Undiagnosed Diabetes Among Hospitalized Patients －－ Analysis of 1096 Hospitalized Patients in A Single Center, MMH

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Abstract

Diabetes mellitus (DM) is an emerging health problem in Taiwan and in many parts of the world. DM has become the fifth leading cause of death in Taiwan. However, around 50% of the diabetic subjects remain undiagnosed. We try to evaluate the hospital care rendered to hyperglycemic individuals who did not have a diagnosis of diabetes at the time of admission or in the discharge summary. A total of 1096 consecutively hospitalized adult patients during a single week between March 1 2002 and March 7 2002 in a single center (Mackay Memorial Hospital) were evaluated. One hundred and fifty-six patients had two or more documented plasma glucose values > 200 mg/dl. Of the 156 patients, 24.5% of all hyperglycemic medical patients and 32.7% of hyperglycemic surgical patients were potentially undiagnosed diabetes. These 43 potentially undiagnosed diabetes had a mean peak glucose of 278 mg/dl, 21 (49 %) were men and 22 (51%) were women. Of the 43 patients, 8 (18.6%) were overweight , 7 (16.3%) were obesity, 10 (23.3%) were hyperlipidemia, 13 (30.2%) were hyperuricemia, 14 (32.6%) had hypertension (H/T), 8 (18.6%) had coronary artery disease (CAD), and 10 (23.3%) had stroke. Thirty-seven percent of the 43 patients received insulin therapy and 46.5% received bedside glucose monitoring, yet 77% of daily patient progress notes failed to comment on the presence of hyperglycemia or diabetes. Twenty-eight (65%) patients were no plan for further evaluation or management of hyperglycemia after hospital discharge. Fifteen (35%) patients had further evaluation of the hyperglycemia after hospital discharge and 10 patients had DM. Despite marked hyperglycemia, most (77%) medical records made no reference to the possibility of undiagnosed diabetes in our study. Every physician should keep alert to this disease when seeing people in the clinical practice. Further evaluation of hyperglycemic hospitalized patients may present an important opportunity for earlier detection and the initiation of therapy. (J Intern Med Taiwan 2003;14:16-22)

Key Words：Diabetes Mellitus, Undiagnosed diabetes, Hyperglycemia

Introduction

Half of the 16 million American with diabetes are undiagnosed 1,2. In Taiwan, diabetes occurs at an incidence about 9/1000 person-year 3, and is the fifth leading cause of death. However, around 50% of the diabetic subjects in Taiwan remain undiagnosed in the community 4. The undiagnosed DM is not a benign condition. Patients with undiagnosed DM are at very high risk for micro- and macrovascular complications 2. During this period of undiagnosed and untreated diabetes, microvascular disease is apparently progressing, as 15% to 20% of individuals with undiagnosed type 2 DM have diabetic retinopathy and 5 % to 10% have proteinuria5-7. The diagnosis of diabetes is frequently not considered until another medical problem occurs. Mortality in undiagnosed DM is as high as that observed in known DM, and mortality in both is significantly higher than in non-diabetic individuals 8-9. Early identification and treatment of diabetes would require a change in the health care model. Early intervention will significantly reduce diabetic complications and is cost-effective. We set forth to review the hospital care rendered to these hyperglycemic individuals without a diagnosis of diabetes are to determine whether such patients are appropriately evaluated and treated.

Materials and Methods

We retrospectively reviewed all 1096 consecutively hospitalized adult patients during a single week between March 1 2002 and March 7 2002 at Mackay Memorial Hospital. Patients with two or more glucose values > 200 mg/dl were identified by the laboratory data system. In addition to the glucose value, the following data were obtained: name, medical record number, patient age, sex, medical service, weight, height, blood pressure, serum cholesterol value, serum triglyceride value and serum uric acid value.

The medical records of these patients were evaluated after their discharge to determine if diabetes was a diagnosis that was present during their hospitalization. Those patients in whom diabetes was the diagnosis at the time of admission or in the discharge summary were excluded from further analysis. Medical records of hyperglycemic patients without a diagnosis of diabetes at the time of admission or in the discharge summary were further evaluated. A checklist was developed for the purposes of data collection.

