Glycemic Control in Diabetes with Metabolic Syndrome in Community Hospital

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Objective: *To identify the prevalence of the metabolic syndrome in type 2 diabetic patients of Hangchat Community Hospital and to compare glycemic control between patients with and without metabolic syndrome.*
Material and Method: *A cross-sectional, hospital-based study was done in type 2 diabetic patients attending the DM Clinic of Hangchat Community Hospital in July 2007. The patients who have followed up in the diabetic clinic for at least one year, were assessed for the presence of metabolic syndrome using the criteria proposed by the American Heart Association/National Heart, Lung, and Blood Institute (AHA/NHLBI). Demographic data, co-morbid diseases, concurrent medications, fasting plasma glucose, and hemoglobin A1C (HbA1c) were collected and compared among patients with and without metabolic syndrome.*
Results: *Three hundred twenty five patients (64.9% female) with mean age ± SD of 57.8 ± 11.1 years were analyzed. The prevalence of metabolic syndrome in diabetes was 84.0%. Only 29.7% of all patients could meet American Diabetes Association (ADA) goal for HbA1c control (lower than 7%). Compared with those patients without metabolic syndrome, the diabetic patients with metabolic syndrome had lower education, lower income, and lower proportion of achieving good blood pressure control (below 130/80 mmHg). The triglyceride levels of the metabolic syndrome group were higher and the HDL-C levels were lower than the other group. Mean HbA1c levels were not different between diabetes with and without metabolic syndrome (8.0 ± 1.8% and 8.1 ± 2.0%, respectively).*
Conclusion: *The prevalence of metabolic syndrome was about four-fifths in type 2 diabetic patients. Similar to the diabetic patients without this syndrome, the glycemic control of the majority still had not reached the standard of diabetic care. The treatment of metabolic syndrome itself as an independent risk factor should be considered in diabetic patients.*

Keywords: *Metabolic syndrome, Prevalence, Diabetes, Glycemic Control, HbA1c, Thailand*

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The metabolic syndrome (Mets) is common in clinical practice. Initially defined as Syndrome X, which was related to insulin resistance[1], its pathogenesis has been increasingly understood. Much evidence has been shown that this syndrome is related to cardiovascular and all-cause mortality in the general population and also in diabetes[2,3]. With diabetes, risk of cardiovascular complication was even higher as demonstrated in the Third National Health and Nutrition Examination Survey (NHANES III) in 2003[4]. The survey found that diabetes without metabolic syndrome was uncommon and people without metabolic syndrome, regardless of diabetes status, had the lowest coronary heart disease (CHD) prevalence and those who had both diabetes and metabolic syndrome had the highest prevalence of CHD.

For this highest risk group, diabetes with metabolic syndrome, the author still not have much data in Thailand. The author's aim was to determine the prevalence of this high-risk group and to compare the glycemic control among diabetes with and without the metabolic syndrome.

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Material and Method

Population and data collection

Type 2 diabetic patients who visited Hang Chat

Hospital Diabetes Clinic during July 2007 on a regular basis were recruited in this cross-sectional study. Among this group, only patients who had followed up in the clinic for at least one year and had fasted overnight for at least twelve hours before attending the clinic were included.

The sample size was calculated to acquire enough samples to represent the metabolic syndrome in diabetic cases and detecting the difference on "good glycemic control" (defined as HbA1c < 7%). Based on the prevalence of the metabolic syndrome in diabetic patients reported by a pilot study in Hang Chat Hospital, which was 80%, and Thailand Diabetes Registry that found that 30.7% of diabetic patients had good diabetic control defined as HbA1c < 7%, the sample size needed was 322.

Patients were categorized as having the metabolic syndrome if they met at least 3 of 5 criteria for diagnosis proposed by the American Heart Association/ National Heart, Lung, and Blood Institute (AHA/NHLBI) for Asian populations which are: waist circumference > 90 cm in men and > 80 cm in women, blood pressure > 130/85 mmHg or receiving antihypertensive treatments, plasma triglyceride > 150 mg/dl or receiving treatment, HDL-C < 40 mg/dl in men and < 50 mg/dl in women or receiving treatment, fasting plasma glucose >100 mg/dl or on diabetic treatments[5].

