Prior neck irradiation is a risk factor for thyroid malignancy[3]. An irradiation of >0.5 Gy to thyroid during the first 3-4 years of life has been associated with 1-7% incidence of thyroid cancer occurring in 20 years of life [3 7,9].

Because of high prevalence of 20-40% of cancer in nodules resected from irradiated glands the finding of a solitary thyroid nodule or more clear-cut nodules in irradiated gland or a cold one on scan requires consideration for removal. However, multiple lesions do not mean absence of malignancy.

Lump

History of lumps in the neck is important. Changes like sudden onset of hoarseness, rapid growth, pain, enlarged lymph nodes, brachial plexus symptoms and tenderness suggest malignancy. Sudden swellings and tenderness particularly in a nodule suggests haemorrhage into a benign lesion. Nodules that have not transformed over a long period of time suggest benign process rather than malignancy. Some malignancies however, grow slowly in 10-15 years.

Physical Examination

Solitary thyroid nodule is typically felt as a discrete neck lump in the thyroid gland. It moves with the gland. Associated primary and secondary adenopathy suggest malignant disease. Fixation of the nodule to the strap muscles and trachea also suggest malignancy.

Pain, tenderness, and rapid swelling of the nodule usually indicate haemorrhage into the nodule but can also be features of malignant transformation. Hoarseness may arise from pressure or by infiltration of the recurrent laryngeal nerve by the neoplasm. Usually fluctuance in the lesion suggests the presence of a cyst that is most likely benign but not always.

Diffuse multinodular gland ascertained on palpation or sonography usually can be interpreted as a sign of benign goiter. However, if one area within the multinodular goitre is distinctively different from the rest of the gland on the basis of palpation or demonstrates rapid growth then the possibility of malignancy rather than benign multinodular goitre needs to be considered. Although multinodularity reduces the risk of malignancy, malignancy can occur in multinodular goitre[16].

Apart from a nodule, thyroiditis is encountered in 14-20% of thyroid cancer specimen. It may be diffuse or focal[17].

Evaluation of the thyroid nodule

Tests of evaluation of Thyroid nodule include;

- Thyroid function tests
- Chest X-ray and neck X-ray
- Calcitonin test
- Ultrasound
- Isotope scans
- Fine Needle Aspiration Cytology (FNAC)

Thyroid function tests

Patients with solitary thyroid nodule are usually euthyroid. Normal levels of serum T_4 and TSH are evident. Low T_4 and TSH suggest thyroiditis. Serum thyroglobulin concentration may be elevated as in goitre and hence it is of no value in differential diagnosis of thyroid carcinoma[2,16].

Calcitonin Assay

Positive in medullary thyroid carcinoma, which constitutes 5-10% of thyroid malignancies, and even a smaller percentage of thyroid nodules. Routine screening would be invaluable in finding tumors early before metastasis but the cost is prohibitive for adoption as a routine laboratory screening tool[16].

Thyroid Ultrasonography

This accurately determines the volume, number and size of nodules. Under experienced hands and high resolution nodules of 3mm diameter can be demonstrated, cystic areas, capsule around nodules and the size of nodules can be visualized.

This technique is non-invasive, less time consuming and allows for serial examination. It is inexpensive and often displays the multiple nodules even when only one nodule is evident clinically.

Thyroid ultrasonography shows that 3-20% of lesions are found to be cystic. Pure cystic lesions have malignancy rate of 3% compared with 10% for solid lesions[11,12].

Isotope scanning

In the past scintiscan aided in differential diagnosis of thyroid lesions. The scan can provide evidence for a diagnosis in multinodular goitre and Hashimoto's thyroiditis. The chance of malignancy is low if the scan demonstrates a hyper functioning nodule suppressing the remainder of the gland and if the patient is thyrotoxic with low TSH, high T_4 and T_3. Malignant tumors usually fail to accumulate iodide to a degree equal to that of normal thyroid gland. Most cold nodules are benign adenomas and cysts rather than thyroid carcinoma.

Thyroid radioisotope scans classify thyroid nodules as cold, hot or warm. 85% of thyroid nodules are cold, 10% warm and 5% hot. 85% of cold nodules are benign, 90% of warm nodules are benign and 95% of hot nodules are benign[33]. Hence, even

though thyroid radio-isotope scans can describe the nodule as hot, cold or warm, it is not conclusive in defining the state of the nodule thus the management modality[1,2].

