British Journal of Medicine & Medical Research
4(15): 2896-2909, 2014

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Current Clinical Status and Vascular Complications among Patients with Type 2 *Diabetes Mellitus* at Tertiary Hospitals in Malaysia

Mun Chieng Tan[1*], Ooi Chuan Ng[2], Teck Wee Wong[3], Abdul Rahman Hejar[4] and Anthony Joseph[2*]

[1]Department of Nutrition and Dietetics, Faculty of Medicine and Health Sciences, Universiti Putra Malaysia, Serdang, Selangor Darul Ehsan, Malaysia.
[2]Department of Medicine, Faculty of Medicine and Health Sciences, Universiti Putra Malaysia, Serdang, Selangor Darul Ehsan, Malaysia.
[3]Heart and Lung Centre, iHEAL Medical Centre Kuala Lumpur, Level 7 & 8, Annexe Block, Menara IGB, Mid Valley City, Lingkaran Syed Putra, Kuala Lumpur, Malaysia.
[4]Department of Community Health, Faculty of Medicine and Health Sciences, Universiti Putra Malaysia, Serdang, Selangor Darul Ehsan, Malaysia

Authors' contributions

This work was carried out in collaboration between all authors. Author MCT conceived of the study, contributed in acquisition of data, conducted the statistical analyses and interpretations, and substantially conceptualized, designed and written the manuscript. Authors OCN, TWW, AJ were the principal investigators and adjudication committee members of the study, participated in the study design and coordination, assisted in the statistical analyses, provided supervision regarding the writing of the manuscript sufficiently and revised the paper critically. Author ARH assisted in the statistical analyses and interpretation, and revised the manuscript. All authors read and approved the final manuscript.

Original Research Article

Received 15th November 2013
Accepted 23rd January 2014
Published 7th March 2014

ABSTRACT

Objective: To assess the prevalence of diabetic vascular complications and cardiovascular risk factors control in type 2 diabetic patients at tertiary settings.
Methods: This cross-sectional study was conducted among 313 patients diagnosed with

**Corresponding authors: Email: docavvai@gmail.com, mun_chieng_tan@yahoo.com*

type 2 *diabetes mellitus* (T2DM) at two tertiary referral hospitals in Malaysia. Data regarding socio-demographics, macro- and microvascular complications, family health history, blood pressure, anthropometric indices, glycaemic control, and lipid profile were obtained from medical records, face-to-face interview and physical examination.
Results: The mean age of patients was 55.7±9.2 years, mean diabetes duration was 10.1±8.1 years, and 52.1% were females. Approximately 36.1% patients had cardiovascular disease (CVD). There were high prevalence of established coronary artery disease (30.7%), cerebrovascular disease (10.2%), and peripheral vascular disease (5.1%). Peripheral neuropathy, diabetic nephropathy and retinopathy were present in 41.5%, 17.6% and 15.0% patients respectively. Only 14.1% of the patients reached optimal HbA_{1c} level and 21.1% patients achieved target fasting plasma glucose. The overall prevalence of dyslipidemia was 89.1%, hypertension was 80.2%, and obesity was 35.9% (BMI) and 86.5% (waist-to-hip ratio).
Conclusions: Diabetic vascular complications were highly prevalent among the type 2 diabetic patients. Cardiovascular risk factors control was suboptimal. Both awareness and application of recommended guidelines need to be reinforced.

Keywords: Diabetic vascular complications; cardiovascular disease; neuropathy; nephropathy; retinopathy; cardiovascular risk factors; type 2 diabetes mellitus; tertiary referral hospitals.

1. INTRODUCTION

Diabetes mellitus (DM) is one of the most challenging health problems in the 21st century and the fastest growing non-communicable disease globally. The International Diabetes Federation has predicted that approximately 366 million individuals were afflicted with DM worldwide in 2011, and this is expected to increase to 552 million of the adult population by 2030 [1]. Our population is not spared, Malaysia ranked ninth among the Asian countries with high DM estimates, i.e. 11.6% of comparative prevalence [2]. Type 2 *diabetes mellitus* (T2DM) accounts for 90–95% of all diagnosed DM cases [3,4].

