

CHARACTERIZATION OF RADIOIMMUNOASSAY AND SCINTIGRAPHY AS DIAGNOSTIC TOOLS FOR GOITER IN SUDANESE PATIENTS

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Abstract: *Thyroid scintigraphy using Tc-99m pertechnetate in addition to the hormonal measurement are the most common procedures used routinely in nuclear medicine. This study aimed to assess the value of nuclear medicine (NM) and thyroid function test (TFT) in the diagnosis of thyroid goiter in Sudan. The subjects of this study were the patients referred to the department of nuclear medicine at radio isotope center Khartoum (RICK) for thyroid function test and thyroid scan in the period from January 2007 to December 2010 were included in this study. Out of the 600 patients were studied 87(14%) were males and 513(86%) were females. Simple sensitive RIA was used for the measurement of thyroid related hormones (T4, T3 and TSH), and gamma camera for scintigraphy. The results showed that the goiter in most patients was grade (1) 390 (65%). ^{99m}Tc distribution was homogeneous in 54%. 23% showed nodules. 57% had a regular shape. 49% showed diffuse uptake and (1%) had diffuse goiter extending to supra sternal notch (SSN), no correlation was found between thyroid volume and thyroid related hormones. Thyroid volume was higher in males than females. Uses of RIA scintigraphy together could help to obtain accurate results, demonstrate any anatomical variation and pathological changes. The palpation alone, especially in the adolescent age, is not suitable in detection of early goitre development.*

Keywords: *Thyroid, Goitre, Nuclear Medicine, Radioimmunoassay*

INTRODUCTION

Thyroid disorders affect a wide spectrum of population in Sudan. Numerous imaging modalities, including nuclear medicine, ultrasonography, X-ray fluorescence (XRF), computerized tomography (CT) and magnetic resonance imaging (MRI), have been used in an attempt to provide a pathophysiologically related diagnosis in patients with different diseases of the thyroid (Sharp, et al 2005)

For most patients with thyroid disease, the combination of skilled physical examination, thyroid function, fine needle aspiration biopsy, and scintigraphy provide the most cost-effective means of evaluating the thyroid gland

and its diseases (Nusynowitz et al ,1999) Measurement of urine iodine concentration gives insight into iodine intake and determine its role as the most common on factor in goiter etiology .

A suppressed serum thyroid stimulating hormone TSH concentration is the earliest biochemical manifestation of hyperthyroidism (Wu and Weiss, 2006)

The primary indication for a scan in the case of euthyroid nodular goiter with a low or suppressed TSH level, when autonomous toxic nodule is suspected Sarkar, (2006).Autonomously functioning thyroid nodules appear "hot" on scintigraphy because they selectively concentrate radionuclide to a greater extent than the remaining thyroid gland, which is controlled by the normal T4-TSH feedback mechanism.

Thyroid scan and uptake may be used to distinguish between different causes of hyperthyroidism. Scintigraphic characteristics also help in differentiation between nodular and Graves' disease. Scintigraphy combined with ultrasound examination may be used to identify the underline cause of congenital hypothyroidism such as thyroid agenesis, dysmorphogenesis, and incomplete thyroid descent(Intenzo et al 1993) Moreover, ultrasound distinguishes cystic form solid thyroid cold nodule,

The scintigraphic findings in Hashimoto's thyroiditis are highly variable and can mimic any thyroid abnormality and most of its pattern is diffusely enlarged thyroid gland similar to toxic diffuse goiter(Afschrift1990). Less common forms of thyroiditis include Riedel's struma, which is characterized by extensive fibrosis of the thyroid gland, and acute suppurative thyroiditis, which is a bacterial infection(. Konig et al 1975)

Thyroid scan can determine the retrosternal extension of a huge goiter. The cervico-thoracic CT-scan is the key examination for the assessment of a retrosternal goitre making it possible to appreciate its features, anatomic relations and tracheal involvement⁷.