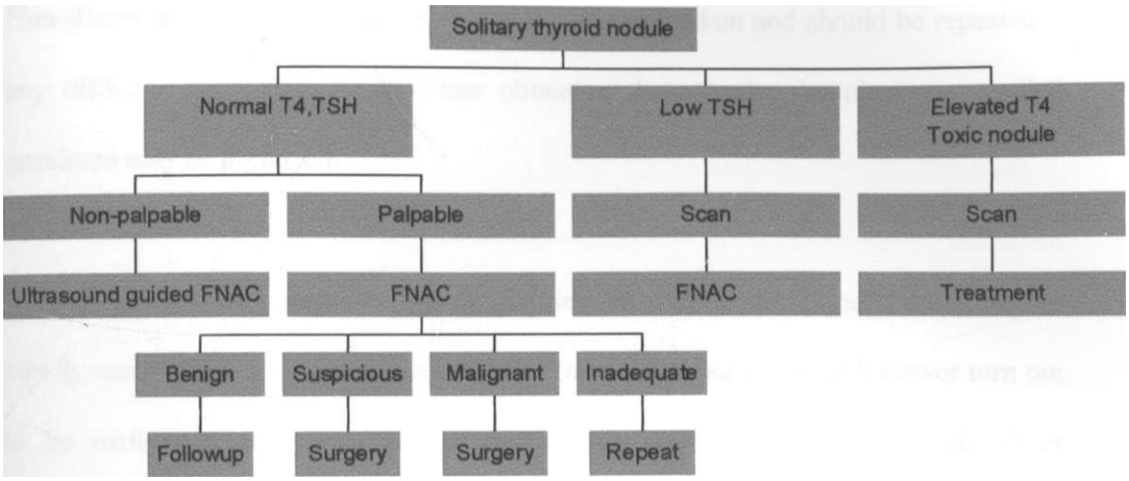
Reported incidence of carcinoma in cold nodules is highly variable. A review of 400 cases found 10% to be carcinoma[36]. The current scanning techniques cannot pick tumors smaller than 1cm diameter. Thus a nodule less than this will fail to collect radioactive iodine (cold nodule) and will not be delineated by scintiscan. Many nodules fail to turn out as cold or hot. The role of scintiscan is its value in demonstrating clearly toxic nodules only. It is not reliable predictor to determine whether a palpable thyroid nodule is malignant or benign[1,2,6].

Fine Needle Aspiration Cytology (FNAC)

Fine Needle Aspiration Cytology (FNAC) also referred to as Aspiration Biopsy Cytology, was first performed by an American surgeon Dr. Hayes Martin in 1920's[39]. Karolinska Institute in Sweden[29] promoted the procedure in 1940's. The procedure involves aspiration of masses using gauge 21-23 disposable needle connected to a lOcc air tight plastic syringe, local anaesthetic is not necessary. The skin is cleaned with an antiseptic. The mass is entered with the needle and a vacuum created in the syringe. The needle is moved back and forth several times within the mass as material is sucked into the needle by negative pressure. Before withdrawal, suction is released to avoid aspiration of material into the syringe barrel. Once withdrawn, the material in the needle barrel is forcefully ejected onto slides by a newly created negative pressure in the syringe. If the smear is thick it is evenly spread with the needle. The slide is immediately fixed with 95% ethyl alcohol or Clarke's fixature for at least 2 minutes. Delayed fixation results in cellular distortion. Once fixed, staining can be done immediately or within 2 weeks using Papanicolau or Haematoxylin and Eosin

staining methods. Once stained the slides are ready for interpretation by cytopathologists. The complete process can take as short as 30 minutes and can be an office procedure[1,8,14,17,38].

Algorithm for the investigation of solitary thyroid nodule



The **malignant** nodule can further be sub-classified as;

- Papillary
- Medullary
- Lymphoma
- Anaplastic
- Metastasis to the thyroid[4,5,8J2)33]

Follicular cancer and the Hurthle cell cancer cannot be diagnosed by Fine Needle Aspiration Cytology due to the fact that vascular invasion and membrane penetration cannot be assessed[14].

Benign nodules comprise the majority of solitary thyroid nodules and usually have benign follicular epithelium with variable amount of colloid.

Non-diagnostic nodules comprise 5-10% of aspirates taken and should be repeated if any difficulty was encountered when obtaining the sample. An ultrasound-guided specimen may be preferred.

Suspicious nodules comprise 10% of biopsies with the aspirated cells being neither clearly malignant nor benign. About 25% of these suspicious lesions however turn out to be malignant when patients undergo thyroid surgery. They are usually either follicular cancer or Hurthle cell cancer. Therefore, surgery is the recommended treatment for suspicious thyroid nodules[8,12].

Fine Needle Aspiration Cytology is the investigation of choice in the evaluation of confirmed solitary thyroid nodules. It is the only method that can help differentiate between malignant and benign lesions preoperatively[17]. Unlike ultrasound or thyroid radioisotope scans, Fine Needle Aspiration Cytology can help in making a conclusive management decision. It is cheap and hence reduces the cost of management of the solitary thyroid nodules. Adequate specimen can be obtained in >90% of patients when 2-3 slides are prepared for analysis.

In majority of cases it is minimally invasive. Several aspirates are obtained and are described and the nodule is then classified as:

- Malignant
- Benign
- Suspicious
- Non-diagnostic

Gharib et al analysed data on 10,000 Fine Needle Aspiration Cytology reports and found that procedure to be preferred first step diagnostic tool. It has a diagnostic accuracy of approximately 98% and less than 2% false positive and false negative[8]. A 5-8% of aspirates are diagnostic of malignancy. 10-20% are considered suspicious but not diagnostic. 2-5% fail to provide adequate specimen and the remainder are benign usually suggestive of thyroiditis. An inadequate specimen requires re-aspiration.

Fine Needle Aspiration Cytology of non-palpable or deep nodules can be performed under ultrasound guidance. Non-palpable thyroid nodules of less than 1cm diameter in size are usually malignant[9].

Patients with suspicious Fine Needle Aspiration Cytology findings should also undergo surgery since 25% prove at surgery to be malignant. Patients not undergoing surgery should be seen at six to twelve months intervals and examined for any signs of pain, growth, hoarseness or nodes that might indicate a transformation to malignancy. Another FNAC is performed after 2-3 years and again 5-8 years to document the benign nature of the lesion[9].

