Discordance between Spinal and Hip Bone Mineral Density Values in Patients with Lumbar Scoliosis – Experience of a Single Institute

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ABSTRACT

Osteoporosis and scoliosis are encountered concurrently. Scoliosis predisposes to osteoporosis but degenerative scoliosis could falsely elevate lumbar bone mineral density measurement leading to discordance. This study was conducted to determine the prevalence of discordance between lumbar spines and hip bone mineral density in patients with lumbar scoliosis and to evaluate the risk factors of discordance. The prevalence of osteoporosis and discordance was determined as major and minor discordance. Old age, age at menopause, sex and BMI were considered as possible risk factors for discordance and were used in multivariate logistic regression analysis. Discordance between lumbar spines and hip was found in 55 (78.6 %) patients and among them major and minor discordance of T-scores were seen in 18 (25.7%) and 37 (52.9%) respectively. Concordance of T scores was seen in 15 (21.4%). In multivariate logistic regression analysis female sex, age older than 60 years and BMI less than 30 kg/m2 was identified as risk factors for T-score discordance.

In lumbar scoliosis the overestimation of lumbar spine may lead to diagnostic dilemma, whereas hip DEXA appears to be more reliable in these cases. In such cases it is in the jurisdiction of the physician to look for possible underlying causes of discordance of T score.

Key words: **Bone Mineral Density (BMD), Discordance and Scoliosis.**

INTRODUCTION

Osteoporosis and scoliosis are frequently encountered concurrently. Osteoporosis is the world's most prevalent metabolic disease of bone and expressed as low bone mass, increased fragility, decreased bone quality and increased risk of fracture(1). Dual-energy X-ray absorptiometry (DEXA) is a routinely used, widely accepted, cost-effective method to measure bone mineral density (BMD).The World Health Organization (WHO) has established DEXA as the best densitometry technique and recognized as the reference method for assessing BMD in postmenopausal women. According to WHO diagnostic criteria, osteoporosis is defined in terms of a T-score below 2.5 and osteopenia, when T-score is between -2.5 and -1, normal bone density when T-score is more than -1 (2, 3). BMD has measured at different sites and it has been shown that although the values of different sites correlate, the agreement between these sites are low. Disagreement of T-score between lumbar spine and hip bone leads to discordance. Discordance is a commonly observed phenomenon in densitometry study and has been divided into two groups: major discordance and minor discordance. Degenerative lumbar scoliosis is one of the responsible factors for discordance in the bone mineral density values in lumbar spine and hip bone. Degeneration of the lumbar spines or lumbar spondylosis is frequently encountered in elderly persons and developed in a skeletally mature patient (4,5).

It has been suggested that scoliosis predisposes to osteoporosis but degenerative scoliosis could falsely elevate lumbar bone mineral density measurement leading to discordance. When both osteoporosis and scoliosis coincide in the same person, the diagnosis of osteoporosis and treatment of spinal condition become cumbersome. The falsely elevated lumbar bone mineral density measurement even though osteoporosis is evident in the hip bone leads to diagnostic dilemma. This study was conducted to determine the prevalence of discordance between lumbar spines and hip bone mineral density in Bangladeshi patients with lumbar scoliosis in order to evaluate the risk factors of discordance.

PATIENTS AND METHODS

This is a prospective study carried out with Norland DEXA- XR 36 machine at NINMAS of Bangbandhu Sheikh Mujib Medical University campus, Shahbag, Dhaka, over a period of eleven months between July 2014 and May 2015. Patients referred for BMD test at NINMAS and having lumbar scoliosis in DEXA scan were included in this study. A total of 70 patients were enrolled in this study. The scoliosis of lumbar spine was determined by observation from the coronal images of DEXA scan. Written informed consent was obtained from each participant and detailed history were taken and recorded. Patients having history of spine fracture or implants were excluded from this study.

The T scores were recorded for determining osteoporosis in lumbar spines and hip bones (Ward's triangle of femur neck). The prevalence of osteoporosis and discordance of bone density was determined as major and minor discordance. Minor discordance happens when the different diagnostic classes are adjacent, that is, patient is diagnosed as osteoporotic in one site and osteopenic in the other site, or, osteopenic in one site and normal in the other site. If the diagnosis is osteoporosis in one site and the other site is in the normal range, the discordance falls into the major group (6). The study subjects were divided again into four groups according to body mass index (BMI), i.e. low BMI or underweight group (≤18.5 Kg/m2), normal BMI or normal weight group (18.5-24.9 Kg/m2), over weight group (25-29.9 Kg/m2) and obese group (≥30 Kg/m2). Old age, female gender and low BMI were considered as possible risk factors for discordance and were used in multivariate logistic regression analysis.

