Bone mineral loss related to menstrual history

Evangelos Georgiou[1], Konstantinos Ntalles[1], Athanassios Papageorgiou[1], Anastasios Korkotsidis[2] and Charalambos Proukakis[1]

We measured the bone mineral content (BMC) of the forearm in 173 normal postmenopausal women. We also examined the relation between BMC and the chronologic age, the number of years elapsed since menopause, and the total number of menstrual cycles during the reproductive years. BMC had a better linear relation to the total number of menstrual cycles than with the years elapsed since menopause or with chronologic age.

It is well known (Nilsson 1970) that years elapsed since menopause contributes to a greater or to at least the same extent as age to the rate of bone loss, a finding reconfirmed by recent reports (Geusens et al. 1986, Georgiou et al. 1987, Nordin et al. 1987). On the other hand, it is well established that during the reproductive years, estrogens protect against loss of bone mineral (Horsman et al. 1983, Richelson et al. 1984, Lindsay 1987). This suggests that the total duration of the action of endogenous estrogens during the reproductive years must be of importance for the subsequent bone mineral loss.

Because both chronologic age and years since menopause do not provide a measure of the levels of endogenous estrogens during the reproductive years, we estimated these levels by calculating the total number of menstrual cycles.

We report the correlation of such data with the bone mineral content in the forearm.

Patients and methods

A total of 173 normal postmenopausal women, aged from 41 to 79 years, gave informed consent and participated in the study. Subjects who had any medical disorder associated with metabolic disease, who were taking medication or drugs known to affect mineral metabolism, or who were using excessive amounts of alcohol were identified by questionnaire and excluded from the study. Bone mineral content (BMC) of the nondominant forearm was measured by single-photon absorptiometry (Nuclear Data, Model 1100a) by means of a ^{125}I source (100 mCi) with a photo peak at 27 KeV. With this method, BMC was measured in the proximal and distal parts of the forearm, with a content of trabecular bone of 10 percent and 45 percent, and with a precision of 1 percent and 1.5 percent, respectively (Nilas et al. 1985).

For each subject the following variables were recorded: menarche age, menopause age, and mean cycle duration in days during the reproductive years.

Complete single- and multiple-regression analyses were performed to assess the contribution of age, the years since menopause, and the total number of menstrual cycles to the variability of BMC.

Results

The contribution of each one of the variables under study, as well as their combinations in explaining distal and proximal bone mineral content changes is presented in Table 1, except mean cycle duration, which exhibited a very low R^2 in both distal and proximal regressions (1 and 5 percent, respectively).

Distal BMC was better correlated with the investigated variables than proximal BMC. Single-variable

Departments of Medical Physics[1] and Economic Sciences[2], Athens University, Athens, Greece

Correspondence: Dr. Evangelos Georgiou, Department of Medical Physics, Athens Medical Schoool, 66-70 Imitou Str., Athens 11634, Greece

Table 1. Bone mineral content correlated with age and menstrual history

Variables[a]	Distal			Proximal		
	R^2	adj-R^2	t	R^2	adj-R^2	t
1	33	32	−9.2 ***	32	32	−9.0 ***
2	51	50	−13	33	33	−9.2 ***
3	55	54	14	29	28	8.3 **
1 + 2	51	51	1.4	35	34	−2.3 **
			−8.0 ***			−2.8 **
1 + 3	56	55	−2.0 *	36	36	−4.6 ***
			9.4 ***			3.4 ***
2 + 3	55	54	−0.8	33	32	−3.5 ***
			4.1 ***			−0.4
1 + 2 + 3	58	57	−3.3 **	38	36	−3.5 ***
			2.8 **			1.8
			5.1 ***			2.6 **

[a] 1 Age; 2 Years since menopause; 3 Total number of cycles * = $P < 0.05$, ** = $P < 0.01$, *** = $P < 0.001$.

models showed that distal content had a better linear relation to the total number of menstrual cycles than to years since menopause or age ($R^2 = 5$, 1, and 3, respectively). Use of two or three variables did not substantially improve the correlation index.

Discussion

The commonly used variables (age, sex, height, weight) in explaining bone mineral loss in postmenopausal women contribute to at most one third of the variability (Yano et al. 1984), a fact suggesting that other factors should be investigated.