Erdogan et al investigated the outcome of re-aspiration of benign nodular thyroid disease in studies on **216** patients. **3** of the **216** had a diagnosis changed from benign to papillary carcinoma at the time of the second biopsy. The authors concluded that a second aspiration of clinically suspicious nodules can correct some initial false negative results but routine re-aspiration was not useful in clinically stable disease.

The degree of reliability of Fine Needle Aspiration Cytology in thyroid pathology shall open up its use in other pathologies and overall reduction in expenses incurred in more delicate and complicated investigations e.g. CT scan and MRI which currently when not financially prohibitive exerts enormous burden on available medical resources.

Justification of Study

In the background of escalating medical costs and devastating poverty in our environment, the medical fraternity is expected to continually provide adequate medical services without compromise on standards with the increasing population and diminishing funding.

The question that needs to be addressed at the end of the study will be the sensitivity and specificity of Fine Needle Aspiration Cytology in investigating the solitary thyroid nodule. The role of FNAC in the diagnosis of solid tumors and other pathological conditions would be an eye opener while setting up protocols for investigative procedures in our environment where majority of the patients live in abject poverty.

Thyroid nodular disease affects all people across the social spectra and whereas others have financial capacity to finance the investigative management of their condition others cannot even afford to finance their fare to a medical institution.

If found to be acceptably sensitive in the investigation for solitary thyroid nodule, then Fine Needle Aspiration Cytology shall not only be reasonably affordable to the majority but shall ensure the maintenance of high standards in the management of solitary thyroid nodule disease and by extension other accessible solid or cystic masses.

On average 1.3 patients have undergone thyroidectomy weekly in our surgical unit over the last seven months.

Objectives

Research question:

Should Fine Needle Aspiration Cytology (FNAC) be the ultimate investigative procedure of the solitary thyroid nodule at Kenyatta National Hospital?

Broad objectives

To describe the clinical presentation, FNAC results and compare with histological findings of solitary thyroid nodule disease as seen at Kenyatta National Hospital.

Specific objectives

1. To compare post-operative histological findings with FNAC in solitary thyroid nodule disease.
2. To determine the cytology findings associated with solitary thyroid nodule.

Materials and methods

Research Design

The research was exclusively carried out at Kenyatta National Hospital

It is a retrospective descriptive study that covered a period 5 years (Junl996- may 2001).

Study Population

184 patients, who presented to the unit with solitary thyroid nodule and had Fine Needle Aspiration Cytology preoperatively and had postoperative histology reports for excised tissues over the study period.

Study Methodology

A proposal for the study was submitted to the Kenyatta National Hospital Ethics and Research Committee. The committee approved the study in writing. This gave the principal investigator the green light to commence the study.

Names of eligible candidates for the study were retrieved from the operating theatres' daily procedure books over the study period. At the same time the cytopathologists* record books were perused at the pathology department. This facilitated the retrieval of patients' names that had had their tissue specimens analysed. Those whose tissue specimens had not been analysed were excluded from the study.

With the information obtained from the above sources the principal investigator went to Medical Records Department to retrieve the medical files of all the eligible patients. An access fee authorized by the hospital was paid prior to this.

A proforma questionnaire (Appendix 1) was used to retrieve information needed for the study from the files thus obtained. To further facilitate confidentiality of the information from the files most of the items on the questionnaire were coded.

All the files stayed in the Medical Records Department during the period of the study under the usual department's security details. All the work on the files was therefore carried out in the department's study room.

The patients' files that missed from the medical records were excluded from the study.

All the completed questionnaires were kept under lock and key only accessible to the principal investigator to ensure maintenance of confidentiality of the patients and their clinicians.

The following details were obtained from the files:

- Demographic data
- Presenting complaints
- Investigations performed
- FNAC findings
- Histological findings post-operatively

The study was concluded with the presentation of the obtained information for analysis.

All the files used were handed over to the person assigned those duties in the department.

Ethical Issues

The Kenyatta National Hospital Ethics and Research Committee's permission was sought at the proposal stage and obtained in writing.

All information obtained from the patients was treated with confidentiality and only used for the intended purpose.

All questionnaires used were coded by serial numbers and bore no patient's name.

Eligibility

Inclusions

All patients who presented with solitary thyroid nodule and underwent FNAC and thyroid surgery at KNH during the study period.

Exclusions

All patients whose files were missing.

All patients' who had FNAC but no histology reports.

All patients' who had no FNAC report but had histology reports.

Study Limitations

Being a retrospective study the principal investigator relied entirely on someone else for history taking and the physical examination and also histology reporting.

Some information was incomplete from some files.

Varied expertise was available for the obtaining of especially the FNAC samples.

Varied expertise was available for the reporting of the FNAC and histology samples over the 5year period and ranged from senior house officers to senior consultants.

Data Management and Analysis

All data obtained from the medical records was entered into a proforma questionnaire and stored safely until the time of analysis.