Personal history, socioeconomic status, and medical history including co-morbid diseases, hypoglycemic episodes, antidiabetic agents, antihypertensive agents, and antiplatelets were collected by interviewing patients and from medical records. Physical examination was done by research nurses. Patients were weighed using calibrated digital weighing scale. Waist circumference was measured horizontally at the umbilicus level as campaigned by the Ministry of Public Health of Thailand in 2007. After resting for 5 minutes, blood pressure was measured twice on the left arm, 2 minutes apart, with calibrated digital blood pressure monitor (Omron). If either systolic or diastolic value of both blood pressures differed by more than 5 mmHg, a third measurement would be taken. Mean values of those two or three results were used as final blood pressure.

Fasting plasma glucose (FPG), serum creatinine (Cr), total cholesterol, triglyceride (TG), HDL-C, and glycosylated hemoglobin (HbA1c) were measured. LDL-C level was calculated by Friedewald formula[6]. In cases where the triglyceride levels were higher than 400 mg/dl, LDL-C levels were directly measured. Good diabetic control is defined as presented in standards of medical care for Diabetes by American Diabetes Association (ADA) 2005[7].

Statistical analysis

Prevalence of the metabolic syndrome was estimated with 95% confidence interval. Comparisons of various characteristics were tested by using the Student's t-test, or Mean Whitney U-test. The Chi-square test or Fisher's exact probability test was used to compare proportion difference. Statistical significance was determined if p value < 0.05.

Results

Three hundred and twenty five patients with an age range of 35 to 85 were submitted; mean age $\pm$ SD was 57.8 $\pm$ 11.1 years and 64.9% were female. Mean body mass index (BMI) was 24.8 $\pm$ 4.1 kg/sq.m. Eighty-four percent of the patients had a primary school education. The majority of the subjects (69.8%) had welfare cards and 22.8% had government payment as civil service welfare. 30.5% were unemployed, 29.2% worked as laborers, and 20.3% did housework.

The prevalence of the metabolic syndrome in diabetic patients was 84.0%. Prevalence among some subgroups of patients is demonstrated in Table 1. Table 2 lists the characteristics of the patients including diabetes with metabolic syndrome and without metabolic syndrome. As shown in the table, females were

Table 1. Prevalences of the metabolic syndrome in type 2 diabetes patients

Subjects	No. of Subjects	Mets No.	Prevalence, %
All patients	325	273	84.0
Male	114	88	77.2
Female	211	185	87.7
Age group (yr)			
30-39	6	4	66.7
40-49	79	68	86.1
50-59	115	96	83.5
60-69	57	49	86.0
70-79	61	51	83.6
$\geq$ 80	7	5	71.4
Abdominal obesity	206	201	97.6
Non-abdominal obesity	119	72	60.5
History of hypertension	238	213	89.5
No history of hypertension	87	60	69.0

Table 2. Characteristics of the type 2 diabetes with or without metabolic syndrome

Characteristics	With metabolic syndrome (n = 273) No. of patients (%)	Without metabolic syndrome (n = 52) No. of patients (%)	p-value
Age (yr)	57.7 ± 11.0	58.3 ± 11.9	0.790
Sex			
Male	88 (32.2)	26 (50)	0.010*
Female	185 (67.8)	26 (50)	0.010*
Body weight (kg)	61.7 ± 12.4	55.8 ± 9.3	0.001*
Waist circumference (cm)	88.0 ± 10.4	78.4 ± 6.7	<0.001*
BMI (kg/sq.m)	25.3 ± 4.0	22.4 ± 3.4	<0.001*
Duration of DM (yr)	7.0 ± 5.6	7.2 ± 6.0	0.580
Education			
None	14 (5.1)	0 (0)	0.140
Primary school	235 (85.8)	39 (76.5)	0.100
Secondary school	19 (6.9)	10 (19.6)	0.007*
Bachelor or higher	6 (2.2)	2 (3.9)	0.360
Income (baht/month)	6,564.9 ± 6,913.5	9,700.0 ± 10,732.8	0.007*
Job			
Unemployed	83 (30.4)	16 (30.8)	1.000
House work	60 (22.0)	6 (11.5)	0.090
Labour	77 (28.2)	18 (34.6)	0.410
Skilled worker	8 (2.9)	2 (3.8)	0.660
Professional	10 (3.7)	3 (5.8)	0.440
Merchant	35 (12.8)	7 (13.5)	0.820
Payment scheme			
Welfare card	196 (71.5)	31 (60.8)	0.140
Social security	21 (7.7)	1 (2.0)	0.220
Private insurance	1 (0.4)	1 (2.0)	0.290
Welfare for civil servant	56 (20.4)	18 (35.3)	0.030*
Self payment	0 (0)	0 (0)	1.000
Smoking	11 (4.0)	7 (13.5)	0.010*
Alcohol use	37 (13.5)	14 (26.9)	0.020*
Adequate exercise□	89 (32.6)	15 (28.8)	0.630
Diabetes class attention□	190 (69.8)	36 (69.2)	1.000
Cerebrovascular disease	6 (2.2)	3 (5.8)	0.160
Coronary artery disease	11 (4.0)	2 (3.8)	1.000
Hypertension	213 (78.0)	25 (48.0)	<0.001*
Chronic kidney disease	31 (11.4)	5 (9.6)	1.000
Hypoglycemia	72 (26.4)	13 (25.0)	1.000
Aspirin use□	38 (13.5)	8 (15.4)	0.670
Statin	108 (39.6)	19 (36.5)	0.760
ACEI	143 (52.4)	20 (38.5)	0.070
Metformin	176 (64.5)	38 (73.1)	0.270
Insulin	73 (26.7)	15 (28.8)	0.740
HT medication items	1.5 ± 1.0	1.1 ± 1.1	0.003*