MATERIALS AND METHODS

This study was conducted in Nuclear Medicine Department, Radiation and Isotope Center of Khartoum (RICK) from 2007 to 2010.

A total of 600 patients 87(14%) were males and 513(86%) were females and the average age of the patients studied was 30 years. The peak incidence was among the age between 15-30 years of age presenting the percent of (54.13%) referred to the department for thyroid scan from January 2007 to December 2010 were included in this study, correlated with thyroid function tests.

The scintigraphies were all obtained by using Nucline gamma camera computer system (planer and dual head whole body SPECT) with general purpose collimators made in Hungary.

Generator UltraTechnoKow ® FM DRN 432999Mo/ 99mTc Generator Composition (elute) 99Mo content < 25 Bq/MBq 99mTc.

Specifications are within the guidelines described by monographs of the U.S.A. and the European Pharmacopoeia PH 5.0 – 7.0 ,10-20 minutes after intravenous injection of 37-111MBq of sodium pertechnetateTc 99m.

All radioimmunoassay specific reagents for the measurement of thyroid hormones were obtained from China Institute for Atomic Energy (CIAE), Department of Isotopes (Beijing China).

RESULTS AND DISCUSSION

The majority of patients studied were females **513**(86%), while males represent the **87**(14%).The average age of the patients studied was 30 years. Maximum prevalence of goiter was occurred in patients aged between 15-30 years of age presenting the percent of (54.13%).The majority of patients studied were married (73. %), while (27%) were single. Table (1) shows the distribution of patients according to their residence so majority of patients studied were from Khartoum state (33%), Centre (32%), and West (22%), North (8%), South (3%) and

East (2%). Around one half of population were found to have family history of goiter.,the results of goiter size showed that 42 patients had grade(0)(7%),grade(1) goiters in 390 patients(65 %),), while 168 patients (28 %) presents with grade(2) figure (1) and table(2)

The thyroid related hormones(T3,T4and TSH) were found to be normal in the vast of the patients

Results of the TC^{99m} scan yield the following details Tc^{99m} was homogeneously distributed in (54%) of the patients scanned.

Thyroid gland was found to be regularly shaped in (57%) of the patients, while different irregularity were detected in the rest of the patients .138 out of the patients Tc^{99m} scan detected the presence of a nodule from them 90 patients (15%) were had cold uptake scans, 48 patients (8%) had hot uptake scans.

Tc^{99m} examination confirmed diffuse goitre in 294 patients (49%), nodular goitre in 150 patients (25%), multinodular goitre extending to supra sternal notch in 96 patients (16%), solitary thyroid nodule in 30 patients (5%), simple goitre (2.5%), Multi nodular goitre (1.5%) and Diffuse goitre extending to SSN in 6 patients(1.0%) (Table 3)

The first step in evaluating a patient with suspected thyroid disease is to correlate the findings of Scintigraphic pattern with available biochemical data, clinical history, and physical examination(Smith and Oates 2004).

As the best screening tests for thyroid status hypo- or hyperthyroidism the diagnosis of hypothyroidism is confirmed by a high serum TSH and low values of thyroid hormones(FT4 and T3)while hyperthyroidism is confirmed by low serum TSH value and elevated thyroid hormones(Afschrift 1990) those related to the level of circulating thyroid hormones, thyroid radionuclide uptake tests have lost much of their diagnostic value (Konig ,1975) Thus, taking the scan and radionuclide in isolation, the diagnosis can be misleading and should be evaluated in conjunction with current biochemical analysis particularly in thyroiditis(Kambal Ali ,1986),. In this study all have thyroid function test results during scan reporting

The majority of the sample were females 513 patients in this study yielding percentage of 86 this is in agree with what is found by Elgizouli Elgizouli. 1987) In the adolescent and child bearing age group (i.e. less than 15 years of age 13%) of the sample under study and the age group below 30 years (54%) showed a high rate of some pattern of thyroid gland disorders. This is true since pregnancy, lactation and other stressful stimuli increase the demand for iodine and hence goitre formation specially when iodine supplies are inadequate this is in agreement with what is found by Elzaki(Elzaki,2006)

The most effected age group were young female this goes with line with what was reptred(Elmadani et al 2009).