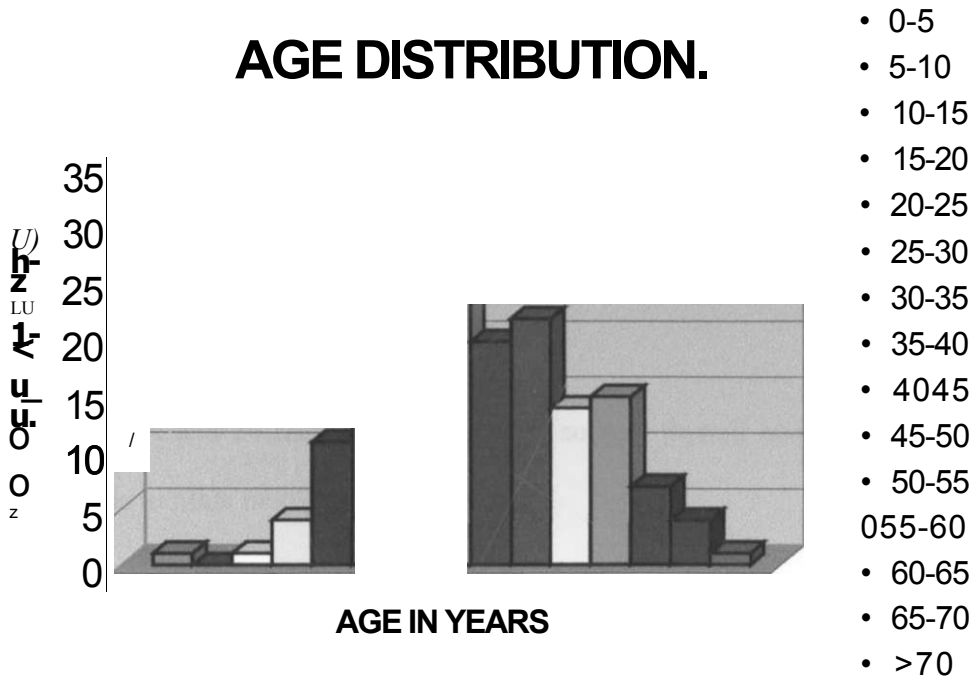
At analysis each item in the questionnaire was separately analysed using the tally method.

The age groups of 5year intervals were set up and all the 184 patients in the study appropriately classified. Gender separation was also done and presented as results ol the study.

Different data presentation methods were used for all the study parameters and presented in the results.

Results

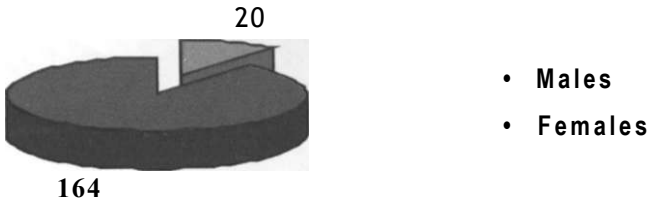
FIGURE 1.



The mean age was 38.5 years with 70% (127) of the patients falling in the 25 - 50 year range (Fig I). Children under 15 years were a minority 1.1% (2).

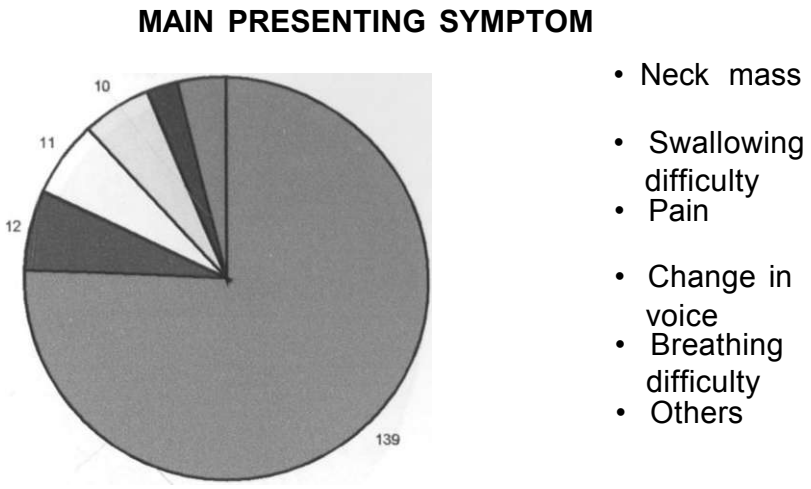
FIGURE 3.

SEX DISTRIBUTION.



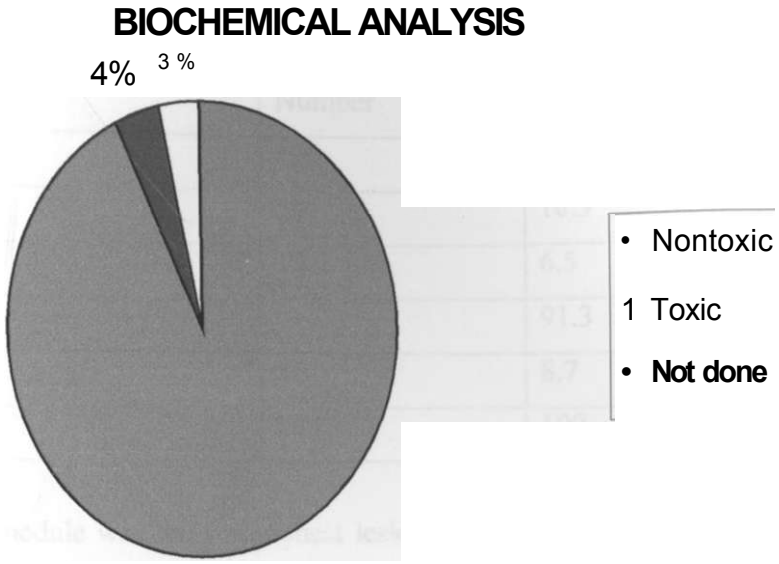
There were 164 Females and 20 males presenting with solitary thyroid nodule. (Fig 2). This gives a Female to Male ratio of 8:1.

FIGURE 3.



