Assessment of Bone Mineral Density of Patient’s with Thyroid Disorder using Computed Tomography

Marvet E. I. Eltyeb\textsuperscript{1}, Suhaib Alameen\textsuperscript{1}, Mohammed F. N. Hammad\textsuperscript{1}, Abbas K. A. Ibrahim\textsuperscript{2}, Asma Alamin\textsuperscript{1}

\textsuperscript{1} College of Medical Radiological Science, Sudan University of Science and Technology, Khartoum, Sudan
\textsuperscript{2} AlRibat National University, College of Medical Radiological Science and Nuclear Medicine, Khartoum, Sudan

*Corresponding author: Marvet E. I. Eltyeb

ABSTRACT:
Study of bone mineral density of patients with thyroid disorders, was carried out in radiology department at Algazira state in Algazira Scan hospital, Wad Madani diagnostic advance, Shakrin diagnostic center and the patients sample was 100 patients whom investigation by CT scan.

And the results sows that the Osteoporosis was dominate in the female and Osteopenia almost same for male and female with frequency 11:10 respectively.

The calcium score gives us a good value of the bone density and the relation between the calcium score and the patients gender, where the male governs the higher score start from 7-8, and the female concentrate at the medium and low scores 3-6. Comparing of means to calcium score between the male and female, where the mean of male 5.70 was higher than the mean for female 6.56. linear regression equation shows that the relation between the age and cerium was decrease with value 0.002 for each year.

Recommended every patient with thyroid disorder may be undergo to CT scan examination to assess significant change in bone mineral density, every patient, such as patients on high dose of steroid medication, may need follow-up periodically by intervals of six months, CT scan modality should be introduced in the syllabus of the faculties of radiology and the post menopause female should takes estrogen to avoid decrease bone density.

Keyword: BMD, CT, Thyroid disorders, DEXA

I. INTRODUCTION
Bone density loss and increased risk for osteoporosis are a cause for concern in Hodgkin lymphoma (HL) patients, but there are no recommendations regarding identification and follow-up of patients at high risk. There is evidence of decreased bone mineral density in post-menopausal women with subclinical hyperthyroidism [1,2], but little evidence in men or pre-menopausal women. In a large cohort of post-menopausal women aged 65 years or older, there was a fourfold increased risk of vertebral fractures and threefold higher risk of occurrence of hip fracture in patients with serum TSH <0.1 0mIU/l [38]. In another study, of patients older than 65 years, the incidence of hip fracture was higher in men but not in women with subclinical hyperthyroidism than euthyroid patients [3].

Thyroid hormones (TH) affect bone metabolism and turnover, increasing the number of bone remodeling cycles, activating and increasing the number of osteoclasts and altering the relation between bone reabsorption and bone formation [4-7]. The disease is typically characterized by an age-related reduction in bone strength that predisposes affected individuals to low-energy fractures. Parathyroid hormone (PTH) is released by the parathyroid glands depending on serum calcium and its major action is to stimulate bone reabsorption through the osteoclasts [8].

Calcitonin (CT) is a hormone mainly produced by the parafollicular cells of the thyroid (C cells) and is a potent inhibitor of bone reabsorption; its secretion is stimulated by calcium. In hypothyroidism there is a lower CT reserve and its response to a hypercalcemic stimulus is significantly reduced [9], probably due to the destruction of (C cells) by the process of chronic thyroiditis. Hypothyroid patients, when starting hormonal replacement therapy, may present bone remodeling of high turnover owing to the action of TH.

CT scanning is widely used in diagnosis and prognosis for cancers. With the high resolution MDCT images, clinicians can obtain important information of BMD, trabecular microarchitectural and mechanical property, as an additional utility to clinical applications. Quantitative Computed Tomography (QCT) may serve as an alternative tool for bone sensitometry with the advantage that its results are independent of extraspinial...
Assessment of Bone Mineral Density of Patient’s with Thyroid Disorder using Computed Tomography

pathology, such as aortic calcifications [10–12]. QCT results in the spine have been found to be reproducible, and they are considered a prognostic factor for pathologic fractures [13,14]. Dual x-ray absorptiometry (DXA) is currently the standard for assessing bone mineral density (BMD) and has been correlated with fracture risk and treatment efficacy [15]. While useful for assessing osteopenia or osteoporosis [16], it is not without methodological limitations [17].

In fact, comparisons between QCT and DXA have shown that the former is better at identifying vertebral fractures [18]. However, the obligatory use of a reference standard and the image post-processing that is required, in addition to the increased cost and radiation dose, has set back the wide use of the method, in spite of its technical superiority.

The use of Hounsfield units (HUs) from CT scanning to assess regional BMD of the spine has recently been described [19]. Based on a defined scale of 0 for water and -1000 for air. Modern radiology imaging software programs allow this to be calculated from a region of interest (ROI) on CT scans without any additional cost or radiation exposure. Values are calculated based on the following formula: 

$$\text{HU} = \left( \frac{\mu - \mu_w}{\mu_w} \right) \times 1000$$

where \(\mu\) is defined as the linear x-ray attenuation coefficient of the selected voxel and \(\mu_w\) the attenuation coefficient of distilled water at room temperature and pressure.

The aim of this study to estimate the bone mineral density of patients that associated with thyroid disorder.

II. METHODOLOGY

The study was carried out in radiology department at Algaizira state in Algaizira Scan hospital, Wad Madani diagnostic advance, Shakrin diagnostic center and the patients sample was 100 patients whom investigation by CT scan. The machine model Toshiba and Siemens both with 16 slices.

Patient preparation

The patient is positioned supine and head – first for complete spine, and during the CT examination of lumber spine only, positioning the patient supine and feet first may improve comfort by limiting how much of the patient’s body enter the gantry.