1.Presence of diabetes in the medical problem list or included in the initial history by the admitting physician.

2.Presence of more than two glucose value > 200 mg/dl.
3.Value of the peak glucose.
4.Documentation in the daily progress notes of diabetes as a possible diagnosis.
5.Documentation of hyperglycemia in the daily progress notes.
6.Orders for medical therapy for the treatment of hyperglycemia.
7.Orders for bedside glucose monitoring.
8.Documentation of follow-up plans for further diabetes work-up or therapy after discharge

Overweight was defined, using the standard of Department of Health of Taiwan as a body mass index of 24 to 26.9 kg/m2; obesity was defined as a body mass index≧27 kg/m2. Hyperlipidemia was defined as a serum cholesterol level≧200 mg/dl, a serum triglyceride level≧200 mg/dl, or if lipid-lowering
agents were being used. Hyperuricemia was defined as a serum uric acid concentration≧7.5 mg/dl (male) or≧6.5 mg/dl (female). Hypertension was diagnosed when the blood pressure was≧140/90 mmHg or if antihypertensive medications were being used. CAD was diagnosed by review of the patient 掇 discharge summary and hospital records, according by the patient 掇 electrocardiogram, heart echo or cardiac catheterization.

Results

Of the 1096 hospitalized adult patients, 156
(14.2%) had two or more documented glucose values > 200 mg/dl. Ninety-eight patients had diabetes documented at the time of admission or in the discharge summary were excluded from further study. Fifteen patients with preexisting diabetes had no diagnosis of diabetes at this admission (Fig. 1).

Among the 156 hyperglycemic patients, 24.5% of all hyperglycemic medical patients and 32.7% of hyperglycemic surgical patients were potentially undiagnosed diabetes. Table 1 describes the distribution of hyperglycemic patients by different medical service. Forty-three patients with hyperglycemia in whom there was no diagnosis of diabetes existing before and at this admission. Of these 43 patients, 21
(49%) were men and 22 (51%) were women. The mean age among these patients was 66 years and the mean peak glucose was 278 mg/dl with a range of 205-653 mg/dl (Table 2). Of these 43 patients, 24 were medical patients, 16 were surgical patients, 2 patients were admitted at ENT service and 1 patient was admitted at GYN service.

Of the 43 patients, glycosylated hemoglobin A1c (HbA1c) was measured in 6 (14%) patients with a mean HbA1c of 6.9%. Eight (18.6%) patients were overweight and 7 (16.3%) patients were obesity by the standard of Department of Health of Taiwan. Ten

(23.3%) patients were hyperlipidemia, 13 (30.2%) patients were hyperuricemia, 14 (32.6%) patients had H/T, 8 (18.6%) patients had CAD, and 10 (23.3%) had stroke. Of the 43 patients, 33 (77%) did not mention possible diabetes or hyperglycemia in the daily progress notes. Six (13.7%) did not use the word diabetes, but described hyperglycemia. Only 4 (9.3%) mentioned diabetes as a diagnostic possibility in the daily progress notes (Fig. 2).

Although 77% of the medical records did not mention diabetes or hyperglycemia, 16 (37.2%) of the 43 patients received both bedside glucose monitoring and regular insulin coverage for their elevated glucose values. Four (9.3%) patients received bedside glucose monitoring but no insulin coverage, and 3 (7%) patients received oral hypoglycemic agents but no bedside glucose monitoring . Twenty (46.5%) patients had no medical orders reflecting the recognition or treatment of hyperglycemia (Table 3).

Of the 43 potentially undiagnosed diabetic patients, 28 (65%) did not have the plans for the further evaluation or specific management of hyperglycemia after hospital discharge. Fifteen (35%) patients had further evaluation of the hyperglycemia after discharge and 10 patients had DM.

