

EVALUATION OF NORMAL HOMOGENOUS THYROID UPTAKE BY USING TC^{99M}

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Abstract: *Thyroid uptake and scintigraphy using 99mTc-pertechnetate has proven to be more advantageous than with 131I-iodide, since the images have better quality, the procedure is faster and the patient is submitted to a lower radiation dose. This study aimed to determine the normal values for 99mTc- pertechnetate uptake, , measure the thyroid volume for patients with homogenous distribution of radiotracer & normal thyroid function test (T.F.T).A total of 100 patients', 85 women and 15 men, with ages ranging from 18to 60 years with homogenous distribution of the radiotracer in the result of uptake and normal thyroid function test (T.F.T), were investigated via thyroid uptake were studied in Radiation and Isotopes of Khartoum- (RICK) by using scintillation gamma camera (Nucline™ SPIRIT DH-V, Variable Angle Dual-Head Digital Gamma Camera for SPECT, equipped with a parallel hole collimator and Tc99m pertechnetate. The laboratory assessment of thyroid function consisted of serum dosages of ultra-sensitive thyroxin and thyrotrophin. 15minutes after an intravenous injection of 4.0 mCi of 99mTc-pertechnetate, the images were obtained.*

The result of this study showed that All the individuals were euthyroid both on clinical and laboratory evaluation, high incidence of thyroid disorder was among the ages of 22-38 year, thyroid uptake increases with increasing of thyroid size The correlation could be fitted in the following equation: $y=0.59x+2.7$ where x refers to thyroid volume and y refers to uptake in percent, uptake of thyroid decrease by increasing patient weight in inverse relation and correlation could be fitted in the following equation: $y=0.33x+6.07$ where x refers to patient weight in Kg and y refers to up take in percent ,the uptake of thyroid gland for patient with normal thyroid function test (T.F.T) and homogeneous distribution of the radiotracer is in the range of 0.4% to 4.5%. The assessment of thyroid structure and function using 99mTc-pertechnetate is a simple, fast and efficient method, which could easily become a part of the routine studies in nuclear medicine laboratories.

Keywords: *Thyroid. Scintigraphy. Thyroid Uptake. [99mTc] pertechnetate, Homogenous*

INTRODUCTION

Thyroid gland is one of the important glands in human bodies that by playing great role in hormone function by producing thyroxin and tri iodothyronin (T3 & T4).

The iodine trapping by thyroid is known in the nuclear medicine investigation by (Thyroid Uptake) (Brucer, 1989). Concerning the high incidence of thyroid disease, the normal range for thyroid hormones level and thyroid uptake have not been established yet for the Sudanese population. The suboptimum level of thyroid dysfunction could lead to some diseases or other pathological states in the human bodies such as (hyperthyroidism, hypothyroidism, thyrotoxicosis, thyroiditis ... etc) (Bracer, 1989). The thyroid gland function depend on the presence of iodine content in the blood, which is a form of minerals and like other chemicals content of the soil is affected by the climate and location. The main supply of the iodine for the thyroid gland is the food (fish as main) and water which is ultimately depend on the iodine content of the soil and water as the soil component and composition vary from area to another (Bracer, 1989). An interpretation of the TSH level depends upon the level of thyroid hormone; therefore, the TSH is usually used in combination with other thyroid tests such as the T4 RIA and T3 RIA (Bracer, 1989). A means of measuring thyroid function is to measure how much iodine is taken up by the thyroid gland (RAI uptake). Remember, cells of the thyroid normally absorb iodine from our blood stream (obtained from foods we eat) and use it to make thyroid hormone (described on our thyroid function page). Hypothyroid patients usually take up too little iodine and hyperthyroid patients take up too much iodine. The test is performed by giving a dose of radioactive iodine on an empty stomach. The iodine is concentrated in the thyroid gland or excreted in the urine over the next few hours. The amount of iodine that goes into the thyroid gland can be measured by a "Thyroid Uptake". Of course, patients who are taking thyroid medication will not take up as much iodine in their thyroid gland because their own thyroid gland is turned off and is not functioning. At other times the gland will concentrate iodine normally but will be unable to convert the iodine into thyroid hormone; therefore, interpretation of the iodine uptake is usually done in conjunction with blood tests (Berman, 1988) Here in Sudan especially in Radiation and Isotopes Center – Khartoum & Elnelain Medical Center the huge number of thyroid dysfunction cases that referred for assessment of normal uptake which is varies among Sudanese native based on their residence areas. Also in contrast with the European level (0.4 – 4.0%) Cameron.et (1992) there is some differences.