* Statistically significant
□At least 30 minutes each session, 5 days or more/week
□Attended at least 3 sessions in a year
□ In patients older than 45 year old

predominant in the metabolic syndrome group (67.8%) compared with non-metabolic syndrome group (50%). The metabolic syndrome group had significantly lower levels of education - lower proportion of secondary school education (6.9% vs. 19.6%) - and lower average monthly income (6,564.9 ± 6,913.5 vs. 9,700.0 ± 10,732.8 baht) compared with the non-metabolic syndrome group. The percentage of payment with welfare for civil

servants, smoking and alcohol use in the metabolic syndrome group was also lower than the other group (p = 0.03, 0.01 and 0.02, respectively).

In Table 3, the percentage of patients with good blood pressure control (BP < 130/80 mmHg), good triglyceride levels (< 150 mg/dl) and good HDL-C levels (< 40 mg/dl in male and < 50 mg/dl in female) was lower in the metabolic syndrome group. Abdominal obesity was significantly more prevalent in the metabolic syndrome group. However, the percentage of good glycemic control, in terms of either FPG in range 90-130 mg/dl or HbA1c < 7 g%, did not differ between both groups (p = 0.76 and 0.62, respectively).

Discussion

The prevalence of metabolic syndrome in type 2 diabetes was 84.0%. In female patients, it was more prevalent than in male patients; 87.7% vs. 77.2%, respectively. Compared with the general population, the metabolic syndrome in diabetic patients was much more common. One study in Nakhon Sawan, a province in the Northern of Thailand, found the metabolic syndrome in about twenty percent of the general population[8]. Among diabetes patients, almost all patients who had abdominal obesity had the metabolic syndrome (97%). Even in the non-abdominal obese group, the prevalence of this syndrome is still high, at sixty percent. In the subgroup of diabetes with hypertension, the metabolic syndrome was also prevalent, at 89.5%.

Compared with the non-metabolic syndrome patients, diabetes with the metabolic syndrome group had poorer blood pressure and metabolic control - the triglyceride levels were higher and the HDL-C levels were lower - by criteria. Interestingly, the LDL-C levels were not different between both groups; 98.8 ± 32.2 mg/dl in Mets group versus 97.5 ± 29.6 mg/dl in non-Mets group; and proportions of statin use did not significantly differ either (39.6% vs. 36.5%, respectively). There were no differences in FPG and HbA1c between both groups. Mean HbA1c levels were 8.0 ± 1.8% (Mets) and 8.1 ± 2.0% (non-Mets), most of which did not achieve the target for controlling diabetes. As reported that there was clinical inertia in adjusting diabetic medication and an increase in diabetic treatments was