75.5% (139) of the patients presented with a neck mass as the main presenting complaint to the clinician. 6.5% (12) with swallowing difficulty. Pain, change in voice and breathing difficulty constituted 6%, 5.4% and 2.7% respectively. (Figure 3).

FIGURE 3.



Biochemical analysis showed that 92.4% (170) of the patients with solitary thyroid nodule were euthyroid, 3.8% (7) had toxic nodular nodules and a further 3.3 (6) had no biochemical analysis performed (Figure 4).

1

SPECIAL INVESTIGATIONS REQUESTED.

a) Ultrasonography

TABLE 1 Ultrasonographic Findings

Nature of nodule		Number	Percentage
Solid		126	68.5
Cystic		30	16.3
Mixed		12	6.5
	Total		91.3
(Not done)		16	8.7
Grand Total		184	100

Solid solitary thyroid nodule was the commonest lesion observed on ultrasonography 68.5% (126) Cystic and mixed pattern nodules constituted 16.3% and 6.5% respectively. This investigation was not performed in 8.7% of the patients,(Table 1)

b) Radionuclide scanning

TABLE 2

	No .of patients	**Nature**	**No. of patients**	**Percentage**
Requested	29	Hot	2	1.1
		Cold	27	14.8
Not requested	155			84.2

All 29 patients undergoing Radionuclide scan except one had ultrasound report. 93.1% (27) turned out to have cold nodules and 6.9% (2) were hot nodules. The one with no ultrasound report had a cold nodule. (Table 2)

Only one patient had CT scan as an investigative procedure.

TABLE 3

Fine Needle Aspiration Cytology Reports

Report		**Total Number**	**Percentage**	
Mixed Follicular Benign lesions				
	Simple Adenoma	87	47.3	
	Colloid	48	26.1	
	Atypical	2	3.5	
	Others	16	8.7	
Malignant				
	Papillary	2	1.1	
				84.2%
Suspicious				
	Follicular Lesion	9	4.9	
	Equivocal	13	7.1	12.0%
Inadequate sample		7	3.8	3.8%
Total		184	100	100%

FNAC was conclusive in 84.2% (155) of the patients and inconclusive in 15.8% (29) of which 12% (22) were suspicious lesions and 3.8% (7) had inadequate sample. Majority of the nodules were adenomas with very low malignancy rate at final needle aspiration cytology - 1.1% mainly papillary- no follicular carcinoma was picked at fine needle aspiration cytology (Table 3).

TABLE 3

Histological reports.

Histology	Number	Percentage
Trabecular/ Macrofollicular adenoma	131	71.2
Haemorrhagic degenerative	15	8.2
Follicular carcinoma	6	3.2
Hashimotos	5	2.7
Papillary carcinoma	3	1.6
Oncocytoma	1	0.01
Others	23	12.5
Total	184	100

Postoperative histology reports showed that (71.2%) 131 of the thyroid nodules were adenomas and 5.4% (10) showed malignancy. Most cystic lesions turned out to be haemorrhage degenerative cysts. Follicular neoplasms were more than the papillary carcinoma by a ratio of 2:1. Auto-immune thyroiditis (Hashimotos) presented as solitary thyroid nodule in 2.7% (5) of the patients (Table 4).

TABLE 3

Analysis of the ten cases with malignant thyroid disease

Age (yrs)	Sex	U/S findings	Radionuclide scan	Diagnostic FNAC	Suspicious FNAC	FNAC not diagnostic	Tumor type
4.5	F	Solid	-	Y	N	N	Oncocytoma
18	F	Solid	-	Y	N	N	Papillary
42	F	Solid	-	N	Y	N	Papillary
54	F	Solid	-	Y	N	N	Papillary
64	F	Solid	-	N	Y	N	Follicular
57	F	Solid	-	N	N	Y	Follicular
75	F	Solid	-	N	N	N	Follicular
52	F	-	Cold		Y	N	Follicular
54	F	Solid	-	Y	N	N	Follicular
54	F	Solid	-	N	N	N	Follicular

Six of the malignant Solitary Thyroid Nodule, 60% were follicular, 4 (40%) were papillary and 1 (10%) oncocytoma. All 10 malignant masses except I were solid on ultrasonography, the one exception was a cold mass on radionuclide scan. One follicular lesion was not suspected to be malignant on fine needle aspiration cytology. 2 out of 3 turned out to be follicular carcinomas (Table 5).

TABLE 3

Summary of results of FNAC

	No of patients	**Percentage**
True positives	155	84.2
True negatives	3	1.6
False positives	6	3.3
False negatives	20	10.9
Total	184	100

There were 155 true positives, 6 false positive, 20 false negative, and 3 true negatives.

(Table 6)

Discussion

Over the 5- year period from June 1996 to May 2001 a total of 184 patients with solitary thyroid nodules were patients were excluded for various reasons involved in the study. All of them had preoperative Fine Needle Aspiration cytology (FNAC) and post lobectomy histology.

Age and Sex Distribution

The mean age was 38.5 years (range 4.5 to 75 years). 127 (70%) falling between the ages of 25 and 50years. Only 2 (1.1%) were children aged below 15 years (Figure 1). Above 15 years the number of patients with solitary thyroid nodule increased steadily to peak at 35-40 years. Thereafter there was a decline. There was a plateau distribution between the ages of 40 and 60 years giving a fairly non-uniform distribution. Above 60 years the number of patients declined steadily, the eldest being 75 years (Figure 1). The age distribution pattern showed thyroid nodular disease as a condition of the middle aged in the study population. The condition affected mainly females, 164 females as opposed to 20 males. Giving a female: male ratio of 8:1 (Figure 2). The biased distribution seems to suggest that certain female factors played a significant role in the aetiology of solitary thyroid nodules. This is maximally seen between the ages of 18 years and 50 years, a period that, coincides with the female reproductive period. The study, however, did not explore the relationship between having solitary thyroid nodule and other factors such as fertility, social status, patient's weight, stature, profession nor hormonal manipulation as in family planning but certainly a strong relationship exists between having a solitary thyroid nodule and being a female of reproductive age.