DM is a serious condition with potentially devastating complications that affects all age groups worldwide. This typically includes macrovascular complications (cardiovascular morbidity such as coronary artery disease, cerebrovascular disease and peripheral vascular disease) and microvascular damages (diabetic nephropathy, peripheral neuropathy and retinopathy). With this background, the burden of DM is enormous in terms of the magnitude of the population affected as a result of increased disability, reduced life expectancy, impaired quality of life, and enormous health costs [1,5].

Extensive evidence has shown that the common co-existing conditions of DM such as dyslipidemia, hypertension and obesity are classic risk factors for cardiovascular disease (CVD) [6,7]. Dyslipidemia is the key mechanism for the development of diabetic atherosclerosis [8], and involves an abnormal, atherogenic lipid profile [high cholesterol, high triglycerides, low level of high density lipoprotein (HDL) cholesterol, and high level of low dense lipoprotein (LDL) cholesterol] [9]. Multiple studies have exhibited the clinical benefits of tight blood pressure control on cardiovascular and microvascular end points [10,11]. Obesity continues to influence an individual's health after the development of T2DM and heightens the risk of CVD, polyneuropathy [12], non-alcoholic fatty liver disease [13], sleep disordered breathing [14] and end-stage renal disease (ESRD) [15].

The objective of the present study was to assess the current clinical status and the degree of control of multiple modifiable cardiovascular risk factors of the patients according to published guidelines and to determine the prevalence of vascular complications among type 2 diabetic patients in tertiary settings in Klang Valley, Malaysia. This study is important to provide reliable baseline data regarding the rate of vascular complications and current status of type 2 diabetic patients in Malaysia. The information is crucial for the adjustment of clinical preventive policies and practices in diabetic care management to gain better control of T2DM for long-term health.

2. MATERIALS AND METHODS

This is a cross-sectional study conducted in two Malaysian tertiary referral hospitals - Hospital Serdang, as well as Hospital Kuala Lumpur, the largest hospital under Ministry of Health (MOH) Malaysia which is also one of the largest hospitals in Asia [16]. A systematic random sampling method was applied to select patients. Data collection was carried out from year 2010 to 2011. For the purpose of the study, T2DM was defined as self-reported physician-diagnosis, confirmed by documentation in the patient's clinical records and registered use of antidiabetic medication. Prior to study entry, patients with T2DM were evaluated according to the inclusion and exclusion criteria justified. Upon invitation to participate in this study, informed consent was obtained from each patient. The patients selected were ambulatory type 2 diabetic patients aged over 30 years. Patients with history of type 1 *diabetes mellitus* (T1DM), gestational DM, malignant disease, psychiatric illness or dementia were excluded. They were interviewed and a standardised questionnaire that captured socio-demographic backgrounds and aspects of personal medical and family health history was completed for every patient. Data collected by the questionnaire were then integrated with information retrieved from the clinical records. The latest data on routine blood tests (glycaemic control and blood lipid profiles) were also accessed from patients' medical records. Physical examination included anthropometric and blood pressure measurements were performed according to standardised protocols [17].

The study protocol conformed to the principles of the Malaysian good clinical practice guidelines which were consistent with the Ethical Guidelines of the Declaration of Helsinki. The study protocol and informed consent were approved by the Committees for Medical Research Ethics of the Faculty of Medicine and Health Sciences, Universiti Putra Malaysia (UPM) and MOH Malaysia (Approval Code: NMRR-10-483-5703). Additionally, all patients were aware of the nature of the study and gave informed consent prior to commencement of interview. Participation in the study was completely voluntary.

