Diabetes mellitus and male osteoporosis

Is there a relationship?

AbdulMohsen H. Al-Elq, *SBIM, FACE,* ***Mir Sadat-Ali,*** *FRCS, D Orth.*

ABSTRACT

Objective: To evaluate the relationship between male osteoporosis and type 2 diabetes mellitus (DM).

Methods: We screened 154 male Saudi Arabian patients over the age of 50 years for osteoporosis between May and December 2005, at the Endocrine and Orthopedic Clinics of King Fahd University Hospital, Al-Khobar, Kingdom of Saudi Arabia. Patients body mass index was calculated. Fasting blood glucose was measured in all patients. All patients with type 2 DM hemoglobin A1c levels were measured at follow up. All had bone mineral density (BMD) measurement of hip area and the lumbar spine using the dual energy x-ray absorptiometry scan, and osteoporosis and osteopenia was assessed on the basis of the World Health Organization guidelines. The data was entered in the database and analyzed using the Statistical Package for Social Sciences software with statistical significance of <0.05 and a confidence interval of 95%.

Results: There were 57 patients in group A (type 2 DM) with an average age of 59.76 years, 34 in group B (impaired fasting glucose) with an average age of 60.90 years and 63 in group C (normal glucose level), with an average age of 62.53 years. Bone mineral density analysis revealed 10 patients (17.5%) in group A, 7 (20%) in group B and 12 (19%) in group C were normal. Analysis did not show any statistical significance among the 3 groups with regard to BMD, T-Score and Z-Score.

Conclusions: The study indicates that the prevalence of osteopenia and osteoporosis is common among the Saudi Arabian males. The presence of type 2 diabetes mellitus in these patients did not influence or increase the incidence of osteopenia or osteoporosis.

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Osteoporosis is a decrease in the bone mass and micro-architectural deterioration of the bone tissue. Lately, it was realized that osteoporosis in male is not as rare as it was previously believed. The World Health Organization reported that in the United States of America 55% of the people over the age of 50 years suffer from osteoporosis.[1] A recent report on primary osteoporosis in male population from Saudi Arabia showed a high prevalence of osteoporosis and osteopenia.[2] Many causes of secondary osteoporosis are known and diabetes mellitus is blamed to be one of them.[3-5] A recent review showed that there was an increased bone resorption and decreased bone mineral density in type 1 diabetes mellitus,[6] while others showed a decreased rate of fractures in patients with type 2 DM.[7] Controversy is still brewing regarding the risk of osteoporosis in type 2 DM.[8-10]

Diabetes mellitus is a common metabolic problem among Saudi Arabian population and the prevalence is reported to be increasing since the 1980's.[11-14]

From the Department of Internal Medicine (Al-Elq) and the Department of Orthopedic Surgery (Sadat-Ali), King Fahd Hospital of the University, Al-Khobar, *Kingdom of Saudi Arabia*.

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Address correspondence and reprint request to: Prof. Mir Sadat-Ali, Professor of Orthopedic Surgery and Consultant Orthopedic Surgeon, King Fahd Hospital of the University, PO Box 40071, Al-Khobar 31952, *Kingdom of Saudi Arabia*. Tel. +966 505848281. Fax. +966 (3) 8971013. E-mail: drsadat@hotmail.com

Physicians over the years have been battling the management of diabetic related complications like diabetic nephropathy,[15] retinopathy,[16] vascular complications[17] and diabetic neuropathies,[18] and in the midst of this it was little anticipated that osteoporosis could become one of the complications of diabetes due to increased life expectancy of patients. Most of the studies reported were assessments of female patients with type 2 DM and little is known regarding the effect of type 2 DM on osteoporosis among male population. The aim of this study was 2 fold; to find if there is an increased risk of osteoporosis and osteopenia among male Saudi Arabs suffering from type 2 DM on the basis of BMD and T-score and to establish if any relationship exists between BMD and T-score and the diabetic control.

