The Impacts of Type 2 Diabetes Mellitus on Bone Markers in the Elderly Thai Women

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A comparison study of bone turnover between the diabetic type 2 and the non-diabetic patients was conducted by using the age matching technique. The bone markers of the diabetic type 2 patients showed CTx = 0.48 ng/ml, NMID osteocalcin = 24.62 ng/ml and PINP = 38.61 ng/ml. All study parameters of bone markers were higher than the control group. Thus, the diabetic cases with high bone turnover assuredly predisposed to osteoporosis. The bone change consistently monitored particularly in the diabetic cases could prevent osteoporosis. The high calcium diets and regular exercises were recommended for the diabetic patients.

Keywords: *Bone Markers, Diabetes mellitus type 2, Elderly*

J Med Assoc Thai 2009; 92 (Suppl 5): S45-8
Full text. e-Journal: *http://www.mat.or.th/journal*

Diabetes mellitus is a non-communicated disease; it is certainly a burdensome expense for both social welfare and individual health care resulting in the poor quality of life. The primary purpose of the analysis was to evaluate the association between the bone markers and the diabetic patients. The common diabetic complications are eyes, renal problems and vascular diseases, *e.g.* stroke and venous thrombosis. Some cases have uncontrollable chronic ulcers leading to loss of their extremities such as legs, toes and fingers. However, bone complication is still overlooked. At present, many reports have confirmed osteoporosis and bone resorption are one of the diabetic complications of the two types[1-5]. Okazaki[4] reported that uncontrollable blood sugar would enhance the bone resorption in diabetes type 2 and it would be reversible if the blood sugar level turned to normal[7]. Guvan[5] and some other studies[6,7] showed that the bone mass of spine and hip of the diabetic type 2 patients had a bone mark decrease when being compared with the control group.

Elderly women are naturally prone to osteoporosis due to the poor quality of the aging bone[8], but the diabetic condition will aggravate the bone resorption which leads to fracture risks[7]. In this study, the bone markers are: 1) formative marker, *e.g.* NMID osteocalcin and PINP and 2) bone resorptive markers, *e.g.* CTx or Betacrosslap were applied to diagnose the status of bone whether it was either low or high bone turnover.

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Material and Method

One hundred and twenty-six diabetic Thai women at the age of 60 or more were enrolled at Family Medicine Unit of Buddhachinaraj Hospital, Phitsanulok, Thailand. The patient's characteristics were shown in Table 1.

Table 1. Characteristics of female patients

Female	n	Min	Max	Mean	SD
Age	125	60	85	68.97	5.77
BW (kg)	126	41	93	59.1349	11.018
Ht (metre)	124	1.4	1.68	1.5331	0.05755
BMI	124	17.36	44.13	25.11	4.508
HbA1C	117	4.4	12.3	7.235	1.39

BW = body weight, Ht = Height BMI = body mass index
HbA1C = hemoglobin A1C

The fasting blood collected between 8.00-9.00 a.m. were kept in the sodium fluoride, potassium oxalate tube and in the K2 EDTA tube for the analysis of blood sugar and bone markers respectively. The control group blood was collected under the same condition.

Statistical analysis

The data analysis was calculated by the SPSS program. The descriptive statistics was applied to display the mean and SD of both study and control groups. Independent t-test was used to compare the levels of PINP, CTx and NMID osteocalcin between the study group and the control one. P-value = 0.05 was considered statistically significant.

Results

The t-test used to equalize the mean of bone markers in the elderly diabetic type 2 women (Table 4) showed the mean of PINP = 38.61 ng/ml, NMID osteocalcin = 24.62 ng/ml and CTX or Betacrosslap = 0.48 ng/ml (Table 2). The control group had PINP = 32.92 ng/ml, NMID osteocalcin = 14.0 ng/ml and CTx = 0.30 ng/ml (Table 3). The bone markers such as NMID osteocalcin and CTx in the elderly diabetic women were significantly higher than the control group (p = 0.01 and p = 0.001 respectively). Additionally, the PINP of the study group was higher than the control, but the value was not significant (p = 0.247).

Discussion

Neither diabetes mellitus type 1 nor type 2 was widely recognized as a cause of osteoporosis. The Nord-Trondelag Health Survey from Norway[9] reported that the relative risk of diabetes type 1 was 6.9, confident interval = 2.2-21.6 in comparison with the control group. Falling is commonly found in the diabetes type 2 patients; its result frequently is hip fracture. The major causes of falling are muscular malfunction, visual problems, peripheral neuropathy and the poor bone quality due to the failure of micro-circulation. The victims are prone to fracture after falling. Schwartz[9] confirmed that the diabetes type 2 elderly gained more experience of higher fracture rate in the region of the hip, humerus and foot than the non-diabetic women. In addition, high blood sugar levels will induce bone resorption which is the early sign of bone deterioration. Okazaki[7] found that the bone resorption could be reversed after the adjustment of blood sugar levels. This study showed

Table 2. Bone markers of the study group

	n	Minimum	Maximum	Mean	SD
NMID	126	2.08	206.8	24.616	22.127
CTx	126	0.053	1.81	0.48	0.2899
PINP	102	15.65	188.9	38.615	25.615