Discussion

The type 2 diabetic patients are at very high risk of micro- and macrovascular complications. In several studies 10-12, the prevalence of microvascular disease sharply increased above 2-hour plasma glucose (2-h PG) levels of 200 mg/dl. In 1997, the Expert Committee of the American Diabetes Association (ADA) revised the DM diagnostic criteria. Three ways to diagnose diabetes, and each must be confirmed on a subsequent day by any one of this three methods. This three diagnostic ways include (1) a casual plasma glucose $\geqq$ 200 mg/dl associated with symptoms of polyuria, polydipsia, or unexplained weight loss (2) fasting plasma glucose (FPG) $\geqq$ 126 mg/dl (3) an oral glucose tolerance test (OGTT) with 2-h postload value $\geqq$ 200 mg/dl. Changing the diagnostic cutpoint for the FPG from 140 mg/dl to 126 mg/dl, is based on the belief that the cutpoints for the FPG and 2-h PG should diagnose similar conditions and is based on the observation that this degree of hyperglycemia usually reflects a serious metabolic abnormality that has been shown to be associated with serious complications.

Although the lowering of the FPG, undiagnosed type 2 diabetes is common in the U.S. and also in Taiwan. Because the hyperglycemia develops gradually and at earlier stages is often not severe enough for the patient to notice any of the classic symptoms of diabetes, the type 2 diabetes frequently goes undiagnosed for many years. Around 50% of the diabetic subjects remain undiagnosed. As a result, the diagnosis of type 2

diabetes is estimated to be delayed by an average of 10 years after the actual onset of the disease 13. Of concern, there is epidemiological evidence that retinopathy begins to develop at least 7 years before the clinical diagnosis of type 2 diabetes is made 2. Because hyperglycemia in type 2 diabetes causes microvascular disease and may cause or contribute to macrovascular disease, undiagnosed diabetes is a serious condition.

In our study, 23% of all 1096 hospitalized adult patients had no record of fasting plasma glucose. Therefore, we chose the patients with two or more documented casual plasma glucose values > 200 mg/dl for further evaluation. One hundred and fifty-six patients had two or more documented plasma glucose values > 200 mg/dl. Forty-three of this 156 hyperglycemic patients had no diagnosis of diabetes existing before and at this admission, including 24.5% of all hyperglycemic medical patients and 32.7% of hyperglycemic surgical patients. Despite therapeutic intervention with insulin in 16 (37.2%) of the 43 patients, there was almost never documentation regarding the hyperglycemia and rarely was diabetes a diagnostic consideration. Of the 43 potentially undiagnosed diabetic patients, 28 (65%) did not have the plans for the further evaluation or specific management of hyperglycemia after hospital discharge. Fifteen (35%) patients had further evaluation of the hyperglycemia after discharge and 10 patients had DM.

We believe that physicians assumed that the hyperglycemia was a transient finding that resulted from the stress of acute illness rather than considering the diagnosis of undiagnosed diabetes. Such stress is known to increase the activity of the sympathoadrenomedullary system 14-16, elevate plasma cortisol levels 17, and possibly enhance secretion of glucagon and growth hormone 18. As a consequence, level of blood sugar and free fatty acids may increase. Many drugs can impair insulin secretion. These drugs may not cause diabetes by themselves, but they may precipitate diabetes in individuals with insulin resistance. For example, glucocorticoids can impair the insulin action, but only 3 % had a positive glucose tolerance test when pretreated with corticosteroids 19. Environmental factors may also play a critical role in the induction, acceleration, and modification of the progression of diabetes.

The pathophysiologic hallmark of type 2 diabetes is insulin resistance. Glucose intolerance and hyperglycemia supervene only when the pancreatic beta cell is unable to maintain compensatory hyperinsulinemia to overcome tissue resistance to insulin action. In addition to having hyperglycemia and insulin resistance, most patients are obese and have a host of other metabolic abnormalities, including dyslipidemia (increased small dense LDL cholesterol, decreased HDL cholesterol, and raised triglyceride levels), hypertension, and abnormalities of coagulation and the fibrinolytic system. In our study, 8 (18.6%) of the 43 potentially undiagnosed diabetic

patients were overweight, 7 (16.3%) were obesity, 10 (23.3%) were hyperlipidemia, 13 (30.2%) were hyperuricemia, 14 (32.6%) had H/T, 8 (18.6%) had CAD, and 10 (23.3%) had stroke. Therefore, patients with undiagnosed type 2 diabetes are at significantly increased risk for coronary heart disease, stroke, dyslipidemia, and hypertension.