RESULTS

Total 70 patients (M-21, F-49) with a M:F ratio of 1: 2.3 and age ranging between 42 to 88 years (mean ± SD = 64.01± 10.55) were included (Table 1, 2). Discordance between lumbar spines and hip was found in 55 (78.6 %) patients and among them major and minor discordance of T-scores were seen in 18 (25.7%) and 37 (52.9%) respectively. Concordance of T scores was seen in 15 (21.4 %) (Table 3).

Table 1: Sex distribution of the patients (n=70)

Sex	Frequency	Percentage
Male	21	30.0
Female	49	70.0
Total	70	100.0
Male: Female ratio	1:2.3	

Table 2: Age distribution of the patients (n=70)

Age	Frequency	Percentage
41-50 yrs	10	14.3
51-60 yrs	18	25.7
61-70 yrs	28	40.0
71-80 yrs	10	14.3
> 80 yrs	4	5.7
Total	70	100.0
Mean±SD Range	64.01±10.55 (42-88) years	

Table 3: Distribution of the patients by type discordance and concordance (n=70)

	Frequency	Percentage (%)
Discordance	55	78.6
Minor discordance	37	52.9
Major discordance	18	25.7
Concordance	15	21.4

Lumbar spines showed osteoporosis in 14 (20.0%), osteopenia in 25 (35.7%) cases, and 31 (44.3%) cases showed normal bone density (Figure 1). Hip bones showed osteoporosis in 55 (78.6%) (Figure 2) and osteopenia in 15 (21.4%) cases, while none showed normal bone density at this region. Comparison between the two sites showed that most of the osteoporosis was measured by hip bone score than by lumbar spine and the difference was significant. Among 70 patients 44.3% patients found normal by lumbar spine score but none is normal by hip score (Table 4).

In multivariate logistic regression analysis female sex (p = 0.34, OR 1.95; CI: 0.43-9.99), age older than 60 years (p = 0.23, OR 2.13; CI: 0.53-9.16) and BMI less than 30 kg/m2 (p<0.001, OR 71.56; CI: 7.85-1653.9) was identified as risk factors for T-score discordance (Table 5).

Table 4 : Distribution of T- scores according to WHO criteria between lumbar spine and hip bone and comparison (n=70)

Classification of T score	Lumbar spine score		Hip bone score		P value
	No.	%	No.	%	
Osteoporosis (T= -2.5)	14	20.0	55	78.6	<0.001*
Osteopenia (-2.5< T = -1)	25	35.7	15	21.4	
Normal (T >-1)	31	44.3	0	0	
Total	70	100.0	70	100.0	

Chi-square test was performed to compare between two sites.

Table 5 : Multivariate logistic regression analysis for risk factors of discordance (n=70)

Variables	Discordance		Odd ratio at 95% CI	p value
	Present (n=55) No. (%)	Absent (n=15) No. (%)		
Sex				
Male	18(32.7%)	3(20.0%)	1.95*	0.34
Female	37(67.3%)	12(80.0%)	(0.43-9.99)	
Age				
< 60 yrs	24(43.6%)	4(26.7%)	2.13*	0.23
> 60 yrs	31(56.4%)	11(73.3%)	(0.53-9.16)	
BMI				
< 30 kg/m^2	46(83.6%)	14(93%)	71.56*	<0.001
> 30 kg/m^2	9(16.4%)	1(6.7%)	(7.85-1653.9)	

*Indicates significant Odds ratio. Data are presented as frequency, percentage and odds ratio (95%) Confidence Intervals in parentheses.

Most of the patients 78.6% had osteoporosis measured by hip bone score but only 20% measured osteoporosis by lumbar spine. 44.3% patients found normal by lumbar spine score but none is normal by hip bone score.

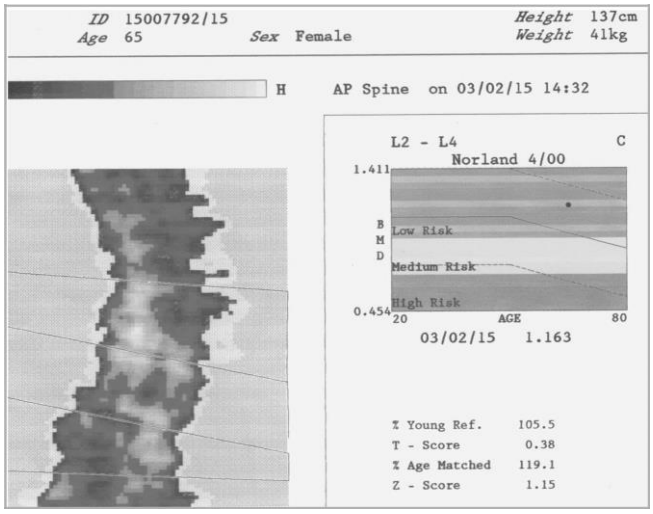

Figure 1: Anteroposterior lumbar spines show scoliosis and T-score 0.38, suggesting normal bone density.

