Effect of Bilateral Oophorectomy and Natural Menopause on Bone Mineral Density

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Abstract

The objective of this study was to assess the effect of bilateral oophorectomy on bone mineral density in comparison with natural menopause. Bone mineral density (BMD) is measured with dual energy X-ray DXA of lumber spine and femoral neck in 133 women, aged ranged (45 -70 years). Two surgical groups consist of 100 women either after or before, surgical after menopause SAM women with mean age (66.55 ± 1.11 years), menopause duration mean (15.88 ± 1.19 years) and body mass index BMI mean (32.09 ± 1.37 Kg /m2).

Women who underwent surgery before menopause SBM the mean age (57.18 ± 0.84 years), (13.31 ± 0.83 years) the mean of menopause duration and (32.26 ± 0.7 Kg /m2) the mean of body mass index BMI. The natural menopause NM include 33 women mean age (56.45 ± 0.93 years) with (6.24 ± 0.81 years) duration of menopause and (33.49 ± 1.08 Kg /m2) BMI.

The mean of BMD and T-score in lumber spine L1-L4 in SAM group was (0.84 ± 0.03 gr/cm2 and -2.32 ± 0.25) respectively, in the SBM group (BMD = 0.82 ± 0.01 gr/cm2 and T-score = -2.46 ± 0.12) comparing to natural menopause group NM (BMD = 1.16 ± 0.03 gr /cm2 and T-score = 0.31 ± 0.23). The mean of BMD measured for femoral neck in SAM (0.72± 0.03 gr /cm2 and T-score = -1.54 ± 0.2), in SBM (BMD = 0.81 ± 0.01 gr/cm2 and T-score = -0.86 ± 0.12), in NM (BMD = 0.93 ± 0.03 gr/cm2 and T-score = 0.3 6 ± 0.03). Bilateral oophorectomy associated with decrease in BMD, in addition age and duration of menopause are important factors affected on BMD.

1 Introduction

Surgical induction of menopause results in stopping menses after surgical removal of the uterus and ovaries1. Such induction before the natural time of menopause may result in an increased risk of bone mineral density (BMD) loss due to premature endogenous estrogen deficiency2-4. Many prospective studies have shown that oophorectomy before the age of 45 years was associated with an increased risk of osteoporosis within 6 years after surgery. The use of hormonal replacement therapy (HRT) in women who undergo surgically-induced menopause mitigates the increased risk of fractures due to BMD loss5. Osteoporosis is a public health problem worldwide6. Characterized by low bone mass and microarchitectural disruption, leading to bone fragility and increased susceptibility to fractures7.

With advances in genetic and cancer research, prophylactic premenopausal oophorectomy has become a more commonly practiced procedure. The aim of the current is study is to examine the effects of such procedure on BMD in comparison to naturally occurring menopause.

2 Material and Methods

2.1 Methodology

The study was carried out in March 2014 to April 2015. One hundred thirty three women of age range (45-70 years) referred to Dual X-ray absorptiometry (DXA) unit at Al-Yarmouk Teaching hospital in Baghdad, Iraq, were included in this study. The exclusion criteria were diabetes mellitus, hyperthyroidism, rheumatoid arthritis, history of corticosteroid therapy intake and women who had only hysterectomy or oophorectomy. Bone
mineral density (BMD) was measured using dual energy x-ray absorptiometry method (DEXA) (DEXXUM3, Osteosys Co.Ltd, Korea, Seoul) of femoral neck and the first to fourth lumber spine. Osteoporosis and osteopenia were assessed based on the World Health Organization (WHO): T-score lower than -2.5 was considered as osteoporosis, T-score between -1and -2.5 indicates osteopenia and T-score more than -1 was considered as normal. Patients were divided into two main groups 33 with natural postmenopausal NM, 100 with surgical post menopause, which are subdivided further into; surgery before menopause SBM and surgery after menopause SAM. All the patients were evaluated by T-score of the lumber spine and femoral neck BMD. Body mass index (BMI) was calculated as the weight in kilograms divided by height in squared meters (weight (kg)/height (m)$^2$). BMI was categorized according to reported of centers for disease control (CDC), as follows; equal or below 18.5 considered as underweight, 18.5 to 24.9 as normal and ≥ 25 kg/m$^2$ as overweight and obese. Local scientific committee in the college of medicine, Al-Mustansiriya University approved the study, and all patients are examined after obtaining their permission.