The majorities of patient were married (73%) and showed a high rate of some pattern of thyroid gland disorders. This is true since pregnancy, lactation and other stressful stimuli increase the demand for iodine and hence goitre formation if the iodine supplies are inadequate

The results of this study showed that (33%) of the patients from Khartoum State Those from Central region constituted (32%) of the patients, Kordofan and Darfur (western Sudan), being known endemic areas of goitre were presented by (22%) of our patients. 52 patients reported from the north region incidence rate of (8 %). Only 16 patients reported from the south region incidence of (3%) and Only 10 patients reported from the east region incidence of (2 %) this is in agreement with what is found

this ratio reflect the actual population intensities of those areas since Khartoum has the heaviest population followed the central region of the country last consent 2008

The majority of these patients were from Khartoum State (33%).

In this study geographical distribution of the patients may not reflect the actual prevalence of the thyroid diseases in the Sudan because some areas were known to be endemic goiter It is very difficult to the patients from these areas to reach the Center because of political conflicts. On the other hand, some may have started their lives in areas and moved recently to the other part where iodine found sufficiency in different and the high incidence of Khartoum state (33%) is due to immigration from the rural areas to the capital center during the last decades .

In this study patients showed a normal range of thyroxine T₄, Triiodothyronine T₃ and TSH hormone levels were normal in more than 90% the same results were reported by a number of investigators It is true since Sudan is considered to be and endemic area of goitre with mild alteration on the thyroid gland hormones levels ,so that the goiter does not effected the thyroid hormonal function this is in agreement with what is found (Medani,2010)

It has been found that (49%) of the scans were diffuse goitre. (25 %) were nodular goitre forming about 150 patients. 96 patients were multi nodular goitre extending to supra sternal notch forming the incidence of (16 %). The solitary thyroid nodule was reported to form the incidence of (5 %) only among the series patients of 600.

It has been found that (49%) of thyroid scans are diffused goitre referring to an enlargement of the thyroid that is not associated with functional,. this agree with previous findings .

In the case of euthyroid nodular goiter, fine-needle aspiration is the most accurate initial test to evaluate for malignancy.

Tindall' 1987) and his group also concluded that thyroid scintigraphy was an unnecessary investigation in approximately 45% of cases. In all cases of goiter no additional useful information was obtained from scintigraphy. Its primary role was in the investigation of the solitary nodule and in detecting toxic nodules in thyrotoxic patients who had no evidence of Graves' disease. Greater discrimination of requests would avoid investigating patients unnecessarily and reduce costs' The same observation were noted by Demena

Preoperative thyroid isotope scan would influence the operative procedure and the preoperative management in patients with nontoxic goiter only if it raises suspicion of malignancy. However, the scintigraphy shows significantly lower sensitivity and specificity in the detection and prediction of malignant nodules in the thyroid gland(Mann, et al 1997)

The study revealed that 30 patients (5%) had solitary thyroid nodules. We suggested fine needle aspiration cytology to rule out the possibility of malignancy in those patients . Although physical examination, thyroid scan, fine-needle aspiration biopsy and measurement of serum thyroglobulin are helpful in the management of solitary thyroid nodule, fine-needle biopsy remains the best single cost effective method. When cytologic examination shows malignancy or unspecified neoplasm, surgery is recommended. For most patients with cytologically benign lesions, careful follow-up will suffice(Christensen et al 1994)

Ultrasound proved to be especially valuable for differentiating between solid and cystic nodules. This is of practical importance because exclusively cystic nodules are most likely benign and may be treated by thin needle puncture with aspiration of the cyst fluid. Differentiating between benign and malignant solid nodules was not possible with ultrasound, however(Thijs et al 1976) In addition, ultrasonically guided percutaneous fine needle biopsy is employed for emptying cysts or gaining material for cytological examination(Petzoldt 1975) Hence adding ultrasound to the fine needle aspiration cytology (FNAC) technique will help in pinpoint in affected cyst and hence improve its specificity, accuracy and positive predictive value.

