The Predictive Value of Skin Thickness in the Diagnosis of Osteopenia

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Abstract

Skin and bone share a similar organic constituent (type I collagen) which decreases with time after menopause due to hypoestrogenism. The interdependence of skin and bone atrophy has been reported[1]. This study was conducted to assess the predictive value of an ultrasonographic measurement of skin thickness in the diagnosis of osteopenia (BMD below -1.5 SD.) in perimenopausal and early postmenopausal women. All patients had skin thickness measured by the same radiologist and had a dual-energy X-ray absorptiometry (DEXA) scan of the lumbar spine and the femoral neck. Of the 77 women studied, the mean age was 50.9 $\pm$ 3.0 years. Thirty patients were in perimenopause and 47 in early postmenopause. Mean skin thickness was 2.1 $\pm$ 0.4 mm. Women with a skin thickness of $\leq$ 1.7 mm carried a higher risk for developing osteopenia at the lumbar spine (odds ratio 8.41, 95% confidence interval 2.19-32.35) and the femoral neck (odds ratio 3.88, 95% CI 1.14-13.17). Patients with a skin thickness of $\geq$ 2.4 mm had a lower probability of osteopenia at the lumbar spines (odds ratio 0.17, 95% CI 0.035-0.845) and the femoral neck (odds ratio 0.22, 95% CI 0.055-0.899). In conclusion, a low skin thickness measurement by ultrasonography may be used as an indicator for osteopenia in perimenopausal and early postmenopausal women.

Key word : Osteopenia, Skin Thickness, Predictive Value

The skin, one of the largest organs of the body, also undergoes changes with increasing age and more visible after menopause. The women may complain of generalized dry, flaky skin and of easy bruising. Several studies have shown that skin thickness and skin collagen decreases proportionally with time after menopause due to hypoestrogenism[2-4]. It has been studied repeatedly and documented for more than 50 years that decreased ovarian estrogen production at menopause also accelerates the pro-

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cess of bone loss, leading to osteoporosis. This is particularly obvious in cancellous bone, in which 80 per cent of bone remodeling occurs. Vertebrae and femoral necks consist predominantly of cancellous bone and are therefore most susceptible[5,6]. Bone is composed of a highly specialized connective tissue of collagen fibers impregnated with a mineral complex (hydroxyapatite). Type I collagen is known to be the major organic constituent of bone and it also comprises 70 per cent of the dermal connective tissue matrix[7,8]. What is less known is that skin thickness measurements largely indicate dermal thickness, with the epidermis accounting for only 7 per cent of the total thickness[9]. Therefore, skin and bone share a similar loose connective tissue in the dermis and the organic matrix[10].

There is evidence that skin collagen content and skin thickness in postmenopausal women can be restored or prevented from declining by estrogen replacement therapy[11-15]. In the same way, estrogen therapy is the single most effective modality for the retardation of bone loss in postmenopausal women[16-19]. This implies an association between skin thickness, bone mineral density and sex hormones. A recent publication has reported that there is also an interdependence of skin and bone atrophy[1]. Thus, the state of the skin might be regarded as a predictive indicator with respect to the organic matrix in bone mass, and, therefore, help to identify those individuals most at risk of developing osteopenia and osteoporosis. The aim of this study was to evaluate the predictive value of a simple measurement of skin thickness by ultrasonogram for diagnosing osteopenia in perimenopausal and early postmenopausal women.