This study aimed to determine the normal range of the thyroid uptake, measure the thyroid volume for patients with homogenous distribution of radiotracer & normal thyroid function test (T.F.T).

METHODOLOGY

This study was conducted in Nuclear Medicine Department, Radiation and Isotope Center of Khartoum (RICK). A total of 100 patients 15 (15%) were males and 85(85%) were females their age ranged from 18-60 years referred to the department for thyroid scan using Nucline gamma camera computer system (planer and dual head whole body SPECT) with general purpose collimators made in Hungary. Generator UltraTechneKow ® 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). patients were prepared according to RICK protocol as the following points: Patient should stop thyroid medication for will before the investigation, prevent from any iodinated contrast media, stop taking any food contain iodine,

female will be inspected if she is pregnancy, the patient will return to there physicians. In case of breast feeding, the patient will be asked to stop feeing for awhile until the radioactive substance been excreted from the body, history of the patient and the clinical condition should be noted, related studies must be available, which is help full in diagnosis.

Technique of uptake:

The method for the calculation of thyroid uptake, based on images of the gland and syringe counts before and after radiopharmaceutical injection, was previously described by Maisey et al.¹² and simplified for routine use.⁷ The number of counts present in the thyroid (T) was determined by an automatic region of interest (ROI) drawn around the borders of the gland. Another ROI was drawn by the same process just below the gland for background subtraction (BG). The counts in the syringe before (B) and after (A) radiopharmaceutical injection were obtained directly from the images. All counts were corrected for the acquisition time and decay of

technetium-99m. The thyroid uptake (TU) was calculated according to the following equation:

$$TU = \frac{T - BG}{B - A}$$

The dose calibrator must be measure accurately before the injection of the radioactive dose and take a 60 seconds image of the full syringe in the gamma camera, then inject the dose of 4.0 mCi of $^{99m}\text{TcO}_4$ – for adult patient. After 60 seconds image for the empty syringe was taken; the patient waited for 15 minutes, for maximum concentration of sodium pertechnetate. Firstly 300 K. counts image AP was taken in supine position with pillow under the shoulder and chin hyper extended for good visualizations of thyroid gland; this image is used in calculation of thyroid uptake. If thyroid gland enlarged marker with point source ^{99m}Tc or ^{57}Co should be used in the subrasternal notch (S.S.N) to determine the extension of the gland. If there is suspicion of any disorder in the first image, additional images (RAO, LAO) should be done, or by using the marker in the location of abnormality, finally ROI was drawn around full syringe ,empty syringe and AP patient image, the computer program should automatically measured the actual activity injected to the patient by subtract the empty activity from the full, after that it can measure the thyroid uptake using special nuclear medicine program.

RESULTS

The result of this study showed that all the individuals were euthyroid both on clinical and laboratory evaluation. high incidence of thyroid disorder was among the ages of 22-38 year, thyroid uptake increases with increasing of thyroid size The correlation as following equation: $y = 0.59x + 2.7$ where x refers to thyroid volume and y refers to uptake in percent, uptake of thyroid decrease by increasing patient weight in inverse relation and correlation as the following equation: $y = 0.33x + 6.07$ where x refers to patient weight in Kg and y refers to up take in percent the uptake of thyroid gland for patient with normal thyroid function test (T.F.T) and homogeneous distribution of the radiotracer is in the range of 0.4% to 4.5%.