CONCLUSION

The vast majority of patients in this study were young females with normal thyroid function test. No more particular information gained when the patient is detected clinically and biochemically to have goiter. Nodular goiter is also common pattern.

Khartoum has the highest incidence in all types of thyroid disorder (33percent).

There is no significant association between thyroid hormone levels and goitre prevalence. The use of various diagnostic modalities together help to obtain accurate results especially in the adolescent age. The palpation is not sensitive method in detection of early developed goiter. There is strong relationship between thyroid gland nodules and goitre size , Thyroid scan should be requested only for selected patients because the radiation hazards and cost. NM should be considered in detecting goiter because it offers information about functional status in spite of its high dose.

Establish another NM department to reduce the time waiting to the patients.

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Table 1: shows Geographical area Distribution

Residence	F	%
Khartoum	200	33
center	190	32
west	132	22
north	52	8
south	16	3
east	10	2

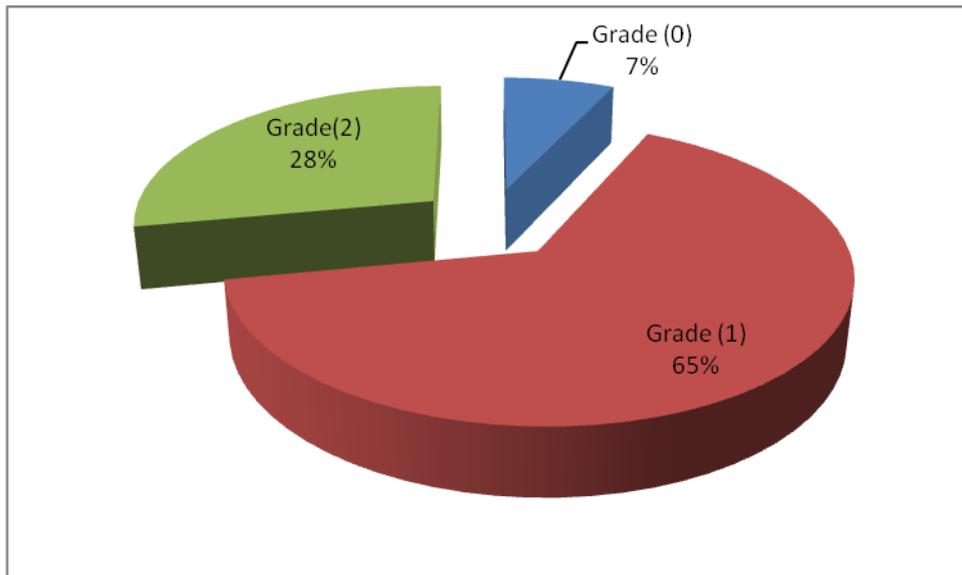


Figure 1: Grade of goiter

Table 2: WHO simplified classification of goiter^(.Alnagar ,1996)

Grade 0:	No palpable or visible goitre.
Grade 1:	A mass in the neck that is consistent with an enlarged thyroid that is palpable but not visible when the neck is in the normal position. It moves upward in the neck as the subject swallows. Nodular alteration (s) can occur even when the thyroid is not visibly enlarged.
Grade 2:	A swelling in the neck that is visible when the neck is in a normal position and is consistent with an enlarged thyroid when the neck is palpated.

Table 3: Thyroid pattern on Tc^{99m}

Thyroid pattern on Tc ^{99m} scan	No	%
Diffuse goiter	294	49
Nodular goiter	150	25
MNG extending to supra sternal notch	96	16
Solitary thyroid nodule	30	5
Simple goiter	15	3
Multi nodular goiter	12	2
Diffuse goitre extending to SSN	6	1