Methods. One hundred and fifty-four male Saudi Arabian patients over the age of 50 years were included and screened for osteoporosis. The exclusion criteria were secondary osteoporosis and type 1 DM. Secondary osteoporosis was ruled out on the basis of clinical evaluation and laboratory investigations particularly hormonal profile. Patients with type I DM were identified on the basis of clinical presentation and were excluded. The patients were divided into 3 groups: group A who were diagnosed as type 2 diabetes mellitus as defined in accordance with the criteria of the American Diabetes Association, group B with impaired fasting glucose (serum glucose level between 100-125 mg/dl) and group C with normal blood glucose level.[19] Between May and December 2005, patients attending the Orthopedic and Endocrine Clinics at King Fahd University Hospital, Al-Khobar, Kingdom of Saudi Arabia were screened after a verbal consent. At the time of the clinic visit a detailed history was recorded, weight and height was measured to calculate their body mass index (BMI). Blood samples were drawn after overnight fasting for complete blood picture, erythrocyte sedimentation rate, renal and liver function tests, calcium and phosphorous level. Required investigations were done to rule out endocranial causes of secondary osteoporosis. Patients in group A had their glycosylated hemoglobin (HbA1c) examined to assess the control of the diabetes. The diabetes mellitus was considered controlled if the level of HbA1c was ≤7.[20] All patients had bone mineral density (BMD) measurement of hip area and the lumbar spine using the dual energy x-ray absorptiometry (DEXA) scan (Hologic Inc., Waltham, MA, USA). Patients with a T Score of –2.5 SD and lower, were considered as osteoporotic and those between –1 to –2.5 SD were taken as osteopenic for analysis. The data was entered in the database and analyzed using the Statistical Package for the Social Sciences software (SPSS, Chicago, Illinois) with statistical significance of <0.05 and confidence interval of 95%.

Results. We were able to analyze the data of 154 patients with an average age of 62.51 years (range 50 - 76 years) ± 7.14 years with a mean BMI of 23.46 (18.42 - 35.5) ± 3.72. **Table 1** gives the demographic data of the 3 groups with the percentage of osteopenia and osteoporosis. The 3 groups were similar in terms of age distribution and BMI. Analysis of the scans of the hip revealed that 27.9% of the patients were osteoporotic with an average BMD of 0.757 gm/cm^2 (0.679 - 0.89) ± 0.017 and a mean T-Score of -3.12 (-2.6 - -4.5) ± 0.07. Eighty-two (53.2%) patients were osteopenic with BMD of 0.914 gm/cm^2 (0.697 - 1.065) ± 0.021 and mean T Score of -1.84 (-1.1- -2.5) ± 0.312. The BMD of spine showed that the prevalence of osteoporosis was 63 (40.7%) with a mean T-Score of -3.40 (-2.8 - -5.1) ± 0.69 and 35% were osteopenic with a T-Score of -1.80 (-1.3 - -2.5) ± 0.32. **Table 2 & 3** shows a comparison of the 3 groups of BMD, T Score and Z-score for osteopenia and osteoporotic patients. The BMD of hip area in uncontrolled DM patients (mean HbA1c of 8.65) was 0.775g/cm^2 compared to the controlled group (mean HbA1c 6.38), which was 0.791g/cm^2, p=0.2.

Table 1 - Demographic data of patients in the 3 groups.

Parameter	Group A	Group B	Group C
Number of patients	57	34	63
Age	59.76 ± 1.46 (51 - 75)	60.90 ± 1.04 (53 - 72	62.53 ± 1.49 (50 - 76)
Body mass index	23.10 ± 0.81 (18.4 - 35.5)	24.67 ± 0.516 (18.5 - 28.5)	23.86 ± 0.391 (20 - 28.9)
Fasting blood glucose	158.6 ± 5.40 (128 - 210)	109 ± 0.99 (101 - 123)	77.86 ± 1.42 (69 - 90)
Glycosylated hemoglobin	8.67 ± 0.34 (7.2 - 15.3)	---------	-------
Calcium	9.47 ± 0.07 (8.9 - 102)	9.65 ± 0.089 (8.9 - 10.9)	9.33 ± 0.04 (8.8 - 9.7)
Phosphorous	3.28 ± 0.076 (2.6 - 4.2)	3.65 ± 0.054 (2.9 - 4.5)	3.65 ± 0.054 (2.9 - 4.2)
Alkaline phosphatase level	84.86 ± 5.35 (50 - 140)	88.90 ± 4.66 (45 - 133)	79.41 ± 2.22 (56 - 108)
Osteoporosis	16	9	18
Osteopenia	31	18	33

Table 2 - Comparison of patients in the 3 groups with osteoporosis.

