Role of Dual Energy X-ray Absorptiometry (DEXA) Scan in the Diagnosis of Chronic Low Back Pain – a Prospective Randomized Controlled Study in Osteoporotic Patients Hospitalized in a Tertiary Care Institute

Muzzafar ZAMAN\(^a\), Aliya SHAH\(^b\), Rikki SINGAL\(^a\), Altaf KIRMANI\(^c\), Abdul Rashid BHA\(^c\), Rajinder Pal SINGAL\(^d\), *

\(^a\)Department of General Surgery, Maharishi Markandeshwar Institute of Medical Sciences and Research (MMIMSR), Mullana, Ambala, 133207, Haryana, India

\(^b\)Department of Microbiology, MMIMSR, Mullana, Ambala, India

\(^c\)Department of Neurosurgery, Sheri Kashmir Institute of Medical Sciences (SKIMS), Srinagar, Jandk, India

\(^d\)Department of Orthopaedics, Maharishi Markandeshwar University Solan, Himacha Pradesh, India

**ABSTRACT**

Objectives: Osteoporosis is a skeletal disorder characterized by a decrease in bone mass, with accompanying microarchitectural damage that increases the risk of bone fracture. The aim of this study is to evaluate various risk factors for osteoporosis and the role of DEXA scan in diagnosing the problem in an earlier stage.

Materials and methods: About 100 patients who presented with complaint of low back pain in our outpatient department were studied and subjected to a DEXA scan.

Results: The age range of patients included in this study was between 35 and 70 years. Of all subjects, 85.10% (n=57) were females and 78.80% (n=26) males. The number of those with significant medical or surgical history was 31% (n=31). The anthropometric characteristics of the studied group included weight, height, and also BMI in kg/m\(^2\), which was 20.23, 21.06 in male subjects and 19.343, 20.42 in female ones.
INTRODUCTION

Osteoporosis is a skeletal disorder characterized by a reduction in bone mass, with accompanying microarchitectural damage that increases bone fragility and risk for fracture (1, 2). Low back pain is highly prevalent in osteoporotic patients and affects their quality of life. It is the most common skeletal disorder seen in orthopaedic clinical practice. Fracture is the clinical manifestation of osteoporosis, occurring particularly at the spine, hip and forearm. The incidence of fractures in the population is bimodal, with peaks in the young and very old people. Overall, the incidence of osteoporosis is higher in females than in males, with a male to female ratio of 1:4.

Vertebral fractures

These fractures are probably the most common type of osteoporotic fractures. The female to male ratio is estimated to range between 2:1 to 8:1 over a lifetime (3, 4).

The various risk factors for the development of osteoporosis can be categorized into non-modifiable (female sex, advanced age, dementia, personal history of fracture, family history of fracture in a first-degree relative) and potentially modifiable risk factors – cigarette smoking (5); early menopause; low calcium intake; vitamin D deficiency; sedentary life style (6).

Several conditions are associated with an increased risk of generalized osteoporosis in adults: hypogonadal states; endocrine disorders; nutritional and gastrointestinal disorders; haematological disorders; selected inherited disorders; certain drugs; immobilization, pregnancy.

Oxidative stress has been found to be an independent risk factor for osteoporosis. It has also been seen that increasing fat mass may not have a beneficial effect on bone mass (7).

Clinical features

Osteoporosis may either cause no symptoms at all or give rise to bone pain and low back pain. About 60% of women with compression fractures do not realize that they have had a fracture. Advanced cases suffer from deformities and alteration in spinal mechanics. The intervertebral disc erodes the surface of vertebrae making them concave, thus leading to a net shortening of the spine and the characteristic humped look and stoop referred to as dowagers hump. Most vertebral body fractures occur after slipping on a stair, lifting or jumping.

Principle of bone mass measurement techniques

Some of the commonly employed bone mass measurement techniques are radiographic absorptiometry techniques, which include single X-ray absorptiometry and dual energy X-ray absorptiometry (DEXA) (7). In DEXA scan there is a simultaneous measurement of X-rays with two different energies through the body, the main advantages including a shortened examination time, higher accuracy, precision of technique, and removal of errors due to source decay correction (8). The preferred anatomic site for DEXA measurement is the lumbar spine L1 to L4.