Information on a complete first-degree family history of coronary artery disease (CAD), stroke, DM, high cholesterol and hypertension was obtained from medical record and confirmed by the face-to-face interview. Specifically, a family history of diseases in this study was defined as the presence of a mother, father, sister, brother, son, or daughter (≥1 first-degree blood relative) with diagnosed DM, high cholesterol, high blood pressure, CAD (i.e., heart attack or heart problems), or stroke. Patients were asked whether their parents, siblings and children have ever been told by a doctor that they had DM, high cholesterol, high blood pressure, heart disease, or stroke, although detailed pedigree structures were not included. A patient was defined as having a positive history of DM, high cholesterol, high blood pressure, heart disease, or stroke if at least one of the parents, siblings or children reported a history of the respective diseases.

The clinical information comprised of cardiovascular events, hypertension, dyslipidemia, peripheral neuropathy, diabetic retinopathy, nephropathy, and diabetic foot problems was obtained through interviews with patients, hospital medical records, and further clinical examinations performed at the time of the survey. Duration of disease was ascertained. The use of cardiac drugs, lipid lowering agents, antihypertensive drugs and antiplatelet drugs was evaluated.

On the whole, CVD consisted of CAD [angina pectoris, myocardial infarction (MI), atherosclerotic heart failure or revascularization procedures], cerebrovascular disease [ischaemic stroke or transient ischaemic attack (TIA)] and clinically significant peripheral vascular disease (PVD) as described previously [18], in which CVD was defined by the presence of one or more of the above described outcomes. The presence of CVD was established based on personal medical history, thorough physical examination, and detailed information collected during face-to-face interview. Any patient who was asymptomatic or had negative investigations was classified as no CVD.

Patients were asked to recall a doctor diagnosis of peripheral neuropathy, diabetic nephropathy, and retinopathy. Evidence of the presence of these diabetic microvascular complications was further obtained by reviews of the patients' practice records including hospital and clinic correspondence. Peripheral neuropathy was diagnosed by clinical criteria on the basis of symptoms and physical examination, including history of numbness, paraesthesias, tingling sensations, jabbing or electric-like pain and burning sensation in a symmetrical "glove and stocking" distribution. Abnormal ankle reflex was also considered diagnostic for neuropathy [19,20]. Based on medical records, the classification of diabetic nephropathy resulted in a few stages, Chronic Kidney Disease (CKD) stages 1-5 were classified together as established diabetic nephropathy [21,22]. Data on diabetic retinopathy were obtained based on fundoscopic examination by physicians or slit lamp biomicroscopy by ophthalmologists and graded as absence or presence of diabetic retinopathy (non-proliferative or proliferative), among which, laser photocoagulation-treated patients were classified as having proliferative diabetic retinopathy [23].

According to the glycaemic recommendations issued by the American Diabetes Association [7], glycated haemoglobin (HbA_{1c}) and fasting plasma glucose (FPG) of less than 7.0% and within 3.9-7.2 mmol/L respectively were considered as good glycaemic control. High levels of total cholesterol (≤ 4.5 mmol/L) [24], decreased levels of LDL cholesterol (≤ 2.6 mmol/L) [25], elevated levels of HDL cholesterol (≥ 1.03 mmol/L in men, ≥ 1.29 mmol/L in women) [26], and raised levels of triglycerides (≤ 1.69 mmol/L) [26] were regarded as treatment targets. Blood pressure was measured with a calibrated digital Omron Automatic Blood Pressure Monitor (Model T8, Omron Healthcare Singapore Pte Ltd, Alexandra Technopark, Singapore). Patients with systolic blood pressure of 130 mmHg or more and/or diastolic blood pressure 85 mmHg or more were classified as having elevated blood pressure [26]. Body mass index (BMI) was calculated by dividing weight in kilograms by height in metres squared. The WHO classification of BMI was used to classify the patients as underweight (BMI < 18.5 kg/m^2); normal (BMI 18.5–24.9 kg/m^2); overweight (BMI 25.0–29.9 kg/m^2); and obese (BMI > 30 kg/m^2) [27]. Waist circumference (widest between the lower rib margin and the iliac crest) and hip circumference (widest over the great trochanters) were measured and used to calculate waist-to-hip ratio (WHR), an index of regional fat distribution. A value > 0.9 in men and > 0.85 in women, respectively, indicates increased risk of metabolic complications [28].