Parameter	Group A	Group B	Group C	*P* value for group A and C	*P* value for group B and C
Number of patients	16	9	18		
Bone mineral density hip	0.757 ± 0.04 (0.679 - 0.744)	0.869 ± 0.006 (0.863 - 0.89)	0.875 ± 0.005 (0.851 - 0.896)	0.2	0.4
Bone mineral density spine	0.744 ± 0.02 (0.527 - 0.856)	0.851 ± 0.024 (0.779 - 0.826)	0.758 ± 0.01 0.713 - 0.82)	0.3	0.2
T-Score hip	-3.5 ± 0.15 (-2.9 - -4.5)	-3.07 ± 0.122 (-2.9 - -3.2)	-2.9 ± 0.039 (-2.6 - -3.1)	0.4	0.2
T-Score spine	-3.74 ± 0.18 (-2.7 - -5.1)	-3.19 ± 0.18 (-2.5 - -4)	-3.27 ± 0.20 (-2.7 - -4.4)	0.5	0.3
Z-Score hip	-1.7 ± 0.2 (-1.5 - -1.9)	-1.25 ± 0.22 (-0.9 - -1.9)	-1.39 ± 0.23 (-0.3 - -1.9)	0.7	0.4
Z-Score spine	-2.88 ± 0.23 (-1.6 - -4.8)	-2.25 ± 0.2 (-1.5 - -3.5)	-2.55 ± 0.20 (-1.6 - -3.5)	0.9	0.6

Table 3 - Comparison of patients in the 3 groups with osteopenia.

Parameter	Group A	Group B	Group C	*P* value for group A and C	*P* value for group B and C
Number of patients	31	18	33		
Bone mineral density hip	0.916 ± 0.1 (0.836 - 1.01)	0.923 ± 0.01 (0.863 - 1.055)	0.938 ± 0.01 (0.874 - 1.065)	0.5	0.4
Bone mineral density spine	0.839 ± 0.02 (0.527 - 1.103)	0.908 ± 0.014 (0.849 - 1.124)	0.930 ± 0.01 (0.802 - 1.055)	0.14	0.3
T- Score hip	-1.89 ± 0.09 (-1 - -2.1)	-1.19 ± 0.08 (-1.4 - -2.5)	-1.64 ± 0.09 (-1.1 - -2.2)	0.8	0.7
T-Score spine	-2.1 ± 0.23 (-0.9 - -2.4)	-1.93 ± 0.07 (-1.4 - -2.5)	-2.12 ± 0.04 (-1.6 - -2.5)	0.8	0.5
Z-Score hip	-0.7 ± 0.09 (0.7 - -1.9)	-0.52 ± 0.10 (0.4 - -1.1)	-1.03 ± 0.13 (-0.2 - -2.3)	0.01	0.05
Z-Score spine	-1.86 ± 0.28 (-0.9 - -2.5)	-1.05 ± 0.06 (-0.3 - -1.5)	-1.01 ± 0.13 (-0.3 - - 2.7)	0.4	0.7

Discussion. Osteoporosis is now recognized as a major public health issue. With the improvement of health care facilities in the developing world, the life expectancy of people has increased, thereby, doubling the risk of fractures due to osteoporosis. Osteoporosis and its related fractures were always thought to be a disease of the postmenopausal women and it was never envisaged that males could also suffer from these fractures in their 50's due to osteoporosis. Although the incidence of osteoporosis related hip fractures is lower in men as compared to women to the extent of 4-5 per 1000 versus 8-10 per 1000,[21] the mortality is double that in women (31% versus 17%).[22.]

There are contradicting reports in the literature regarding the BMD in patients with type 2 DM. Van Daele et al[23] Barrett-Connor and Holbrook,[24] reported that patients with type 2 DM had increased BMD, whereas others found that the BMD in those patients is similar to the control groups[25] or even decreased.[26] Al-Maatouq et al[27] after studying postmenopausal women with type 2 DM, concluded that osteoporosis was more common among the diabetics in comparison to non diabetic Saudi women. One confounding factor, which was reported to influence the decrease in the BMD in diabetics is the poor control of the blood sugar levels.[28] In our own patients, we noticed that patients who had a poor control of diabetes on the basis of the level of Hb1Ac had lower BMD as compared to their counterparts, but that was not statistically significant. Other confounding factor

reported in the literature is the type of anti diabetic therapy, which was not evaluated in this study. The 3 study groups were similar in terms of age and BMI.