The retrospective estimation of estrogen levels during the reproductive years of a certain postmenopausal woman is practically impossible. Therefore, we tried an indirect estimation of their effect by calculating the total number of cycles that a woman had during her reproductive years. Thus, this parameter could be used as a rough index of estrogenic effect on bone. Although the protective role of estrogens against bone mineral loss is very well established in various investigations and under different conditions (Lindsay et al. 1976, Christiansen et al. 1980, Lindsay 1987), we could not find any data on the contribution of the total number of menstrual cycles in bone mineral loss in postmenopausal women.

Our observations clearly demonstrate the importance of the total estrogenic effect during the reproductive years on later bone mineral content. This has been emphasized by Drinkwater (1987), who has shown that in women in reproductive age a prior menstrual history can have an effect also on current bone density. Specifically, she found that the lumbar bone density was highest in those young women who always had regular menstrual cycles; lower in women who had regular periods at present, but a history of amenorrhea; and lowest in those who were currently amenorrheic and had had previous episodes of amenorrhea.

Our finding that years since menopause contribute more than chronologic age to bone mineral content variability agrees with those of other authors claiming that estrogen deficiency and not aging per se is the predominant cause of bone loss (Geusens et al. 1986, Nordin et al. 1987).

The total number of menstrual cycles and chronologic age together explained a higher percentage of the variability than the other combinations, and the combination of all three variables produced a slightly better linear relation. These findings suggest that the total number of menstrual cycles should be considered as an explanation of variations in bone mineral content in postmenopausal women. Our study provides further support to the abundant evidence that links osteoporosis with estrogen deficiency.

References

Christiansen C, Christensen M S, McNair P, Hagen C, Stocklund K E, Transbol I. Prevention of early postmenopausal bone loss: controlled 2 year study in 315 normal females. Eur J Clin Invest 1980;10(4):273–9.

Drinkwater B L. Maximizing bone mass in the premenopausal years: Positive and negative factors. In: Osteoporosis 1987 (Eds. Christiansen C, Johansen J S, Riis B J). Osteopress, Copenhagen 1987:484–8.

Georgiou E, Korkotsidis A, Metallinos I, Ntalles K, Proukakis C. Retrospective estimation of endogenous estrogens for explaining bone mineral loss in postmenopausal women. In: Osteoporosis 1987 (Eds. Christiansen C, Johansen J S, Riis B J). Osteopress, Copenhagen 1987:575–7.

Geusens P, Dequeker J, Verstraeten A, Nijs J. Age, sex, and menopause related changes of vertebral and peripheral bone: population study using dual and single photon absorptiometry and radiogrammetry. J Nucl Med 1986;27(10):1540–9.

Horsman A, Jones M, Francis R, Nordin C. The effect of estrogen dose on postmenopausal bone loss. N Engl J Med 1983;309(23):1405–7.

Lindsay R. Identification of bone loss and its prevention by sex steroids. A special report. Postgrad Med 1987:13–9.

Lindsay R, Hart D M, Aitken J M, MacDonald E B, Anderson J B, Clarke A C. Long term prevention of postmenopausal osteoporosis by oestrogen. Evidence for an increased bone mass after delayed onset of oestrogen treatment. Lancet 1976;1(7968):1038–41.

Nilas L, Borg J, Gotfredsen A, Christiansen C. Comparison of single and dual photon absorptiometry in postmenopausal bone mineral loss. J Nucl Med 1985; 26(11):1257–62.

Nilsson B. Menopause and femur density. In: Proceedings of Bone Measurement Conference (CONF 700515), United States Atomic Energy Commission, Division of Technical Information 1970:334–7.

Nordin B E, Polley K J, Chatterton B E, Walker C J. Factors influencing and reflecting the rate of peripheral bone loss in normal postmenopausal women. In: Osteoporosis 1987 (Eds. Christiansen C, Johansen, J S, Riis B J). Osteopress, Copenhagen 1987:132–3.

Richelson L S, Wahner H W, Melton L J, Riggs B L. Relative contributions of aging and estrogen deficiency to postmenopausal bone loss. N Engl J Med 1984;311(20): 1273–5.

Yano K, Wasnich R D, Vogel J M, Heilbrun L K. Bone mineral measurements among middle aged and elderly Japanese residents in Hawaii. Am J Epidemiol 1984; 119(5):751–64.