Since the onset of diabetes is insidious, and patient can be relatively symptom-free for years before diagnosis. Screening can identify occult causes of diabetes. The American Diabetes Association recommends that screening for diabetes should start at age 45 years and above, particularly in those with a BMI≧25 kg/m2; if normal, it should be repeated every 3 years in persons without risk factors. Screening should be considered at a younger age or be carried out more frequently in individuals who are overweight and have additional risks factors: (1) have a 1st-degree relative with diabetes, (2) are habitually physically inactive (3) are members of a high-risk ethnic population, (4) have delivered a baby weighing > 9 lbs or have been diagnosed with gestational diabetes mellitus, (5) are hypertensive (≧140/90 mmHg), (6) have an HDL cholesterol level ≦ 35 mg/dl and/or a triglyceride level≧250 mg/dl, (7) had on previous testing an impaired glucose tolerance or an impaired fasting glucose, (8) have polycystic ovary syndrome , (9) have a history of vascular disease 20.

Delays in the diagnosis of diabetes carry with it substantial financial and health ramifications. We believe that the failure to consider the possibility of diabetes represents a missed window of opportunity for marking an earlier diagnosis and for initiating interventions that may delay the devastating complications of this disease. We recommend that physicians assume that hyperglycemia is diabetes until they prove otherwise. Further evaluation of hyperglycemic hospitalized patients after discharge would be needed.

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未診斷之糖尿病－－1096 例住院病例分析

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摘　　要

在台灣糖尿病已躍居十大死亡疾病的第五位。然而約有一半的糖尿病患未被診斷出來。我們調閱從西元 2002 年 3 月 1 日到西元 2002 年 3 月 7 日在馬偕醫院住院的病患，評估有高血糖而未診斷爲糖尿病者。156 例病患有 2 次或 2 次以上血糖值超過 200 mg/dl，其中 43 例有高血糖而未診斷爲糖尿病。43 例中有 8 例體重過重及 7 例肥胖；10 例有高脂血症；13 例有高尿酸血症；14 例有高血壓；8 例有冠狀動脈疾病和 10 例有腦血管病變。16 例住院中有用胰島素治療，20 例有接受血糖監測，但 43 例中 33 例在病歷中卻沒有高血糖記錄。28 例出院後沒有進一步追蹤或治療，15 例出院後有進一步追蹤其中 10 例確定爲糖尿病。