It is known that the risk of osteoporotic fracture in males is less than females, with a lifetime risk at 50 years of 17-22.5% in women and 6-11% in men.[29-30] Reports are appearing in the literature regarding the increased incidence of hip fractures in women with type 2 DM,[31-32] but this is not universally supported.[23, 33-34] Chau and Edelman[35] believed that patients with type2 DM are usually obese having sedentary life and poor coordination and balance that predispose them to fall easily with increased risk of fractures. Earlier Poor et al[36] reported that inactivity and obesity increases the risk of fractures in men in many-fold.

Osteoporosis in men is not that rare as thought previously but consensus and guidelines to screen men for the diagnoses of osteoporosis are still emerging. Amin and Felton[22] and Orwoll[37] recommended that screening for osteoporosis in males should start around 70 years of age. We believe that this recommended age is a little bit late. In an earlier study from our institution, it was found that the prevalence of male osteoporosis and osteopenia is high and start at a younger age compared to the western population.[2] We recommend that the male population in this part of the world should be screened from the 5th decade onwards and may be earlier in patients with risks of secondary osteoporosis.

In conclusion, the results of this study indicate that Saudi Arabian male patients with type 2 DM does not have an increased risk of osteoporosis as compared to the non-diabetic counter parts, and controlled DM had no bearing on the risk and severity of osteoporosis.

References

1. National Osteoporosis Foundation. America's Bone Health: The State of Osteoporosis and Low Bone Mass in Our Nation. Washington DC: National Osteoporosis Foundation; 2002.
2. Sadat-Ali M, Elq AH. Male Osteoporosis Among Saudi Arabian Population: Will we miss the bus again? Proceedings of the 6th European Congress on Clinical and Economic. Aspects of Osteoporosis and Osteoarthritis, 15-18 March, 2006, Austria, Vienna.
3. Templeton K. Secondary osteoporosis. ***J Am Acad Orthop Surg*** 2005; 13: 475-486.
4. Boling EP. Secondary osteoporosis: underlying disease and the risk for Glucocorticoid-induced osteoporosis.***Clin Ther*** 2004; 26: 1-14.
5. Hirano Y. The change of bone mineral density in secondary osteoporosis and fracture incidence. ***J Bone Miner Metab*** 1999; 17: 119-124.
6. Olmos JM, Pere-Castrillon JL, Garcia MT, Garrido JC, Amado JA, Gonzalez-Macias J. Bone densitometry and biochemical bone remodeling markers in type I diabetes mellitus. ***Bone and Mineral*** 1994; 26: 1-8.
7. Leidig-Bruckner G, Ziegler R. Diabetes mellitus a risk for osteoporosis? ***Exp Clin Endocrino Diabetes*** 2001; 109 Suppl 2: S493-514.
8. Bouillon R. Diabetic bone disease. ***Calcif Tissue Int*** 1991; 41: 119-133.
9. Kayath MJ, Tavares EF, Dib SA, Vieria JGH. Prospective bone mineral density evaluation in patients with insulin dependent diabetes mellitus. ***J Diabetes Complications*** 1998; 12: 133-139.
10. Nicodemus KK, Folsom AR. Type 1 and 2 diabetes and incident hip fractures in postmenopausal women. ***Diabetes Care*** 2001;24: 1192-1197.
11. Al-Nozha MM, Al-Maatouq MM, Al-Mazrou YY, Al-Harthi SS, Arafah MR, Khalil MZ, et al. Diabetes mellitus in Saudi Arabia. ***Saudi Med J*** 2004; 25: 1603-1610.
12. El-Hazmi MAF, Al-Swailem A, Warsy AS, Sulimani R, Al-Swailem A. Prevalence of diabetes mellitus in Saudi Arabia. ***Saudi Med J*** 1995, 16: 294-299.
13. Abu-Zeid HAH, Al-Kassab ASK. Prevalence and health-care features of hyperglycaemia in semi urban-rural communities in southern Saudi Arabia. ***Diabetes Care*** 1992, 15: 484-489.
14. Fatani HH, Mira SA, El-Zubier AG. Prevalence of diabetes mellitus in rural Saudi Arabia. ***Diabetes Care*** 1987; 10: 180-183.
15. Al-Khader A. Impact of diabetes in renal diseases in Saudi Arabia. ***Nephrol Dial Transplant*** 2001; 16: 2132-2135.
16. Lightman S. Diabetic retinopathy. ***Clin Cornerstone*** 2003; 5: 12-21.
17. Deewania PC. Diabetes is a vascular disease: The role of endothelial dysfunction in pathophysiology of cardiovascular disease in diabetes. ***Cardio Clin*** 2004; 22: 505-509.
18. Bansal V, Kalita J, Misra UK. Diabetic neuropathy. ***Postgrad Med J*** 2006; 82: 95-100.
19. American Diabetes Association. Diagnosis and Classification of Diabetes Mellitus. ***Diabetes Care*** 2006; 29: (Supp 1); S43-48.
20. American Diabetes Association. Standards of medical care in Diabetes. ***Diabetes Care*** 2006; 29: S1-42.
21. Orwoll ES. Osteoporosis in men. ***Endocrinol Metab Clin North Am*** 1998; 27: 349-67.
22. Amin S, Felson DT. Osteoporosis in men. ***Rheum Dis Clin North Am*** 2001; 27: 19-47.
23. Van Daele P, Stolk RP, Burger H, Algra D, Grobbee DE, Horman A, et al. Bone density in non-insulin dependent diabetes. The Rotterdam Study. ***Ann Intern Med*** 1995; 122: 409-414.
24. Barrett-Connor E, Holbrook TL. Sex differences in osteoporosis in older adults with non-insulin dependent diabetes. ***JAMA*** 1992; 268: 3333-3337.
25. Yawar A, Zuberi LM, Haque N. Type 2 diabetes and risk of osteoporosis. ***J Pak Med Assoc*** 2005; 55: 568-569.
26. Levine ME, Boisseau VC, Avioli LV. Effects of diabetes mellitus on bone mass in juvenile and adult onset diabetes. ***N Engl J Med*** 1976; 294: 241-245.
27. Al-Maatouq MA, El-Desouki MI, Othman SA, Mattar EH, Babay ZA, Addar M. Prevalence of osteoporosis among postmenopausal females with diabetes mellitus. ***Saudi Med J*** 2004; 25: 1423-1427.