Table 3. Bone markers of the control group

	n	Minimum	Maximum	Mean	SD
NMID	30	8.45	19.91	14.001	3.725
CTx	30	0.127	585	0.30313	0.1251
PINP	30	11.89	72.6	32.916	14.447

Table 4. T-test for equalizing the mean

		t-test for equalizing the mean						
		t	df	Sig. (2-tailed)	The mean difference	Std. error difference	95% confidence interval of the difference	
							Lower	Upper
NMID	Equal variances assumed	2.612	154	0.010	10.61	4.0631	2.5877	18.640
	Equal variances not assumed	5.090	147.5	0.000	10.61	2.0852	6.4935	14.735
B crosslap	Equal variances assumed	3.280	154	0.001	0.1777	0.05420	0.07069	0.28487
	Equal variances not assumed	5.156	109	0.000	0.1777	0.03448	0.10944	0.24613
P1NP	Equal variances assumed	1.163	130	0.247	5.699	4.8989	3.9928	15.391
	Equal variances not assumed	1.557	86.25	0.123	5.699	3.6592	1.5749	12.973

that diabetes type 2 was an indicator of bone turnover compared with the age matching women whose the resorptive bone marker called Betacrosslap was = 0.48 ng/ml and the bone formative marker called NMID was = 24.62 ng/ml. Both markers of which the p-values = 0.001 and 0.01 respectively were significantly higher than the control group. The procollagen type 1 named nitrogenous peptide (PINP) had no significant value. This study also confirmed that the diabetic type 2 elderly had high bone turnover which predisposed them to bone deterioration. The researchers insisted that the bone markers were the essential tools for checking the bone status in order to prevent bone fracture. The common site of fracture occurrence is hip after falling. The concept of hip fracture prevention should be seriously considered. If a fracture happens, the costly expense of hip fracture treatment would be patients' big burden. They could possibly pay almost 116,458.60 Baht for the first year of ailment[10] while the cost of bone markers for 2 items is 800 Baht. Decreasing blood sugar levels are of paramount importance for bone loss prevention. Besides, it should be recommended to diabetic cases to perform body exercise regularly and that they be provided adequate minerals and vitamin D.

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การเปลี่ยนแปลง bone marker ในโรคเบาหวาน ชนิดที่สอง

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ผู้สูงอายุมีความเสี่ยงในการเกิดโรคกระดูกพรุน เมื่อมีค่ามวลกระดูกลดลง จะมีโอกาสต่อการเกิดกระดูกหัก จากการศึกษาในต่างประเทศที่ผ่านมาพบว่า ผู้ป่วยเบาหวานชนิดที่ 1 มีภาวะกระดูกพรุนเป็นโรคแทรกซ้อนแอบแฝง และพบว่าในหญิงวัยหมดประจำเดือนที่ป่วยเป็นเบาหวานชนิดที่ 2 มีค่า bone turnover rate ต่ำกว่าหญิงวัยหมดประจำเดือนที่ไม่ได้ป่วย วัตถุประสงค์ของการศึกษานี้ต้องการรู้ว่าในผู้หญิงไทยสูงอายุที่ป่วยเป็นโรคเบาหวานชนิดที่ 2 จะมีอิทธิพลต่อ bone turnover rate หรือไม่ และแตกต่างกับผู้หญิงสูงอายุที่ไม่ได้ป่วยเป็นโรคเบาหวานหรือไม่ โดยวัดระดับ bone formation markers (P1NP, N-Mid Osteocalcin) และ bone resorption marker (Beta Crosslap)

จากการศึกษานี้พบว่า ในผู้หญิงสูงอายุที่ป่วยเป็นโรคเบาหวานชนิดที่ 2 ค่าเฉลี่ยของ P1NP เป็น 38.61 นาโนกรัมต่อมิลลิลิตร N-Mid Osteocalcin เป็น 24.62 นาโนกรัมต่อมิลลิลิตร Beta Crosslap เป็น 0.48 นาโนกรัมต่อมิลลิลิตร เมื่อเปรียบเทียบกับผู้หญิงสูงอายุที่ไม่ได้ป่วยเป็นโรคเบาหวานพบว่า ค่า N-Mid Osteocalcin, Beta Crosslap ของผู้หญิงสูงอายุที่เป็นโรคเบาหวานมีค่าสูงกว่าอย่างมีนัยสำคัญทางสถิติ ส่วนค่า P1NP สูงกว่าแต่ไม่มีนัยสำคัญทางสถิติ โดยสรุป ผู้หญิงสูงอายุที่ป่วยเป็นโรคเบาหวานชนิด ที่ 2 มีค่า bone turnover rate สูงกว่าผู้หญิงสูงอายุที่ไม่ได้ป่วยเป็นโรคเบาหวานโดยเฉพาะ bone resorption marker จึงสมควรให้มีการเฝ้าระวังภาวะกระดูกพรุนในผู้หญิงสูงอายุ ที่ป่วยเป็นโรคเบาหวาน โดยให้คำแนะนำการรับประทานอาหารที่มีแคลเซียมสูง ออกกำลังกายอย่างสม่ำเสมอ และให้ตรวจวัดระดับสารในเลือดที่บ่งชี้ถึงการเปลี่ยนแปลงของมวลกระดูก เพื่อประเมินความเสี่ยงต่อการเกิดโรคกระดูกพรุนเป็นระยะ