MATERIAL AND METHOD

Seventy-seven women attending the menopause clinic, Chulalongkorn Hospital, from October 1997 to June 1998, aged between 40 and 55 years, were recruited for the study. The term "perimenopause" is defined as having irregular vaginal bleeding during the previous 12 months and serum follicle stimulating hormone above 10 IU/L ; "early postmenopause" is defined as natural menopause devoid of vaginal bleeding for between 1 to 5 years. Patients with current skin or bone diseases, taking drugs known to induce skin or bone alterations and who had received any prior hormonal treatment were excluded. Skin thickness was measured by ultrasonography using an Acuson 128 with a linear 7.5 MHz probe adjusted for thyroid resolution at the right great trochanter area. All tests were performed by the same radiologist. Each measurement was made six times and the mean was calculated. Bone mass measurement was conducted utilizing a dual energy X-ray absorptiometer, Hologic QDR 2000. The long term precision was 1.5 per cent. Bone mineral density (BMD) of the lumbar spine (L_1-L_4) and the femoral neck at the nondominant side were scanned. Women with a T-score of BMD below 1.5 standard deviation (SD) from the mean value of peak bone mass in young normal women were considered to have low bone mass (osteopenia).

Statistical analysis was performed using mean $\pm$ SD. Groups of patients with low and high skin thickness in the control normal and osteopenia groups were compared applying Fisher's exact test (two-tailed).

RESULTS

Of the 77 women who participated in this study, 30 were perimenopausal, 47 were early postmenopausal. The population characteristics, time since menopause (in the postmenopausal group) and mean skin thickness are shown in Table 1. Forty-eight per cent (37/77) and 54.5 per cent (42/77) of the population studied were diagnosed as suffering from osteopenia at the lumbar spine (L_1-L_4) and femoral neck, respectively. Subjects who had a skin thickness of 1.71 mm or less (> 1 SD below the mean skin thickness of the population studied) were considered to have low skin thickness and patients who had a skin thickness of 2.43 mm or thicker (> 1 SD above the mean) were included in the high skin thickness group. Women with a low skin thickness carried a higher risk of developing osteopenia at the lumbar spine (odds ratio 8.41. 95% confidence interval 2.19-32.35) and the femoral neck (odds ratio 3.88, 95% Confidence interval 1.14-13.17). (Table 2, 3) Patients with a high skin thickness had a lower probability of osteopenia at both sites measured (lumbar spine, odds ratio 0.17, 95% Confidence interval 0.035 - 0.845 ; femoral neck, odds ratio 0.22, 95% CI 0.055 - 0.899). (Table 4, 5)

DISCUSSION

The dermis layer of the skin is composed of collagen. Type I collagen constitutes the major connective tissue protein of skin, bone and a number of tissues, accounting for 90 per cent of body collagen[7-9]. Skin collagen has been shown to decrease

Table 1. Characteristics of the population studied (n = 77).

Characteristics	$\bar{x} \pm SD$
Age (year)	50.9 ± 3.0
Time since menopause (month)	34.9 ± 18.2
weight (kg)	57.4 ± 7.9
Height (cm)	154.6 ± 4.9
BMI (g/m^2)	24.2 ± 2.9
Skin thickness (mm)	2.07 ± 0.36

Table 2. Low skin thickness and probability of osteopenia (lumbar spine).

Skin thickness (mm)	BMD	
	Osteopenia	Normal
≤ 1.71	15	3
> 1.71	22	37

Table 3. Low skin thickness and probability of osteopenia (femoral neck).

Skin thickness (mm)	BMD	
	Osteopenia	Normal
≤ 1.71	14	4
> 1.71	28	31

Table 4. High skin thickness and probability of osteopenia (lumbar spine).

Skin thickness (mm)	BMD	
	Osteopenia	Normal
≥ 2.43	2	10
< 2.43	35	30

Table 5. High skin thickness and probability of osteopenia (femoral neck).

Skin thickness (mm)	BMD	
	Osteopenia	Normal
≥ 2.43	3	9
< 2.43	39	26

after menopause. The rate of decrease was higher during the initial postmenopausal years with some 30 per cent being lost in the course of the first 5 years[4,11]. Skin thickness which relates to skin collagen content becomes thinner after menopause[21]. Moreover, the decline of skin thickness and bone mass during menopause has been found to occur simultaneously. This suggests that both tissues share some common factor (type I collagen)[21]. It appears possible, therefore, to use skin thickness to predict who is at risk of developing postmenopausal osteopenia and osteoporosis.