28. Gregorio F, Cristallini S, Santeusanio F, Filpponi P, Fumelli P. Osteopenia associated with non-insulin dependent diabetes mellitus. What are the causes? ***Diabetes Res Clin Pract*** 1994; 23: 43-54.
29. Melton LJ, Kan SH, Wahner HW, Riggs BL. Lifetime fracture risk: An approach to hip fracture risk assessment based on bone mineral density and age. ***J Clin Epidemiol*** 1988; 41: 985-994.
30. Oden A, Dawson A, Dere W, Johnell O, Jonsson B, Kanis JA. Lifetime risk of hip fractures is underestimated. ***Osteoporosis Int*** 1998; 8: 599-603.
31. Nicodemus KK, Folsom AR. Type 1 and type 2 diabetes and incidence of hip fractures in postmenopausal women. ***Diabetic Care*** 2001; 24: 1192-1197.
32. Forsen L, Meyer HE, Midthjell K, Edna TH. Diabetes mellitus and incidence of hip fractures: results from the Nord-Trondelag Health Survey. ***Diabetologia*** 1999; 42: 920-925.
33. Leidig-Bruckner G. Diabetes mellitus a risk for osteoporosis? ***Exp Clin Endocrinol Diabetes*** 2001; 109 Suppl2 : S493-514.
34. Hirano Y, Kishimoto H, Hagino H, Teshima R. The change of bone mineral density in secondary osteoporosis and vertebral fracture incidence. ***J Bone Miner Metab*** 1999;17: 119-24.
35. Chau DL, Edelman SV. Osteoporosis and Diabetes. ***Clinical Diabetes*** 2002;20:153-57.
36. Poor G, Atkinson EJ, O'Fallon WM, Melton III LJ. Prediction of hip fractures in elderly men. ***J Bone Miner Res*** 1995; 10: 1900-1907.
37. Orwoll E. Assessing bone density in men. ***J Bone Miner Res*** 2000;15: 1867-1870.

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