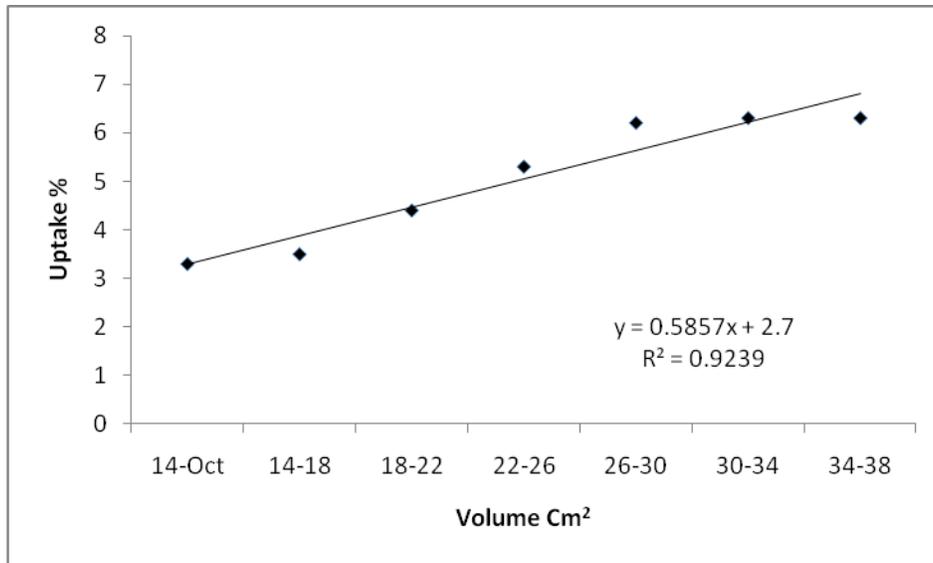


Figure 1: shows the relationship between the thyroid uptake and thyroid volume

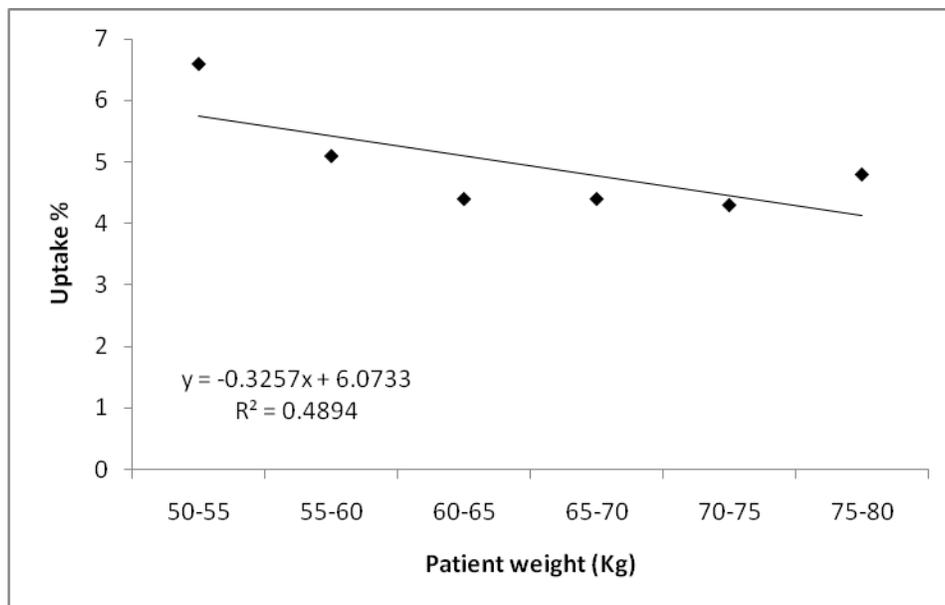


Figure 2: shows the relationship between the thyroid uptake and weight of the patients