T-Score and Z-score

T-score indicates the difference between the patient’s measured BMD and the ideal peak bone mass achieved by a young adult. If T-score is < -2.5 at the spine, hip, or forearm; the patient is classified as having osteoporosis. If T-score is between -2.5 and -1 at the spine, hip, or forearm; the patient is classified as having osteopenia. If T-score is >-1 the patient is classified as normal. Z-score indicates the difference between the patients’ measured BMD and the ideal peak bone mass achieved by aged-matched peers. Z-score cannot be used to diagnose osteoporosis. Indicate a need for further medical tests. (12)

III. RESULTS AND DISCUSSION

Osteopenia is a bone condition characterized by a decreased density of bone which leads to bone weakening and an increased risk of breaking a bone fracture. And this study tends to identify the role of CT scan in the diagnosis bone diseases and monitor the ability of CT scan in diagnostic of bones diseases with hypothyroidism.

### Table 1 Statistical parameters for all parameters

<table>
<thead>
<tr>
<th></th>
<th>Age</th>
<th>height</th>
<th>Weight</th>
<th>Serum Ca</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>63.16</td>
<td>163.04</td>
<td>68.14</td>
<td>6.064</td>
</tr>
<tr>
<td>Median</td>
<td>65.00</td>
<td>165.00</td>
<td>70.00</td>
<td>6.000</td>
</tr>
<tr>
<td>Minimum</td>
<td>29</td>
<td>145</td>
<td>40</td>
<td>3.8</td>
</tr>
<tr>
<td>Maximum</td>
<td>99</td>
<td>190</td>
<td>93</td>
<td>7.9</td>
</tr>
</tbody>
</table>

### Table 2. crosstabulation between the gender and Bone Mineral D for all patients:

<table>
<thead>
<tr>
<th>Gender</th>
<th>BMD T-score</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Osteoporosis</td>
<td>Osteopenia</td>
</tr>
<tr>
<td>Female</td>
<td>28</td>
<td>1</td>
</tr>
<tr>
<td>Male</td>
<td>11</td>
<td>10</td>
</tr>
<tr>
<td>Total</td>
<td>39</td>
<td>11</td>
</tr>
</tbody>
</table>
Table 3. Crosstabulation between the gender and calcium level for all patients:

<table>
<thead>
<tr>
<th>Serum Ca</th>
<th>Gender</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Female</td>
<td>Male</td>
</tr>
<tr>
<td>3-4</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>4.1-5</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>5.1-6</td>
<td>11</td>
<td>6</td>
</tr>
<tr>
<td>6.1-7</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>7.1-8</td>
<td>5</td>
<td>9</td>
</tr>
<tr>
<td>Total</td>
<td>29</td>
<td>21</td>
</tr>
</tbody>
</table>

Table 4. T-Test to compare the mean of Serum Ca for the patients according to their gender:

<table>
<thead>
<tr>
<th>Serum Ca</th>
<th>Gender</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Female</td>
<td>5.703</td>
<td>1.0608</td>
<td>.1970</td>
</tr>
<tr>
<td></td>
<td>Male</td>
<td>6.562</td>
<td>1.0072</td>
<td>.2198</td>
</tr>
</tbody>
</table>

IV. DISCUSSIONS

The statistical parameters showed as mean, median, standard deviation, minimum and maximum for all patient’s parameters, the age median was 65 years, and the mean ± standard deviation for the patients high 163.04±11.57 cm, for the patient’s weight and calcium score was 68.14±13.55 kg and 6.06±1.11. as shown in table 1.

Table 2. showed the difference between the patient’s gender measured the BMD and categorized to Osteoporosis and Osteopenia, where the Osteoporosis was dominate in the female and Osteopenia almost same for male and female with frequency 11:10 respectively.

The calcium score gives us a good value of the bone density and the relation between the calcium score and the patients gender, where the male governs the higher score start from 7-8, and the female concentrate at the medium and low scores 3-6 table 3.

Table 4. show compare of means to calcium score between the male and female, where the mean of male 5.70 was higher than the mean for female 6.56.
Assessment of Bone Mineral Density of Patient’s with Thyroid Disorder using Computed Tomography

Fig 1. A linear regression equation shows that the relation between the age and cerium was decrease with value 0.002 for each year every patient with thyroid disorder may be undergo to CT scan examination to assess significant change in bone mineral density, every patient, such as patients on high dose of steroid medication, may need follow-up periodically by intervals of six months. CT scan modality should be introduced in the syllabus of the faculties of radiology and the post menopause female should takes estrogen to avoid decrease bone density.

V. CONCLUSION

This study was carried out in radiology department at Algazira state in Algazira Scan hospital, Wad Madani diagnostic advance, Shakrin diagnostic center and the patients sample was 100 patients whom investigation by CT scan the Osteoporosis was dominate in the female and Osteopenia almost same for male and female with frequency 11:10 respectively.

The calcium score gives us a good value of the bone density and the relation between the calcium score and the patients gender, where the male governs the higher score start from 7-8, and the female concentrate at the medium and low scores 3-6.

Comparing of means to calcium score between the male and female, where the mean of male 5.70 was higher than the mean for female 6.56, linear regression equation shows that the relation between the age and cerium was decrease with value 0.002 for each year

Recommended every patient with thyroid disorder may be undergo to CT scan examination to assess significant change in bone mineral density, every patient, such as patients on high dose of steroid medication, may need follow-up periodically by intervals of six months. CT scan modality should be introduced in the syllabus of the faculties of radiology and the post menopause female should takes estrogen to avoid decrease bone density.

REFERENCES


*Corresponding author: Marvet E. I. Eltyeb
College of Medical Radiological Science, Sudan University of Science and Technology, Khartoum, Sudan