Table 3. Cardiometabolic parameters in diabetes patients

Characteristics	With metabolic syndrome (n = 273) (mean ± SD)	Without metabolic syndrome (n = 52) (mean ± SD)	p-value
Systolic BP (mmHg)	132.8 ± 18.8	126.9 ± 22.3	0.06
Diastolic BP (mmHg)	73.0 ± 10.7	72.2 ± 11.0	0.63
FPG (mg/dl)	128.8 ± 41.2	140.3 ± 59.8	0.72
Triglyceride (mg/dl)	206.9 ± 168.3	109.8 ± 48.5	<0.01*
HDL (mg/dl)			
Male	46.0 ± 9.0	51.6 ± 11.0	0.03*
Female	48.0 ± 8.9	57.0 ± 10.0	<0.01*
LDL (mg/dl)	98.8 ± 32.2	97.5 ± 29.6	0.82
HbA1c (%)	8.0 ± 1.8	8.1 ± 2.0	0.77
Creatinine (mg/dl)	1.3 ± 0.9	1.1 ± 0.4	0.21
Categories	**No. of patients (%)**	**No. of patients (%)**	**p-value**
Abdominal obesity	201 (73.6)	5 (9.6)	<0.001*
Good BP control□	104 (38.1)	28 (53.8)	0.04*
Good FPG control□	134 (49.1)	27 (51.9)	0.76
Triglyceride < 150 mg/dl	104 (38.1)	48 (92.3)	<0.001*
Good HDL-C level□	121 (44.3)	46 (88.5)	<0.001*
LDL < 100 mg/dl	149 (54.6)	31 (59.6)	0.76
HbA1c < 7%	81 (29.7)	17 (32.7)	0.62
HbA1c < 6.5%	51 (18.7)	11 (21.2)	0.57

* Statistically significant
□ Blood pressure < 130/80 mmHg
□ Fasting plasma glucose 90-130 mg/dl
□ HDL-C > 40mg/dl (male), > 50mg/dl (female)

potentially developed with the recent HbA1c greater than 8 percent[9,10], many of our patients still might not have enough aggressive treatments. Moreover, the HbA1c test is not widely available in rural Thailand. Most of the community hospitals could not perform this costly test. In the presented patients, only 17.2% had one previous HbA1c testing in the one year and no patient had more than one testing (data not shown). In comparison with the good HbA1c group (< 7%) and the poor HbA1c group (≥ 7%), the good HbA1c group was significantly more associated with higher age, higher serum creatinine, higher mean blood pressure, greater prevalence of chronic kidney disease and had lower rate of metformin use as shown in Table 4. These correlations have shown neither good glycemic control related with patient cooperation nor the treatment itself but possibly associated with the consequences of poorer kidney function. In this case, the Cr level might have some masking effect to HbA1c difference among Mets and non-Mets group. However, when a comparison of the mean HbA1c level in Mets group and non-Mets group in those patients with normal kidney function (Cr < 1.5) was determined, they were not statistically different; 8.2 ± 1.9% and 8.1 ± 2.0%, respectively (p value = 0.38, data not shown). This was possibly due to inadequate power for detection in this subgroup or the survival-biased nature of the cross-sectional study.

In the present study, the author found that eighty-four percent of type 2 diabetic patients had metabolic syndrome which was similar to a study from the UK that found 82%[11]. The age-adjusted prevalence in diabetes was not very different among various age groups, which was in contrast to the metabolic syndrome prevalence in the general population, which increased with age[12]. Therefore, this syndrome should be considered even in newly-diagnosed or young diabetic patients. Also accepted is that intensive glycemic control by either sulphonylureas or insulin substantially decreases the risk of microvascular complications[13] and metformin was associated with less weight gain in diabetes treatment[14], the aggressive treatments have been attempted in the authors' diabetes clinic. Despite high rate of insulin use (27.1%) - whereas the insulin usage of the intensive treatment group in United Kingdom Prospective Diabetes Study (UKPDS) was 38% and in conventional treatment group was 16%[13] -, high rate of metformin use (75.5% of patients with Cr < 1.5) and low rate of monotherapy with sulfonylurea (10.1%), the mean HbA1c level of the presented patients was 8.1% (95% Confidence Interval 7.9-8.3%). Only 30.6% of all patients could meet ADA goal for HbA1c control, which was similar to data reported in Thailand Diabetes Registry[15].

All that the author has learned from the present study makes treating diabetic patients with metabolic syndrome, as having another independent risk factor, which is not directly related to glycemic control, more challenging. Together with the lower education and lower income in these patients, much more knowledge might be needed to make any measures, either weight reduction program or other methods, appropriate and effective enough to address patients' health problems.