Who should receive a DEXA scan

1) High risk patients with:
   - untreated premature menopause
   - prolonged secondary amenorrhea
   - primary hypogonadism
   - chronic rheumatological disorders
   - BMI less than 19 kg/m²
2) People with X-ray evidence of osteopenia
3) Patients receiving or expected to receive steroids equivalent to 7.5 mg of prednisolone or more
4) Patients with primary hyperparathyroidism

Regarding DEXA measurements, the bone mineral density was 0.97±0.27 (0.48, 1.96) for males and 0.83±0.21(0.01, 1.60) for females, with a total of 0.88±0.24 (0.01, 1.96).

Conclusion: Low back pain is highly prevalent in postmenopausal women. DEXA is a widely accepted radiological tool used to detect osteoporotic changes in bones earlier, with a higher accuracy than plain radiographs of skeletal system. It is relatively cheap, needs no special preparation and involves less radiation hazard.

Keywords: osteoporosis, DEXA scan, fracture, low back pain.
MATERIALS AND METHODS

The present study was carried out in the Department of Neurosurgery in collaboration with radiodiagnosis and imaging SKIMS Srinagar, a tertiary care hospital in Kashmir valley that caters all the regions of Jammu, Kashmir and Ladakh. About 100 patients of both genders were included in this study that was carried out over a period of 28 months, from August 2006 to January 2009. The subjects came to the outpatient department of neurosurgery with chief complaints of low back pain. Analysis of records included their chief complaints, signs and symptoms, diagnostic investigations, and treatment modalities.

In patients presenting with chief complaints of low back pain, complete history was elucidated, and general physical and neurological examination was done. Various relevant investigations were carried out, including X-ray DL-spine, DEXA scan and CT (if required), apart from all routine blood investigations including serum calcium and PTH levels.

Inclusion criteria: patients of both genders, aged over 18 and under 75, with complaint of low back pain.

Exclusion criteria: patients’ age >75, presence of radiological documented lumbar disk or vertebral disease.

RESULTS

The total number of patients studied and evaluated was 100, out of which 33 were males and 67 females. Their age was in the range of 35-70 years (Table 1) (56.54±91). The total number of subjects who presented with severe low back pain was 83% (n=83) (Table 2), out of which 85.10% (n=57) were females and 78.80% (n=26) males. The number of patients with significant past medical or surgical history was 31% (n=31). Regarding demographic features of patients, the total number of patients from urban areas was 73% (n=73) and from rural areas 27% (n=27) (Table 3).

Regarding patients’ lifestyle characteristics, 72 (15 males and 57 females) out of 100 had sedentary habits. There were 19 (9 males and 10 females) moderate workers and 9 (9 males, no females) heavy workers (Table 4). Regarding menstrual characteristics, out of the 67 female

<table>
<thead>
<tr>
<th>Gender</th>
<th>Number</th>
<th>Mean age (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Males</td>
<td>33</td>
<td>57.79±7.73</td>
</tr>
<tr>
<td>Females</td>
<td>67</td>
<td>55.93±9.70</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>56.54±9.1</td>
</tr>
</tbody>
</table>

**TABLE 1.** Age of patients included in the study

<table>
<thead>
<tr>
<th>Presentation</th>
<th>Males</th>
<th>Females</th>
<th>Total</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Severe LBA</td>
<td>26</td>
<td>57</td>
<td>83</td>
<td>0.348 (NS)</td>
</tr>
<tr>
<td>Severe LBA with radiculopathy</td>
<td>7</td>
<td>6</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>Mild LBA with radiculopathy</td>
<td>0</td>
<td>4</td>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>

**TABLE 2.** Distribution of significant history amongst patients presenting with back pain

<table>
<thead>
<tr>
<th>Residence</th>
<th>Males</th>
<th>Females</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural</td>
<td>21</td>
<td>52</td>
<td>73</td>
</tr>
<tr>
<td>Urban</td>
<td>12</td>
<td>15</td>
<td>27</td>
</tr>
</tbody>
</table>

**TABLE 3.** Patients’ demographic features

<table>
<thead>
<tr>
<th>Lifestyle</th>
<th>Males</th>
<th>Females</th>
<th>Total</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sedentary</td>
<td>15</td>
<td>57</td>
<td>72</td>
<td>0.000 (sig)</td>
</tr>
<tr>
<td>Moderate worker</td>
<td>9</td>
<td>10</td>
<td>19</td>
<td></td>
</tr>
<tr>
<td>Heavy worker</td>
<td>9</td>
<td>0</td>
<td>9</td>
<td></td>
</tr>
</tbody>
</table>

**TABLE 4.** Lifestyle of the studied patients

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Males</th>
<th>Females</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight (kg)</td>
<td>50±3.25</td>
<td>46±4.2</td>
<td>0.000</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>156±3.05</td>
<td>152±4.8</td>
<td></td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>20.23,21.06</td>
<td>19.34,20.42</td>
<td></td>
</tr>
</tbody>
</table>

**TABLE 6.** Anthropometric measurements of the studied patients
patients, 22.4% (n=15) were non-menopausal women and 77.60% (n=52) menopausal women, with age at menopause 46.44±3.27 (35.50) and duration of menopause 13.54±6.38 (1.27) (Table 5).

