

Quantitative ultrasound measurements at the calcaneus in natural and surgically induced menopause

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Abstract

Objective: The aim of the study was to assess skeletal status in natural and surgically induced menopausal women regarding the presence of previous osteoporotic fracture.

Methods: Ninety-three females after bilateral oophorectomy in mean age of 56.8 ± 8.3 y. (48 without and 45 with fracture, groups 1 and 2, respectively) and 285 females with natural menopause in mean age of 56.4 ± 7.0 y (176 without and 109 with fracture, groups 3 and 4, respectively) were studied. Mean age, age of menopause, years since menopause (YSM), duration of fertile period (durFER) and body size did not differ between women after surgical and natural menopause and between non-fractured and fractured groups. No additional factors known to influence bone metabolism (either diseases or medications) or osteoporosis treatment were noted in the subjects studied. Skeletal status was evaluated by quantitative ultrasound (QUS) of the calcaneum using the Achilles system (Lunar, USA).

Results: Calcaneal QUS results were significantly higher: in women after natural than surgical menopause ($p < 0.05$), in non-fractured females after natural menopause than in non-fractured females after surgical menopause ($p < 0.001$) and in women after natural menopause without fracture compared with those with fracture ($p < 0.000001$). The same comparisons between fractured groups and between women after surgical menopause with and without fracture revealed no significant differences. QUS parameters were regressed in a stepwise, multiple regression analysis on age, YSM, durFER, weight and height for all groups. In group 1, YSM had a negative influence and durFER was a protective factor; in group 2, age and durFER were a negative factors and YSM had no influence; in group 3, age and YSM were a negative factors (no role of durFER) and in group 4, only YSM had a negative influence, and durFER was a protective factor.

Conclusion: Surgical menopause seems to be a risk factor for osteoporotic fracture because of low ultrasound values.

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1. Introduction

Among several factors influencing bone metabolism are ageing, gender, heredity, a low level of physical activity, a low diet calcium intake, etc., and the

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function of the endocrinological system. It was shown that the postmenopausal period and cessation of ovarian function are associated with rapid bone loss [1,2]. Obviously, bone loss is caused in large part by estrogen deficiency, but postmenopausal women have also lower levels of a variety of sex steroids, in addition to estrogens [3]. Testosterone and androstendione producing by the ovary can serve as a substrate for extragonadal estrogen production after the menopause [4]. Ovarian function is an important factor in regard to bone loss especially in the first 8–10 years after the menopause [5]. Seventy-year-old women had lost 11% of their bone loss due to the menopause and 18% as a function of age [6]. Surgically induced menopause is considered to be a risk factor for osteoporosis, because as opposed to the natural menopause, preparatory hormonal changes are lacking due to its abrupt nature, and additionally to estrogen deficiency peripheral conversion to estrogen is diminished. Therefore, surgical menopause is an interesting model for the studying of skeletal changes in comparison to the natural menopause due to differences in hormonal status. In female populations the influence of the surgical menopause was assessed for bone markers [7–10], bone mass measurements [7–14] and in respect to fracture risk [15,16]. Generally, women after surgical menopause showed greater bone changes than those observed in women after natural menopause. More recently, quantitative ultrasound (QUS) was introduced into bone status evaluation. The calcaneus is the most popular evaluation site for detecting bone changes in several clinical circumstances e.g. bone growth [17], effects of the therapy [18,19], ageing [20] and fracture prediction [21–23]. Recently, Gambacciani et al. [24] has discussed the role of QUS in the management of postmenopausal women as a valid technique.

The aim of the study was to assess skeletal status using calcaneal QUS in natural and surgically induced menopausal women regarding the presence of previous fracture.

2. Materials and methods

2.1. Materials

In the study, 93 females after surgical menopause (48 without fracture—group 1 and 45 with previ-

ous fracture—group 2) and 285 females after natural menopause (176 without fracture—group 3 and 109 with previous fracture—group 4) were evaluated. All subjects were studied in Outpatient Medical Care for screening purposes and were recruited from the same region of the country. Mean age, age of menopause, years since menopause (YSM), age at menarche, duration of fertile period (durFER) and body size did not differ between all women after natural and surgical menopause and between non-fractured and fractured groups. Table 1 presents clinical characteristics of women studied. Surgically induced menopausal women have undergone bilateral oophorectomy and hysterectomy because of uterine leiomyomas. In groups 1 and 2, menopause was established at the age of surgery, and in groups 3 and 4, menopause was defined as the last menstrual bleeding after a break lasting of at least 12 months.

All fractures were a result of minimal trauma (a fall from a standing height or less). In group 2, 69 fractures occurred (32 wrist, 14 spine, 11 feet, 5 ankle, 3 rib, 2 humerus and 2 hip) and 19 females had more than one fracture. In group 4, 175 fractures were noted (81 wrist, 32 spine, 26 feet, 12 humerus, 11 rib, 9 ankle, 3 clavícula and 1 hip) and 38 women had more than one fracture.

No additional factors known to influence bone metabolism (either diseases or medications) or osteoporosis treatment including the use of hormone replacement therapy were noted in subjects studied. A local ethics committee gave permission for the study. All women gave their informed written consent for study participation.

2.2. Methods

Evaluation of the skeletal status was based on QUS measurements at the right calcaneus. In the case of a previous fracture within the lower extremity, the opposite calcaneus was measured. The speed of sound-SOS (m/s) and broadband ultrasound attenuation-BUA (dB/MHz) were measured with the Achilles system (Lunar, Madison, WI, USA). The Achilles software calculates a stiffness index (SI [%]) = $[0.67 \times \text{BUA} + 0.28 \times \text{SOS}] - 420$ which does not express biomechanical stiffness but rather is an attempt by the manufacturer to derive a clinically useful index combining BUA and SOS. *T*-score and *Z*-score

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