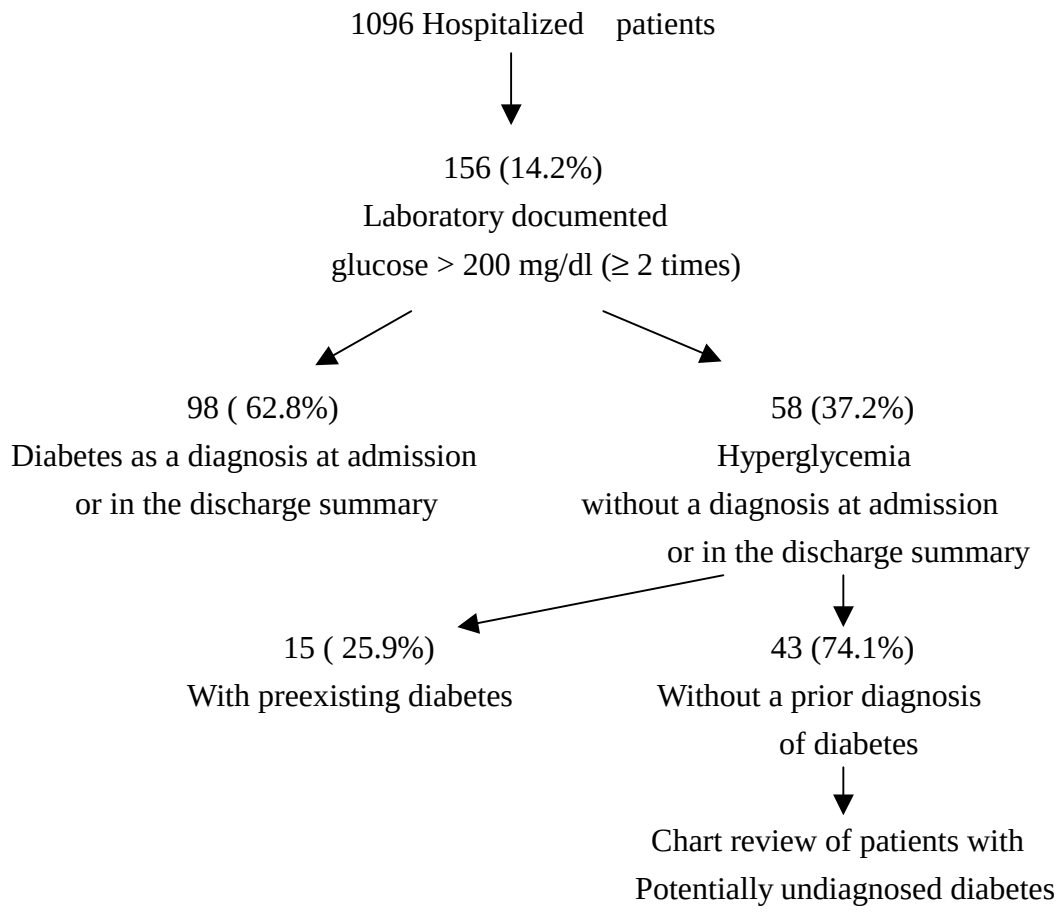

Fig.1. Schematic of hospitalized patients evaluated for hyperglycemia.

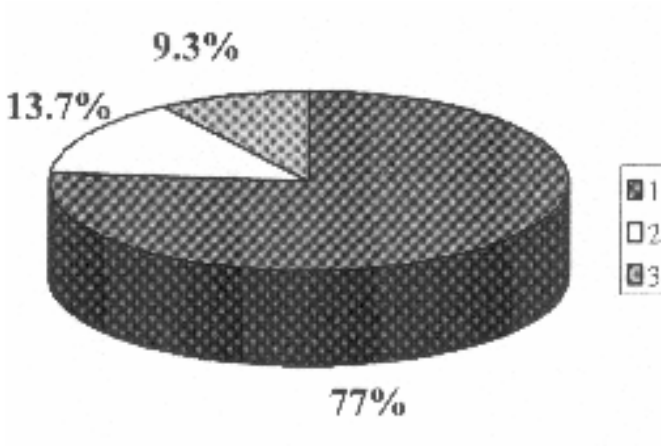

Fig.2. Documentation of diabetes or hyperglycemia in the physicians daily progress notes 1.No mention of diabetes or hyperglycemia (77%)

2.Hyperglycemia mentioned (13.7%)

3.Possibility of diabetes mentioned (9.3%)

Table 1. The distribution of hyperglycemic patients by medical service

Service	Glucose >200 mg/dl	Diabetes diagnosed before or at admission	Hyperglycemia without a diagnosis of diabetes	Possibility of undiagnosed diabetes(%)
N	156	113	43	----
Medicine	98	74	24	24.5
Surgery	49	33	16	32.7
GYN	2	1	1	50
ENT	4	2	2	50
Ophthamology	3	3	0	0

Table 2. Characteristics of the 43 hyperglycemic patients without a diagnosis of diabetes

Sex (%) (M/F)	49%/51%
Age (years)	66 (28-89)
Mean peak glucose (mg/dl)	278 (205-653)
Overweight	8 (18.6%)
Obesity	7 (16.3%)
Hyperlipidemia	10 (23.3%)
Hypertension	14 (32.6%)
Hyperuricemia	13 (30.2%)
Coronary artery disease	8 (18.6%)
Stroke	10 (23.3%)

Table 3. Therapeutic intervention for hyperglycemic patients without a diagnosis of diabetes

Intervention	percentage
Received insulin treatment and bedside glucose monitoring	37.2
Received bedside monitoring without insulin treatment	9.3
Received OHA treatment without bedside glucose monitoring	7
No medical orders for hyperglycemia	46.5