The anthropometric characteristics of the studied group included weight, height, and BMI in kg/m², which was 20.23, 21.06 in males and 19.34, 20.42 in females (Table 6). Regarding DEXA, bone mineral density was 0.97±0.27 (0.48,1.96) in males and 0.83±0.21 (0.01,1.60) in females, with a total of 0.88±0.24 (0.01,1.96) (Table 7).

**DISCUSSION**

Our study on low back ache and osteoporosis was a prospective study conducted on 100 randomly selected patients with the chief complaint of low back pain, who attended the OPD of the Department of Neurosurgery, SKIMS, from August 2006 to January 2009.

Among these 100 patients, 67 were females and 33 males, with a 1:2.03 male to female ratio, which is comparable to the results obtained by Cooper and Kanji in 1992 (2:1 and 8:1, respectively). The total number of patients who presented in our OPD with chief complaints of low back pain only was 83, which is in agreement with the findings (66%) reported by Maria et al. in 2005, who conducted a study to evaluate the impact of osteoporosis on patients’ quality of life (10); the majority of patients belonged to urban areas (73%), while 27 were from rural areas. In 1985, Raphael et al. had also noticed a higher proportion of people with a sedentary lifestyle in urban areas, and suggested that the level of physical activity may modify the amount of bone loss in postmenopausal women with a sedentary lifestyle.

Out of 100 patients studied by us, 50% had a significant past medical and surgical history, including history of hysterectomy, hypothyroidism, and intake of antiepileptics. This was also suggested by Barrett et al. in 2008, whose study on a large cohort of postmenopausal women had sufficient power to identify 18 risk factors for osteoporosis (11). In our study, 73% out of 100 patients had a sedentary lifestyle and fewer were doing moderate to heavy work (p value =0.000, 0.000), as also suggested by the studies conducted by Raphael in 1985, and Mahmoud in 2007, on 429 men.

Out of 33 males, 19 were smokers and had a high incidence of osteoporosis, as also reported by Lorentzon (in 2006), who found that smoking in young men was associated with lower bone mineral density and reduced cortical thickness (p value = 0.000, 0.006). In the present study, male subjects had a BMI in the range of 20.23 to 21.06 and female ones in the range of 19.34 to 20.42. The results suggested that the BMI was inversely proportional to the bone mineral density (BMD). This was also found by Kofi Asomaning et al. in their cross sectional study conducted among a sample of women aged 50-84 years, from October 1998 to September 2000; the authors concluded that women with a low BMI are at increased risk of osteoporosis (12).

The number of menopausal women (77.60%) exceeded that of non-menopausal patients (22.40%) in the study group, which was comparable to the report of Jang et al., who found (in 2006) that the prevalence of osteoporosis in postmenopausal women increased with age from 46.3% in those aged 45-64 to 68.70% in those aged 75 and over. Lean body mass appeared to be a significant contributor. Also, the prevalence of osteoporosis with low back pain increased with the duration of menopause (13).
X-ray dorsolumbar spine of patients revealed that 72% of all subjects had osteopenia and the BMD in females was on lower side (0.01-1.60) as compared to males (0.48-1.96). In 2006, Singer et al. found that nearly half of all women and one quarter of all men aged over 50 would experience an osteoporosis related fracture during their lifetime (14). DEXA scan is one of the major tools used for detecting osteoporosis in postmenopausal women and older men at an early stage, as also reported by Singer and Potocchi (in 2006), who found that sensitivity, examination time, cost and radiation exposure to X-rays, CT scan and DEXA scan differ greatly, just as it has been concluded by the present study too.

CONCLUSION

Low back pain is highly prevalent in postmenopausal women with other risk factors. The various risk factors for osteoporosis and low back ache are smoking and medical diseases such as diabetes mellitus and thyroid disorders. DEXA scan is a widely accepted radiological tool that can detect osteoporotic changes in bones earlier and with a higher accuracy than plain radiographs of the skeletal system. It is relatively cheap, it requires no special preparation and involves less radiation hazard, so it can be used as a primary diagnostic modality for detecting osteoporosis in patients with low back pain.

Conflicts of interest: none declared.
Financial support: none declared.