2.2 Statistical analysis

Data were expressed as mean ±SD, the comparison between groups was by using ANOVA, P < 0.05 was considered as statistically significant. Independent t-test was used to compare between any two groups. Correlation test between variables considered r >± 0.3 as statistically significant.

3 Results

The study parameters were checked on 100 women who underwent surgery either before menopause (SBM) or after menopause (SAM) and 33 women with natural menopause (NM) were shown in the table 1.

Table 1: Distribution of study parameters among the three groups of postmenopausal women

<table>
<thead>
<tr>
<th>Particulars</th>
<th>NM</th>
<th>SAM</th>
<th>SBM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>56.45±0.93</td>
<td>66.55±1.11</td>
<td>57.18±0.84</td>
</tr>
<tr>
<td>Duration after surgery (years)</td>
<td>7.75±1.2</td>
<td>15.88±1.19</td>
<td>13.31±0.83</td>
</tr>
<tr>
<td>Duration of menopause (years)</td>
<td>6.24±0.81</td>
<td>0.84±0.03</td>
<td>0.82±0.01</td>
</tr>
<tr>
<td>BMI (kg/m2)</td>
<td>33.49±1.08</td>
<td>32.09±1.37</td>
<td>32.26±0.7</td>
</tr>
<tr>
<td>Lumbar BMD (g/cm2)</td>
<td>1.16±0.03**</td>
<td>-2.32±0.25</td>
<td>-2.46±0.12</td>
</tr>
<tr>
<td>Lumbar T-score</td>
<td>0.31±0.23**</td>
<td>0.72±0.03**</td>
<td>0.81±0.02</td>
</tr>
<tr>
<td>Femoral neck BMD (g/cm2)</td>
<td>0.93±0.03**</td>
<td>-1.54±0.2</td>
<td>-0.86±0.12</td>
</tr>
<tr>
<td>Femoral neck T-score</td>
<td>0.36±0.03**</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Values are expressed as Mean±SEM,*P < 0.05, **P<0.001 a-NM, b- SAM, c=SBM; NM: natural menopause, SAM: surgical oophorectomy after menopause, SBM : surgical oophorectomy before menopause

Table 1 illustrated the significant difference in duration of menopause for both SBM and SAM compared to NM. A significant difference was found in BMD and T-score of lumber spine in surgical groups compare to the normal group, but not found between SAM and SBM. Lower level in femoral BMD and T-score in SAM group, presenting significant difference between this group as compared with NM and SBM. The mean of BMI indicated that all the groups examined were obese, with no significant difference between them.

Table 2 showed there was a significant difference in both age and duration after surgery P < 00.01, between SBM and SAM groups, but there was no significant difference found in menopause duration. No significant difference was found between BMD values and T-score of SAM and SBM in lumber spine while the significant difference was in the femoral neck BMD and T-score (p < 00.01 ). The change in femoral neck T-score was statistically significant between patients of SAM and SBM, but the change in lumbar T-scores was not (Fig 1).

![Fig 1: Comparison of lumbar spine & femoral neck T-scores in postmenopausal women who had oophorectomy before (SBM) and after (SAM) the time of natural menopause. Data represent means, bars are standard error of mean, **= P-value<0.001](image)
There were no significant correlations between BMD of lumber spine and age. But there was a weak negative correlation ($r = -0.339$) between age and BMD of the femoral neck (Fig 2).