2.1 Statistical Analysis

All statistical analyses were performed by using IBM SPSS statistics (Version 21.0, SPSS Inc., Chicago, IL, USA). Descriptive statistics such as frequencies, percentages, means, ranges and standard deviation (SD) were used to describe the data. Categorical variables were expressed as absolute number and percentage (%), and continuous variables were expressed as means±SD.

3. RESULTS

Overall, a total of 313 type 2 diabetic patients who fulfilled the eligibility criteria participated in the present research upon written informed consent. The socio-demographic characteristics along with the family history of DM, hypertension, CAD, stroke and dyslipidemia of the study patients were summarised in Table 1. In regards to family health history, a majority of the patients demonstrated familial DM (regardless of type 1 or 2) and hypertension, but not CAD, stroke and dyslipidemia.

Table 1. Characteristics of the type 2 diabetic patients (n=313)

Characteristic	n (%)	Mean±SD
Age categories (years)		55.7±9.2
30-39.9	19 (6.1)	
40-49.9	53 (16.9)	
50-59.9	118 (37.7)	
60-69.9	112 (35.8)	
≥70	11 (3.5)	
Age at diabetes diagnosis (years)		45.6±10.1
Diabetes duration (years)		10.1±8.1
Hypertension duration (years)		7.1±8.5
Gender		
Male	150 (47.9)	
Female	163 (52.1)	
Ethnicity		
Malay	147 (47.0)	
Chinese	80 (25.6)	
Indian	86 (27.5)	
Marital status		
Single	10 (3.2)	
Married	254 (81.2)	
Divorced	11 (3.5)	
Widowed	38 (12.1)	
Education (years)		9.5±6.0
No formal education	30 (9.6)	
Primary school	72 (23.0)	
Secondary school	138 (44.1)	
Tertiary education	73 (23.3)	
Family history of diseases		
Diabetes mellitus	236 (75.4)	
Hypertension	168 (53.7)	
Coronary artery disease	108 (34.5)	
Dyslipidemia	101 (32.3)	
Stroke	65 (20.8)	

Table 2 represents the prevalence of diabetic vascular complications among our type 2 diabetic patients in the study. One of the most disconcerting observations is that, the prevalence of macrovascular complications among the patients was high, with one or more cardiovascular events ever been experienced (36.1%). The prevalences of CAD, cerebrovascular disease and PVD were 30.7%, 10.2% and 5.1%, respectively. Among the patients with history of cerebrovascular disease, 9.6% documented with ischaemic stroke and 4.5% with TIA. Peripheral neuropathy was found to be the main microvascular complication among the patients, accounting for 41.5%, followed by diabetic nephropathy (17.6%) and retinopathy (15.0%). Diabetic foot ulcer was observed among 2.9% patients, with no case of leg amputation noted.

Table 2. Prevalence of diabetic vascular complications among type 2 diabetic patients*

	n (%)
Cardiovascular disease	113 (36.1)
Coronary artery disease	96 (30.7)
Angina pectoris	69 (22.0)
Myocardial infarction	34 (10.9)
Coronary artery bypass grafting (CABG)	14 (4.5)
Percutaneous transluminal coronary angioplasty (PTCA)	29 (9.4)
Cerebrovascular disease	32 (10.2)
Ischaemic stroke	30 (9.6)
Transient ischaemic attack (TIA)	14 (4.5)
Peripheral vascular disease	16 (5.1)
Peripheral neuropathy	130 (41.5)
Nephropathy	55 (17.6)
Retinopathy	47 (15.0)
Diabetic foot ulcer	9 (2.9)

**Multiple medical conditions*

Clinical characteristics of the patients are elaborated in Table 3. The HbA_{1c} levels of the patients ranged from 5.4% to 17.2%, with a notably high mean value of 8.7±2.1; and a high mean FPG level was recorded (8.8±3.6 mmol/L). In addition, the mean total cholesterol, LDL cholesterol, HDL cholesterol, and triglycerides were 4.9±1.3 mmol/L, 2.9±1.1 mmol/L, 1.2±0.3 mmol/L, and 1.8±1.2 mmol/L, respectively. A majority of the patients was suffering from at least dyslipidemia or hypertension. Of note, as much as 74.4% the patients were having both hypertension and dyslipidemia. The mean BMI of the patients was 29.0±5.0 kg/m^2, and their average WHR was 0.9±0.1.