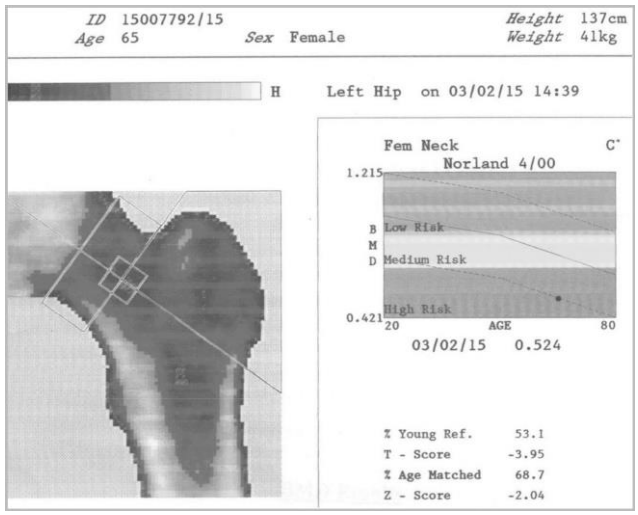

Figure 2: Hip bone (Neck femur) shows T-score -3.95, suggesting marked osteoporosis.

DISCUSSION

Discordance between lumbar spine and hip bone in DEXA scan is a common phenomenon and up to 45% of patient referred for DEXA scan may show diagnostic discordance (7). Depending upon the causes discordance has defined as physiologic discordance, patho-physiological discordance, anatomic discordance, artifactual discordance and technical discordance (6). The patho-physiological discordance is also called secondary discordance and occurs secondary to any disease or use of medicine like degenerative lumbar diseases. Degenerative lumbar spine disease is associated with development of vertebral osteophytes, facet degeneration, sclerosis of the inter-vertebral disc. These changes are responsible for falsely elevated lumbar spine T-score and thereby elevated spinal BMD measurement in DEXA scan leading to discordance, the patho-physiological discordence (8).

In our small study population, scoliosis was found mostly in the female group. T score discordance was prevalent and present in 78.6% cases. Concordance was present in 21.4 % cases. Minor and major discordance was observed in 52.9% and 25.7% cases respectively. Similar findings were observed and reported in a study on minor and major discordance between lumbar spine

and hip DEXA scan. In another study conducted on lumbar scoliotic patients by Ioannis P. Pappou et al 2006, the spinal BMD exhibited discordantly high values despite the presence of significant hip osteoporosis (8). In our study osteoporosis was determined in 78.6% cases in hip DEXA and only 20.0 % cases in lumbar spine. Comparison between the lumbar spine and hip DEXA in scoliosis showed hip DEXA superior and more reliable or sensitive in the diagnosis of osteoporosis in the scoliosis patients. Lee-Ren Yeh et al (2004) and Ioannis P. Pappou et al (2006) stated similar finding in their reported studies (8,9).

In our patients we looked for potential risk factors for T-score discordance. We considered old age, sex and BMI as possible risk factors for discordance and multivariate logistic regression analysis was done. In multivariate logistic regression analysis female sex ($p = 0.34$, OR 1.95; CI: 0.43-9.99), age older than 60 years ($p = 0.23$, OR 2.13; CI: 0.53-9.16) and BMI less than 30 kg/m2 ($p<0.001$, OR 71.56; CI: 7.85-1653.9) was identified as risk factors for T-score discordance. We found T -score discordance was more prevalent in female than male. In older age and patients having BMI less than 30 kg/m2, the prevalence of discordance was more. Similarly female sex and old age were identified as risk factors in two studies. But in some studies BMI more than 30 Kg/m2 or obesity was identified as potential risk factor for T score discordance (9,10). This finding is however not in agreement with our study result.

The high prevalence of discordance in lumbar scoliosis patient could induce problems or dilemma for the physician in diagnosis and management. Internationally it is recommended to use both spine and hip for DEXA scans and classify the patient based on the lowest T score value.

CONCLUSION

In lumbar scoliosis DEXA scan might show overestimation of lumbar BMD and high prevalence of discordance. The overestimation of lumbar spine may lead to diagnostic dilemma, whereas hip DEXA appears to be more reliable in these cases. In such cases it is in the jurisdiction of the physician to look for possible underlying causes of discordance of T score.

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