D'Adrea et al[53], undertook a prospective study involving 30 patients. The aim of his study was to compare preoperative, intra-operative and definitive histological findings. In his study D'Adrea found a mean age of 49 years with a range of 27-68

years and a female: male ratio of 5: 1(26 females and 4 males). In comparison with this study, the age difference was found to be significantly different, ($p>0.07$). The gender difference was however not significant ($p < 0.001$).

In a Canadian study by Bartos et al [73] with 20 patients all of them females the mean age was 52 years with a range of 18-76 years, compared with this study there was a significant age difference ($p > 0.072$).

The age difference can probably be explained by the fact that the populations under study are different in terms of geographical location and have different socio-economic backgrounds and life expectancy. However, the gender pattern is similar irrespective of the location of the study.

In the study population, patients presenting with malignant thyroid nodule had a mean age of 47.4 years. All the malignant solitary thyroid nodules were in females. The mean age of patients with malignancy was higher than the study mean of 38.5 years, an indication that chances of malignancy in a solitary thyroid nodules increases with increasing age(Figure 1). The fact that all were females does not however mean that males do not develop malignant solitary thyroid nodules.

According to studies done by Tocholl-Ducommun[22]and Tubiana[27] malignancy in solitary thyroid nodules occurred frequently between the 6th and 7th decade. In their studies, papillary malignancy was the commonest. It accounted for 60-70% of all thyroid cancers in persons below 40 years. It affected females more than males a ratio of 6: 1. Their findings concur with those of this study but differ on tumour type present. The commonest cancer type in this study was follicular carcinoma. This could be explained by the fact that follicular carcinomas are commoner in endemic goitre areas than papillary carcinomas[29]. The areas covered by this study include areas of endemic goitre.

All the 3 studies have a common conclusion that solitary thyroid nodule is not a condition seen in childhood but rather a condition that presents in middle age affecting mainly females, irrespective of the geographical or socio-economic state. The elderly females have higher chances of malignancy in the nodule[6].

Presentation

A neck mass was the commonest presenting symptom. 75% of the patients studied presented with a neck mass as the main single complaint (Figure 3). The masses varied in size, from those that were very large, disfiguring the neck to those that could only be appreciated on palpation and /or special imaging. The neck masses also varied in shapes and consistency. The character of the neck mass coupled with the anatomical location of the thyroid gland led to other forms of presentation. These included pain 6%, swallowing disturbance 6.5%, change in voice 5.4% and breathing difficulty 2.7% (Figure 3). A 75year old female patient presented with severe respiratory distress. She had been on herbal medicine for a period of 20 years for the management of a neck swelling that had over the period increased in size. The mass turned out to be a follicular carcinoma on histology. The mass had been exerting pressure on the airway.

The neck mass being the main presenting complaint in the study was not unexpected. This is because the anterior neck, the site of the thyroid, is exposed and hence swelling get noticed fairly early by patients or their relatives. Even those who presented with other complaints usually had noticed the mass but chose to ignore it until other symptoms occurred. These were primarily due to pressure effects of the mass. Those who presented with pain, tended to be of acute onset. It could have been as a result of acute haemorrhage within an already existing thyroid nodule'[5]. Jayarama and co-workers [4Q] in a study involving 1835 patients reported neck mass as the main presenting complaint in 70% of the patients. Change of voice and airway obstruction followed in that order. The difference was insignificant in comparison

with this study ($p < 0.001$). A similar finding is reported by Fauci et al[24] whose study indicated that over 80% of solitary thyroid nodules presented as a neck mass.

The main presenting complaint other than the neck mass was important in determining the malignancy status of the solitary thyroid nodules. The patients with malignancy tended to present with either pressure symptoms or alteration of voice. This was seen in 6 out of the 10 patients with malignancy. 3 had breathing difficulty, 2 had change of voice and 1 difficulty in swallowing. Patients who presented with these symptoms were those who had a long history of a neck mass or a mass that had been rapidly increasing in size. The duration of symptoms was however, not recorded in this study.

Thyroid Function Tests

96.7% of the patients with solitary thyroid nodule were subjected to thyroid function tests. The assumption was that any changes noticed would be attributed to the presence of the solitary thyroid nodule in the gland. T3 and T_4 levels were the factors tested. Patients were considered to be toxic if the levels were high, and euthyroid if they fell within the normal range. The normal range for T3 is (l-2.6nmo!/L) and for T_4 is (10-27pgmol/L). In this study 92.4% (171) of the patients turned out to be euthyroid whereas 3.8% (7) were considered toxic. 3.8% (7) of the study population did not have the tests done (Figure 4). The findings were comparable with those obtained by Van Herle et al[16] and Thomas et al[28] in their studies. Both studies undertaken in USA showed more than 87% of the patients presenting with solitary thyroid nodule to be euthyroid.