In the current analysis, only one-fifth (19.8%) of the patients demonstrated good HbA_{1c} control, while 80.2% had suboptimal control with their HbA1c ≥ 7.0%; and majority of the patients (42.5%) did not achieve optimal FPG level, indicating poor glycaemic controls among the patients. Dyslipidemia was found in 89.1% of the patients, of which total cholesterol level was higher than normal in 59.6%, LDL cholesterol in 54.8%, and triglycerides in 39.7% patients. On the other hand, 59.1% males and 40.1% females met the recommended HDL cholesterol levels regardless of any treatment strategy. Hypertension was observed in 80.2% of patients as judged by antihypertensive treatment. Systolic blood pressure under optimal control was 66.8% patients, whereas inadequate control was recorded in 33.2%. In terms of diastolic blood pressure, 65.2% achieved the target, all of which indicate that most patients had satisfactory blood pressure control. Obesity was

observed in one-third (35.9%) of the patients; meanwhile 43.3% patients were overweight. Different degree of obesity was found using WHR (86.5%).

Table 3. Clinical characteristics of the type 2 diabetic patients (n=313)

Variables	n (%)	mean±SD
Diabetes treatment		
Oral agents only	190 (60.7)	
Insulin only	25 (8.0)	
Oral agents and insulin	98 (31.3)	
HbA_{1c} (%)		8.7±2.1
< 7.0%	62 (19.8)	
≥ 7.0%	251 (80.2)	
Fasting plasma glucose (FPG) (mmol/L)		8.8±3.6
< 3.9 mmol/L	0 (0.0)	
3.9 - 7.2 mmol/L	133 (42.5)	
> 7.2 mmol/L	180 (57.5)	
Total cholesterol (mmol/L)[§]		4.9±1.3
≤ 4.5 mmol/L	126 (40.4)	
> 4.5 mmol/L	186 (59.6)	
LDL cholesterol (mmol/L)[§]		2.9±1.1
≤ 2.6 mmol/L	141 (45.2)	
> 2.6 mmol/L	171 (54.8)	
HDL cholesterol (mmol/L)[¥]		
Men		1.2±0.3
≥ 1.03 mmol/L	88 (59.1)	
< 1.03 mmol/L	61 (40.9)	
Women		1.1±0.3
≥ 1.29 mmol/L	65 (40.1)	
< 1.29 mmol/L	97 (59.9)	
Triglycerides (mmol/L)[§]		1.8±1.2
≤ 1.69 mmol/L	188 (60.3)	
> 1.69 mmol/L	124 (39.7)	
Dyslipidemia (%)	279 (89.1)	
Hypertension (%)	251 (80.2)	
Dyslipidemia and hypertension (%)	233 (74.4)	
Systolic blood pressure (mmHg)		137.9±18.9
≤ 130 mmHg	104 (33.2)	
> 130 mmHg	209 (66.8)	
Diastolic blood pressure (mmHg)		80.7±11.8
≤ 85 mmHg	204 (65.2)	
> 85 mmHg	109 (34.8)	
Obesity		
Body mass index (BMI) (kg/m^2)[§]		29.0±5.0
Underweight (< 18.5)	1 (0.3)	
Normal (18.5–24.9)	64 (20.5)	
Overweight (25.0–29.9)	135 (43.3)	
Obese (> 30)	112 (35.9)	
Waist-to-hip ratio[§]		0.9±0.1
Normal	42 (13.5)	
Obese	270 (86.5)	