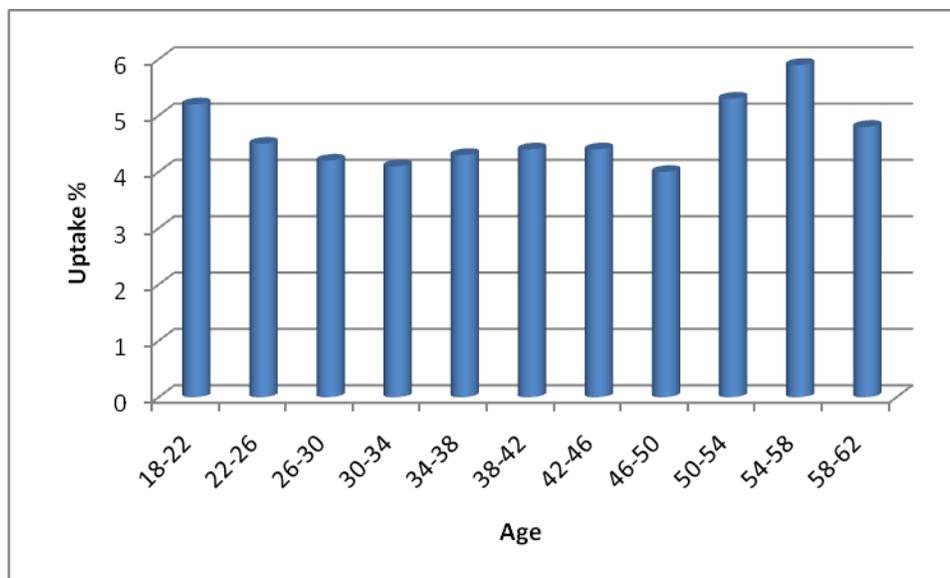


Figure 3: shows the relation between thyroid uptake and age of the patients

DISCUSSION

The radiopharmaceuticals currently chosen are ^{99m}Tc -pertechnetate has become the tracer of choice, since it is readily available and has a low cost. Its uptake is similar to that of iodide, although ion organification is absent. (Andros et al 1965),(Smith et al, 1990). The maximum thyroid uptake of ^{99m}Tc -pertechnetate takes place 10 to 20 minutes after intravenous injection, in contrast to ^{131}I -iodide, which requires a 24-hour measurement period. Schneider (1979),(Selby et al(1979) The absolute ^{99m}Tc -pertechnetate uptake by the thyroid gland is low and ranges from 0.3 to 3.0%.13, The participants in this study 85% of the sample under study were female relative to 15% as male, the high incidence of thyroid problems among female expected due to hormones disturbance in female rather than male.

The high incidence group was among ranged from 22-38 year is due to thyroid hormone problem in the young patient and binding that with the activities which done in this level of age (Berman, 1988), Figure.1 shows the relationship between the thyroid uptake and the thyroid volume and it reveals that the thyroid uptake increases with increasing of thyroid size, because the enlargement of thyroid area which means a lot off trapping of iodine ion in human body (Berman, 1988). The correlation could be fitted in the following equation: $y = 0.59x + 2.7$ where x refers to thyroid volume and y refers to uptake in percent.

The data showed that: the uptake of thyroid decrease by increasing patient weight in inverse relation and correlation could be fitted in the following equation: $y = -0.33x + 6.07$ where x refers to patient weight in Kg and y refers to up take in percent. Such result is due to volume increases which in turn consume up with distribution the radioactive material as has been explain by Berman, (1988),Figure 3 shows the relation between thyroid uptake and age of the patients, that result in high uptake young patient in age between 18 -26 years and slightly stable (reasonable high and low) under fifty, then increase to be high again, The increasing of high uptake in age 18-26 years known area of changes in hormonal activity to be stable, then it becomes slightly stable till below 50 and after that go to increase (Berman, 1988).

Conclusion: Thyroid gland affected by the presence or absent of iodine, according to the amount of iodine in the body the gland cells can be depresses or enlargement. This situation of gland cells can be investigated with

thyroid uptake test which measure the amount of iodine trapped by thyroid cells ,the uptake of thyroid gland for patient with normal thyroid function test (T.F.T) and homogeneous distribution of the radiotracer is in the range of 0.4% to 4.5%. Further study should do with very larger sample to explain the normal range of thyroid uptake as well as to these result in thyroid with homogenous distribution of radiotracer. The dose of ^{99m}Tc must be accurately adjusted using Q.C passed dose calibrator with constant factor for radioactive decay. The dose also can be exceeded up to 4.0 mCi to evaluate the uptake. The distance between the patient head and gamma camera detector must be constant. The time between patient injection and imaging must be constant at 20min for all subject that may included in other studies. The simplicity and reproducibility of this methodology and the added advantages of low dosimetry, availability and low cost make ^{99m}Tc -pertechnetate the best option for thyroid scintigraphy and uptake studies

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