It has been reported that skin thickness measured by ultrasonography is more precise than that performed by radiography[12]. We conducted skin thickness measurements at the level of the right great trochanter in order to avoid possible environmental influences such as ultraviolet radiation, which might affect the skin thickness. Each measurement was performed six times by the same observer and the mean was calculated in order to minimize intraobserver variation. Regarding bone mass measurement at the lumbar spine (L_1-L_4) and the femoral neck, those women with a T-score of BMD below 1.5 SD from the mean value of peak bone mass in young normals were considered to have osteopenia. The population studied comprised women in perimenopause and early postmenopause. Ovarian functions in these groups vary from early decline to complete cessation, thus, skin and bone changes may be seen as early as the perimenopausal period. Our study demonstrated that women with low skin thickness (≤ 1.71 mm.) carried a higher risk of suffering from osteopenia at the sites studied (lumbar spine and femoral neck) than those with normal or high skin thickness (≥ 2.43 mm.). Based on our study and others; it appears that skin and bone probably contain a common pathological factor reponsible for similar changes in these periods of life, and hence it would be possible to utilize skin thickness measurements to predict those women at risk of developing osteopenia. However, the present study was limited only to women in the perimenopausal and early postmenopausal periods. Further studies in women in the late postmenopausal period are required to confirm whether or not skin thicknesses can also be used to predict those at risk of developing osteopenia and osteoporosis.

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การทำนายโรคกระดูกบางในสตรีวัยหมดระดูโดยการวัดความหนาของผิวหนัง

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เพื่อศึกษาความเสี่ยงต่อการเกิดกระดูกบางในสตรีวัยหมดระดูโดยการวัดความหนาของผิวหนัง สตรีที่ศึกษาจำนวน 77 ราย อายุเฉลี่ย 50.9 ± 3.0 ปี แบ่งเป็น 30 รายอยู่ในวัยใกล้หมดระดู 47 รายอยู่ในวัยหมดระดูระยะต้น ไม่มีโรคทางผิวหนัง หรือได้รับยาที่มีผลต่อผิวหนัง และไม่เคยได้รับฮอร์โมนทดแทนมาก่อน สตรีทั้งหมดจะได้รับการวัดความหนาแน่นของผิวหนังที่ตำแหน่ง Great trochanter ข้างขวา โดยใช้เครื่องตรวจคลื่นเสียงความถี่สูง Acuson 128 และได้รับการวัดความหนาแน่นของกระดูกโดยเครื่อง Dual energy X-ray absorptiometer ตรงตำแหน่งกระดูกสันหลัง L_1-L_4 และกระดูกสะโพกตำแหน่ง Femoral neck ผลการศึกษาพบว่าความหนาของผิวหนังมีค่าเฉลี่ย 2.1 ± 0.4 มิลลิเมตร สตรีที่มีผิวหนังบางกว่า 1.7 มิลลิเมตร (ต่ำกว่า 1 SD) จะมีความเสี่ยงสูงต่อการเกิดกระดูกบางที่ L_1-L_4 (odds ratio 8.41, 95% confidence interval 2.19-32.35) และที่ Femoral neck (odds ratio 3.88, 95% CI 1.14-13.17) ในทางกลับกันสตรีที่มีผิวหนังหนากว่า 2.4 มิลลิเมตร (สูงกว่า 1 SD) จะมีความเสี่ยงต่ำต่อการเกิดกระดูกบางที่ L_1-L_4 (odds ratio 0.17, 95% CI 0.035-0.845) และที่ Femoral neck (odds ratio 0.22, 95% CI 0.055-0.899) กล่าวโดยสรุปความหนาของผิวหนังที่วัดโดยคลื่นเสียงความถี่สูง อาจช่วยทำนายโรคกระดูกบางในสตรีวัยใกล้หมดระดู และวัยหมดระดูในระยะต้นได้

คำสำคัญ : โรคกระดูกบาง, ความหนาของผิวหน้า, การทำนายโรค

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