Discordance Between Hip and Spine Bone Mineral Density Measurement Using DXA: Prevalence and Risk Factors

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Background: Diagnostic discordance for osteoporosis is the presence of different categories of T-scores in 2 skeletal sites of an individual patient, falling into 2 different diagnostic categories identified by the World Health Organization classification system.

Objectives: To evaluate the prevalence and risk factors for T-score discordance between spine and total hip measurement sites.

Methods: Demographic data, anthropometric measurements, and risk factors for osteoporosis were derived from a database of 3479 patients referred to a community-based outpatient osteoporosis testing center. Dual-energy x-ray absorptiometry (DXA) was performed on L1-L4 lumbar spine and total hips for all cases. Minor discordance was defined as present when the difference between 2 sites was no more than 1 World Health Organization diagnostic class. Major discordance was present when 1 site is osteoporotic and the other is normal. Subjects with incomplete data were excluded.

Results: In 3479 participants (2871 women; mean age, 55.7 ± 11.9 years), concordance of T-scores, minor discordance, and major discordance were seen in 54, 42, and 4%, respectively. In multivariate logistic regression analysis, age, menopause, and obesity were identified as risk factors against T-score discordance.

Conclusion: Densitometrists and clinicians should expect that at least 4 of every 10 patients tested by DXA to demonstrate T-score discordance between spine and total hip measurement sites. T-score discordance can occur for a variety of reasons related to physiologic and pathologic patient factors as well as the performance or analysis of DXA itself.

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Bone mineral density (BMD) assessed by dual-energy x-ray absorptiometry (DXA) is used to diagnose osteoporosis, assess fracture risk (1), and monitor changes in BMD over time. DXA has many advantages: short scan times, quick setup of patients, low radiation dose, and good measurement precision. The World Health Organization (WHO) has proposed a set of operational criteria to define osteoporosis in postmenopausal white women (2). Bone measurements are expressed as T-scores, which are the difference between the patients measurements and a mean value for a young adult population and divided by the young adult standard deviation. The International Society for Clinical Densitometry has recommended that BMD should be measured for the purpose of diagnosing osteoporosis at 2 preferred skeletal sites, the hip and lumbar spine. A third site (33% or one-third of the radius of the nondominant forearm) should be investigated if technical problems arise at any of these 2 primary sites. The International Society for Clinical Densitometry recommended also that osteoporosis be diagnosed on the basis of the lowest T-score for BMD found at the spine, total hip, and femoral neck (3). Actually, 1 of the reasons for measuring BMD in several sites is the presence of discordance, which can affect the diagnosis and therapeutic plan in an individual person.

Discordance in diagnosis of osteoporosis is defined as the presence of different categories of T-scores (osteopo-

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rosis, osteopenia, and normal) in 2 skeletal sites of an individual patient (4). This phenomenon has been divided into 2 groups: major and minor (5). Minor discordance happens when the different diagnostic classes are adjacent, ie, patient is diagnosed as osteoporotic in 1 site and osteopenic in the other site, or, osteopenic in 1 site and normal in the other site. If the diagnosis is osteoporosis in 1 site and the other site is in the normal range, the discordance falls into the major class.

Various studies have analyzed the prevalence and impact of T-score discordance on the management of osteoporosis (5-10). However, most of these studies did not evaluate risk factors for this phenomenon. Thus, we aimed in this study to evaluate the presence and risk factors for T-score discordance in a large sample of patients.

METHODS

Patients

This was a retrospective review of DXA data collected from March 2003 to July 2007 from 1 center. Data were evaluated for all patients who had lumbar spine and hip scans performed in the same scanning session. Participants were excluded if BMD was affected by documented pathology or technical issues. A considerable proportion of these cases were healthy postmenopausal women consulting spontaneously or referred by clinicians for densitometric evaluations (11). A total of 3479 patients were identified with 608 men and 2871 women. The mean age was 54.9 (range, 20 to 92 years). Informed consent was obtained from all of the participants. The research protocol was approved by our institutional review board.

A standardized questionnaire was filled before densitometry for all participants. Demographic data (including age and sex) as well as other known or suspicious risk factors for osteoporosis (including menopause, age at menopause, age at menarche, history of osteoporotic fractures, drugs, and smoking) were collected. All participants had their standing height and weight measured. Body mass index (BMI) was calculated by dividing weight in kilograms by height in meters squared.

BMD Measurement

All the BMD measurements were done for diagnostic purposes and none of the participants were on treatment with bone active agents (hormone replacement therapy was not considered a bone active agent). BMD was determined by a Lunar Prodigy Vision DXA system (Lunar Corp., Madison, WI). The DXA scans were obtained by standard procedures supplied by the manufacturer for scanning and analysis. All BMD measurements were performed by 2 experienced technicians. Daily quality control was performed by measurement of a Lunar phantom. At the time of the study, phantom measurements showed stable results. The phantom precision expressed as the coefficient of variation (%) was 0.08. Moreover, reproducibility has been assessed recently in clinical practice and showed a smallest detectable difference of 0.04 g/cm^2 (spine) and 0.02 (hips) (12,13). Patient BMD was measured at the lumbar spine (anteroposterior projection at L1-L4) and the femurs (femoral neck, trochanter, ward, and total hip).

Using the Moroccan normative data for lumbar spine and hip (14), and the WHO diagnosis of osteoporosis (T-score $\leq$ 2.5) and osteopenia ($-1 \leq$ T-score $<$ 2.5), each patient was categorized as having 1 (only) of the following: concordance (osteoporosis, osteopenia, or normal BMD on both sites), minor discordance (osteoporotic in 1 site and osteopenic in the other site, or osteopenic in 1 site and normal in the other site), and major discordance (osteoporosis in 1 site and the other site is in the normal range).

Statistical Analysis

Independent sample t-test and χ^2 test were used first to compare presence of various risk factors in participants with and without T-score discordance. Potential risk factors were entered to a multivariate logistic regression analysis and the resulted odds ratios with 95% confidence intervals were reported. P values less than 0.05 were taken to indicate statistical significance. Statistical analyses were performed using SPSS 13.0.

RESULTS

Characteristics of the 3479 participants are summarized in Table 1. The main reasons of referral for BMD measurement were menopause in 50%, old age in 20%, glucocorticoid use in 7%, history of low energy fractures in 1.5%, and other reasons (such as metabolic disorders, rheumatoid arthritis, osteoporotic fracture family history,

Table 1 Characteristics of the Study Population

	Men (n = 608)	Women (n = 2871)
Age (yr)	51.1 (15.1)	55.7 (11.9)
Weight (kg)	72.6 (12.8)	70.8 (12.9)
Height (cm)	171.4 (6.9)	157.4 (6.2)
Body mass index (BMI) (kg/cm^2)	24.7 (4.0)	28.6 (5.0)
History of osteoporotic fracture	8 (2.4)	47 (1.2)
Corticosteroid use	41 (7.8)	127 (5.1)
Hormone replacement therapy		6 (0.2)
Menopause		1739 (57.7)
Total hip BMD (g/cm^2)	0.978 (0.15)	0.903 (0.14)
Lumbar spine BMD (g/cm^2)	1.071 (0.18)	0.976 (0.17)
Total hip T-score	−0.50 (1.21)	−0.91 (1.21)
Lumbar spine T-score	−1.02 (1.51)	−1.62 (1.45)

Numbers are presented as mean (standard deviation in parentheses) for numerical variables and frequency (percentage in parentheses) for categorical variables.