According to Thomas et al[28], the solitary thyroid nodule that was associated with toxicity was indeed a dominant nodule in a multinodular goitre[4,31,5<)]. In this study 3 of the 7 (42.9%) hot nodules turned out to be dominant nodules in a multinodular goitre at histology.

The activity of the gland whether euthyroid or toxic did not have any bearing on whether the nodule was malignant or benign. One patient with toxic nodule turned out to have malignancy while the rest were euthyroid.

Special Investigations

Other special investigations available for further evaluation of the thyroid nodule included ultrasonography radionuclide scanning and CT scanning. The usage rates in this study of these specialized investigations were 91%, 16% and 0.6% respectively (Table 1 and Table 2). The choice of investigation used was left to the discretion of the attending clinician

Ultrasonography

Majority of the patients 91.3% had ultrasonography done after thyroid function tests. Ultrasonography was used as an adjunctive investigation to confirm the presence of solitary thyroid nodule. With ultrasonography various characteristics of the nodules were reported. These included the consistency of the nodule, volume, number, size and the lobe of the thyroid gland affected. Only the consistency of the nodule was reported by all ultrasonographists. The other characteristics were not consistently reported. This study has not taken them into consideration, particularly the size of the nodule as measured by ultrasound and hence what bearing it has on outcome - relationship between the size of nodule and probability of having cancer.

In this study 68.5% of the patients had solid nodules, 16% had cystic nodules and 6.5% had mixed (cystic and solid) nodules on ultrasound (Table 1). This compared with studies by Van Harle et al[4] who reported 80% of the nodules as solid and 10% as cystic. Rosai et al[44] reported 85% of the nodules as solid in consistency ($p<0.001$). All the compared studies concurred on the fact that most solitary thyroid nodules present as solid masses on ultrasonography.

9 out of 10 of the solitary thyroid nodules that were malignant in the study were of solid consistency on ultrasonography. None of the malignant nodules in the study

were cystic. Hippi et al" and Erdogan et al[12] in their studies found 3% of pure cystic solitary thyroid nodules malignant as opposed to 10% of solid thyroid nodules. However, it is generally accepted that malignancies are rare in cystic nodules and tend to be papillary when they occur[36 37].

Isotope Scanning

Radionucleoid studies were not requested by majority of the clinicians. Only 29 (15.9%) of the patients in this study underwent this procedure.27 (93.1%) of them had cold thyroid nodules and 2 (6.9%) hot nodules. The small number of requests for this procedure emphasizes its declining role in investigation of solitary thyroid nodules. CT scan was requested for only one patient with a retro-sternal solitary thyroid nodule.

Fine Needle Aspiration Cytology

Many investigators have shown that Fine Needle Aspiration Cytology is the single most sensitive, specific and cost effective method in the investigation of solitary thyroid nodules[40,46,54,69]. The role of FNAC has been to aid in selection for surgery of nodules that have a high probability of malignancy. Therefore, FNAC has taken a centre stage as a screening rather than diagnostic procedure. Surgical excision of nodules and cytological classification still remains the ultimate gold standard of diagnosis.

The accuracy of FNAC is influenced by many factors. The most crucial diagnostic pitfall is in obtaining a satisfactory specimen, a sample that is representative of the thyroid nodule. For a sample to be considered adequate at least 4 to 6 groups of follicular epithelial cells should be present, if not, a large amount of colloid should be present with assurance of experienced aspirator that the specimen has been taken from the lesion.

In this study the final histological diagnosis obtained from excised thyroid tissues was taken as the ultimate diagnosis. The assumption was that no errors of diagnosis were

committed as histopathological diagnosis from paraffin sections is usually easy for a trained histopathologist to interpret. This was compared to the FNAC results obtained prior to surgery.

The FNAC report was considered diagnostic if the two reports had a conclusion that tallied. On comparing the results of FNAC and the post-operative histopathological findings, 84.3% of the results tallied. This indicates that FNAC obtained an accuracy of 84.3% preoperatively where as 12% were considered inconclusive, meaning that they could not be placed in either of the two categories of benign or malignant

83.2% were benign follicular lesions on FNAC. Adenomas and colloid lesions were the majority of these lesions being 73.4%. The rest were classified as others and included infiltrative lymphocytosis or Hashimotos disease, cystic lesions with heamorrhage and one case of oncocytoma . Papillary carcinomas were 1.1%. same as Atypical. 3.8% had inadequate samples.(Table 3).

12% of the lesions reported as suspicious at FNAC were further analysed after sub dividing into two, one group of suspicious follicular lesions (9patients) and the other equivocal (13patients). In the suspicious follicular group 4patients turned out to have follicular carcinoma at post-operative histology, the other 5 patients turned out to have follicular adenomas. In the equivocal group of 13 patients, 9 were reported as having degenerative heamorrhagic tissues with varied levels of colloid, however no malignancy was confirmed. 2 patients had follicular carcinoma as the final diagnosis, 1 patient had normal thyroid tissues and the other was reported not to have thyroid tissues in the specimen provided for analysis.(Table 3).

The resultant breakdown showed that 155 of the patients had FNAC report that concurred with post operative findings, 15 patients had result of FNAC that were suspicious of malignancy but turned out not to contain malignant cells, 6 patients with suspicious FNAC findings for malignancy turned out be malignant at post-operative

histology, 3 patients had their diagnosis not changed they still remained inconclusive. In this study they were not placed in either of the two groups.

Suen[40], and Hawkins[41] and co-workers reported FNAC to have an accuracy of 70 to 80% and suspicious rates of 10 to 20%. In their studies adenomas were the commonest finding and amounted to over 80% of the total solitary thyroid nodules studied. Their findings compared well with those of this study ($p < 0.002$).