Table 4. Characteristics according to HbA1c levels

	HbA1c < 7% No. of patients (%)	HbA1c ≥ 7% No. of patients (%)	p-value
Female	55 (56.1)	153 (68.9)	0.030*
Age (yr)	60.8 ± 11.5	56.6 ± 10.6	0.001*
Duration (yr)	6.0 ± 5.5	7.4 ± 5.4	0.005*
Income (baht/month)	6,075.8 ± 7,059.3	7,293.3 ± 7,895.6	0.090
Chronic kidney disease	18 (18.4)	18 (8.1)	0.010*
Insulin	22 (22.5)	65 (29.3)	0.220
Metformin	53 (54.1)	156 (70.2)	0.007*
Systolic BP (mmHg)	135.2 ± 20.9	130.4 ± 18.8	0.030*
Good BP control□	32 (32.6)	98 (44.1)	0.064
FPG (mg/dl)	110.2 ± 24.6	139.6 ± 48.7	<0.001*
Cr (mg/dl)	1.51 ± 1.27	1.17 ± 0.59	0.002*

* Statistically significant

□ Blood pressure < 130/80 mmHg

Conclusion

The prevalence of metabolic syndrome in type 2 diabetes was very high and mainly found in the obese group and hypertensive patients. Similar to the patients without this syndrome, the glycemic control of the majorities still had not reached the standard of diabetic care. Concurrent diabetes with the metabolic syndrome had not shown to make glycemic control worse. However, it should alert doctors and management teams to be concerned about this frequently neglected important factor to be more aggressively treated.

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การควบคุมระดับน้ำตาลในเลือดของผู้ป่วยเบาหวานที่มี metabolic syndrome ในโรงพยาบาลชุมชน

อรวรรณ วรวงศ์ประภา

วัตถุประสงค์: เพื่อศึกษาความชุกของ metabolic syndrome ในผู้ป่วยเบาหวานชนิดที่ 2 ของโรงพยาบาลห้างฉัตร จังหวัดลำปาง และเพื่อเปรียบเทียบการควบคุมระดับน้ำตาลในเลือดของผู้ป่วยที่มีและไม่มีภาวะเมตาบอลิก

วัสดุและวิธีการ: การศึกษาแบบภาคตัดขวางได้ทำในคลินิกเบาหวานของโรงพยาบาลชุมชน โดยเก็บข้อมูลด้านประวัติ, การตรวจร่างกาย, ตรวจเลือด และแบ่งผู้ป่วยเป็นกลุ่มที่มีและไม่มี metabolic syndrome ตามเกณฑ์ของสมาคมโรคหัวใจร่วมกับสถาบันหัวใจปอดและโลหิตวิทยาแห่งชาติ ประเทศสหรัฐอเมริกา (American Heart Association/ National Heart, Lung, and Blood Institute, AHA/NHLBI) ประเมินความชุกของ metabolic syndrome ในผู้ป่วยเบาหวานและหาความแตกต่างของผลการควบคุมระดับน้ำตาลของผู้ป่วยเบาหวานในกลุ่มที่มีและไม่มี metabolic syndrome

ผลการศึกษา: ในจำนวนผู้ป่วยที่ศึกษา 325 คน เป็นหญิง 211 คน (64.9%) ชาย 114 คน (35.1%) อายุเฉลี่ย 57.8 $\pm$ 11.1 ปี ทราบว่าเป็นเบาหวานมาแล้วเฉลี่ย 7 ปี ความชุกของกลุ่มอาการเมตาบอลิกในผู้ป่วยเบาหวานมี 84.0 เปอร์เซ็นต์ ในจำนวนนี้มีผู้ป่วยเพียง 49.1 เปอร์เซ็นต์ที่ควบคุมระดับน้ำตาลก่อนอาหารเช้าในเลือดได้ในช่วง 90-130 mg/dl และมีเพียง 29.7 เปอร์เซ็นต์ที่สามารถควบคุมค่า HbA1c ได้ดี (ต่ำกว่า 7 เปอร์เซ็นต์) ทั้งนี้เมื่อเปรียบเทียบกับผู้ป่วยเบาหวานที่ไม่มีกลุ่มอาการเมตาบอลิกที่ควบคุม HbA1c ได้ดีซึ่งมี 32.7% แล้วพบว่า ไม่มีความแตกต่างกันอย่างมีนัยสำคัญทางสถิติ

สรุป: ความชุกของ metabolic syndrome ในผู้ป่วยเบาหวานมีสูงมาก ผู้ป่วยในกลุ่มนี้ยังมีปัญหาไม่แตกต่างกับผู้ป่วยเบาหวานในคลินิกเบาหวานทั่ว ๆ ไป คือส่วนใหญ่ยังไม่สามารถบรรลุเกณฑ์การควบคุมเบาหวานที่ดีได้ การดูแลรักษาผู้ป่วยกลุ่มนี้จึงควรให้ความสำคัญในการควบคุมน้ำหนักและระดับน้ำตาลในเลือดให้เข้มงวดยิ่งขึ้น