**Table 2: Comparison between women who had undergone surgical before and after menopause**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Group</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>SAM: 66.55±1.11</td>
<td>SBM: 57.18±0.84</td>
</tr>
<tr>
<td>Duration after surgery (years)</td>
<td>SAM: 7.75±1.2</td>
<td>SBM: 13.31±0.83</td>
</tr>
<tr>
<td>Duration of menopause (years)</td>
<td>SAM: 15.88±1.19</td>
<td>SBM: 13.31±0.83</td>
</tr>
<tr>
<td>BMI (kg/m2)</td>
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</tr>
<tr>
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<td>Femoral neck BMD (g/cm2)</td>
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</tbody>
</table>

* = P-value <0.05, ** = P-value<0.01, NS= No statistical significance

In addition there was a weak negative correlation between duration of menopause and BMD of both lumbar spine ($r = -0.376$) and its T-score the ($r = -0.330$), and in the femoral neck BMD ($r = -0.376$) and its T-score ($r = -0.304$) as shown in figures 3-6.

![Fig 2: Correlation between BMD of femoral neck and age in postmenopausal women](image1)

![Fig 3: Correlation between bone mineral density of lumber spine and duration of menopause in postmenopausal women](image2)

Although osteoporosis risk increased with lower BMI, there was no significant correlation between any score and BMI ($r<0.3$).
4 Discussions

We investigated some factors, which may affect bone loss in oophorectomy and normal menopause including age, time of oophorectomy in relation to menopause, menopause duration and body mass index.

The most significant difference among groups was the age and the decrease in BMD in the femoral neck in SAM compared to SBM and NM. In spite there was decrease in BMD in SBM group, but the degree of reduction was greater in SAM. The study results found no significant correlation between age and BMD in spine, while there were a weak negative correlation between age and BMD in the femoral neck. This may suggest that advancing age is an important factor affecting BMD in the femoral neck. The finding supported by a previous study\textsuperscript{10} which reported that surgical menopause women at age range of 55 – 65 years presented high significant lower BMD in femoral neck value than NM women after 55 years of age.

According to our results the strength of BMD in lumbar spine and femoral neck in NM comparing to surgical groups, may be contributed to the short duration of menopause and the age at menopause. The finding is in agreement with previous study\textsuperscript{11} which reported that the risk of low BMD is relatively low up to seven years after menopause in women at age 50 or later.

Although the age of SBM and NM is closer, women in SBM exhibit more decline in BMD in both lumbar spine and femoral neck scores in comparison with NM. This reduction of BMD in SBM may contribute to the effect of surgical oophorectomy and duration of menopause. This finding is in agreement with Mucowski et al.\textsuperscript{12} reported that oophorectomy is detrimental for bone and BMD loss were worse in women greater than 10 years undergone oophorectomy, where other researchers\textsuperscript{13} found that the rate of bone loss is twice in oophorectomized women in comparison with natural menopause women.

Despite the significant difference in age and duration after surgery between oophorectomized women after and before menopause, our results appeared no significant difference in BMD and T-score in lumbar spine, and both groups exhibit osteopenia with nearly similar values in T-score. The outcomes suggest that surgical oophorectomy is associated with bone mineral loss, especially in lumbar spine, this result contribute to duration of menopause and estrogen deficiency. Similar to our results other studies reported that BMD reduction in oophorectomy occurred mainly in spine causing osteopenia\textsuperscript{14,15}.

As shown in many other studies, BMD had significant correlation to BMI. Our results do not support the existence of relationship between BMD and BMI. This is probably due to the effect of overweight and the distribution of fat.

5 Conclusion

This study identifies both oophorectomy and duration of menopause are important factors affecting bone density, mainly in lumbar spine in both surgical after and before menopause, while advanced age associated with significantly lower in BMD in the femoral neck. Our results did not indicate that BMI has a significant effect on BMD.

We recommend further studies to include a wider range of population and variables assess other risk factors to ascertain the effect of oophorectomy on bone mineral density on a large number of patients.

6 Acknowledgments

The authors are grateful to Department of Radiology at Al-Yarmouk Teaching Hospital for providing the facilities needed to complete this work.

7 Competing Interests

Authors have declared that no competing interests exist.

8 Author’s contributions

NHA carried out literature review and discussion. MHS was responsible for statistical work and calculations in addition to manuscript proofing. AMJ collected the data and gained patient approval. All authors read and approved the final manuscript.

9 References

4. Pansini F, Bagni B, Bonaccorsi G et al. Oophorectomy and spine bone density: evidence of a higher rate of bone loss in

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