Gharib and co-workers, while analyzing data on 10,000 FNAC found out that the procedure is the preferred first step diagnostic tool in the management of solitary thyroid nodules. He had a diagnostic accuracy of 98% and less than 2% false positives and false negatives, in comparison with this study it was found to be statistically significantly different, ($p > 0.07$). The findings of his study has not been reproduced by other workers. It may be possible though to reach a high accuracy level where individuals working in the field of study are very few in number and are highly trained in their specialized areas.

Many workers including Suen et al[40], Aversa et al[72] and Hawkins[41] agree that on average 10-20% of FNAC findings are considered suspicious these are aspirates which are neither clearly benign nor malignant. When these suspected nodules are subjected to surgery it is found that upto 25% of them are malignant. The malignancy most commonly encountered in the suspected nodules is follicular type and at times Hurthle cell cancer, rarely papillary cell cancer may be encountered[8,12]. In this study 24 samples of FNAC were found to be suspicious of which 6 turned out to be follicular carcinoma. This represented 25% of the suspiciously reported samples. There was neither Hurthle cell cancer nor papillary carcinomas The conclusion, here is that lesions that have suspicious FNAC results need close follow-up. Where surgery is not offered as a first option.

Histological Reports

Post operative histological findings showed majority of the conditions subjected to surgery to be benign adenomas 71.2%, heamorrhagic degenerative lesions 8.2%, Hashimotos 2.7%, Follicular carcinoma 3.2%, Papillary 1.6%, Oncocytoma 0.01% and others were 12.5%. The later were mainly cystic lesions, but some lesions were reported as predominant nodules in a multinodular goitre. In the post-operative analysis there were no medullary cancers, lymphomas or anaplastic tumors .The malignant nodules in this study postoperatively were 10 (5.4%). These were mainly follicular (60%), followed by papillary (30%) and the rest (10%) oncocytoma.

These findings do not concur with literature available in textbooks that report papillary carcinoma as the commonest tumor of the thyroid associated with solitary thyroid nodule[27]. However, they agree with the findings of Tayarama et al[49] of Malaysia who reviewed 1853 cases between 1992 and 1997 at Kuala Lumpar University and found nodular goitre as the commonest lesion needled (67.35%) and among the lesion, follicular neoplasms were 64% and papillary 29.4%.

Statistically there were 155 true positives, 6 false positive, 20 false negative, and 3 true negatives (table 6). On the basis of the obtained data the diagnostic accuracy of FNAC was 84.3% sensitivity of 82.4% and specificity of 78%. The results were comparable to those of Aversa et al[7'] who between 1989 and 1998 carried out FNAC on 1250 subjects and obtained an accuracy of 88.5% specificity of 86.7% and sensitivity of 89% Aversa from his findings suggested that FNAC was the most reliable technique for the diagnosis of thyroid lesions particularly neoplasms.

On the basis of the above data FNAC on solitary thyroid nodule management at Kenyatta National Hospital gave a diagnostic accuracy of 84.3% and sensitivity of 82.4%. These figures are in agreement with studies done in other institutions that have adopted the procedure[40,41,49,73]. Therefore, it's use in screening of solitary thyroid

nodules should be adopted. With frequent and continuous use its accuracy should improve.

Conclusion.

On the basis of the data collected and analysed, the conclusion is

- Solitary thyroid nodule is commonly a condition afflicting females of middle age.
- The commonest single presentation for solitary thyroid nodule is a neck mass.
- Malignancy rate for solitary thyroid nodule is at 5.4%.
- Follicular carcinoma is commoner than papillary carcinoma in Kenyatta National Hospital.
- Fine Needle Aspiration Cytology as a screening tool is still the most reliable available technique for diagnosis of thyroid neoplasms.

Recommendation.

1. A protocol should be formulated and availed to personnel managing solitary thyroid nodule, special attention should be paid on the sequence of investigation.
2. All nodules reported as suspicious on Fine Needle Aspiration Cytology requires close follow-up. Surgery is recommended where close follow up is not feasible.
3. Investigators undertaking fine needle aspiration cytology should be kept at most three to improve on diagnostic accuracy this being an operator dependent procedure.
4. Fine Needle Aspiration Cytology is recommended for all solitary thyroid nodules as an investigative tool.

Appendix

Questionnaire:

Demographic Data

A: Study Number_

Age_____years

Sex- male____Female_____male 01 female 02

Occupation

Residence

B: Presenting complaint code 0 no 1 yes

Neck mass

Pains

Change of voice

Swallowing difficulty

Breathing difficulty

- Others

C: Investigations

- Full haemogram, urea /electrolytes
  - Normal 01 Low 02 High 03

Thyroid function tests - T_3

T_4

TSH

Ultra sound Cyst

Nodule

CT scan

- MRI
- Radionucleoid scan hot

  Cold

D: FNAC Report

Mixed follicular neoplasm

Simple adenoma

Colloid (macrofollicular)

Hurthle cell

Atypical

Malignant

Papillary

Anaplastic

Lymphomas

Medullary

Suspicious

Equivocal

Follicular

E: Histology Report 0 no 1 yes

Follicular

Papillary

Trabecular adenoma

Microfollicular adenoma

Anaplastic

	Medullary
	Lymphoma
Fine Needle Aspirate Cytology	Diagnostic
	Non-diagnostic
	Equivocal

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