[§] One case with missing data
[¥] Two cases with missing data

4. DISCUSSIONS

Cardiovascular conditions are always the most predominant chronic complication of T2DM. The overall prevalence of macrovascular complications (36.1%) noted among our type 2 diabetic patients, mainly CVD, was rather comparable to the prevalence of 33.4% reported in a recent study conducted in China [29]. The rates of macrovascular complications from this study were higher than other similar studies undertaken in Spain (25%) [30], Italy (31.7%) [31] and Germany (15.2%) [32]. Probable explanations for the discrepancies are the widely varied study design, screening procedures, and population characteristics of various studies. Besides, the patients from this study were recruited from tertiary referral hospitals, therefore were more likely to have more severe disease and a higher rate of complications. Effective measures for the prevention of cardiovascular complications are essential for reducing overall deleterious effects of DM.

Peripheral neuropathy, with a prevalence of 41.5% in this study, was outperformed than in studies carried out in Canada, the United States, Spain, China and Sweden [29,33,34,35,36]. Nevertheless, our peripheral neuropathy prevalence is slightly lower than 3,469 type 2 diabetic in-patients from 10 medical centres of Beijing, Shanghai, Tianjin, and Chongqing in China, of which the percentage of neuropathy was 51.1% [37]. As stipulated that neuropathy raises the risk of other complications including diabetic foot ulcers and ultimately lower-extremity amputations [38], there is no doubt that early detection and treatment of this complication are clinically effective in preventing and delaying further progression of complications.

Diabetic nephropathy is the single leading cause of ESRD [7] which inordinately increase the mortality in diabetics [1]. The results of the present study showed that the prevalence rate of established nephropathy was 17.6%, alone or in combination with the other complications. The prevalence of nephropathy is considered a high percentage in comparison with other studies which occurred in 5.7% diabetic patients in Spain [36]. Since microalbuminuria is a useful indicator for detection of early manifestations of nephropathy and a marker of increased cardiovascular morbidity and mortality for diabetic patients [7], early screening for microalbuminuria is necessary for our patients.

Diabetic eye disease, particularly diabetic retinopathy, has become a major cause of blindness throughout the world [1,39]. WHO has estimated that diabetic retinopathy is responsible for 4.8% of the 37 million cases of blindness [40]. Diabetic retinopathy is a complication of DM that affects the blood vessels of retina and eventually leads to legal blindness. The progression of retinopathy is gradual, advancing from mild abnormalities, characterized by increased vascular permeability, to moderate, severe non-proliferative, and proliferative diabetic retinopathy, featured by definite neovascularization or/and vitreous or preretinal haemorrhage [41,42]. The prevalence of diabetic retinopathy worldwide ranges from 6.8 to 44.4% in patients with DM [37,43,44,45,46,47,48]. In Malaysia, the prevalence of diabetic retinopathy from the 2007 Diabetic Eye Registry was 36.8% [47] which was double the diabetic retinopathy prevalence of our findings (15.0%). As much as 90% of blindness due to diabetic retinopathy among individuals with DM may be preventable if detected and treated early [6]. For that reason, annual screening for diabetic retinopathy among the patients may be significantly reducing the risk of sight threatening disease, also it is important that the patients are educated to understand the need for annual ophthalmic examinations.

The most surprising finding was the low prevalence of diabetic foot ulcer at 2.9%, although slightly more common than the 8.0% [49] reported for Asian-Americans. However, it should be noted that the criteria employed to establish foot diseases differed between the studies. In the present investigation, foot disease was established through a doctor's diagnosis, whereas the previously mentioned study relied on self-reported symptoms.

Our data indicate the inadequate control of modifiable cardiovascular risk factors in this population studied. A large proportion of the patients had poor glycaemic controls, which is similar to previous reports [50,51,52,53,54]. This is a matter of concern because according to the United Kingdom Prospective Diabetes Study (UKPDS) trial [55], a prospective clinical trial of intensive glycaemic therapy in individuals with newly diagnosed T2DM, poor glycaemic control over a long period of time contributes to chronic diabetic complications and demonstrated a relationship between blood glucose level and risk of diabetes complications. To this respect, we should aim to maintain normoglycaemia as far as is safely possible. Although we could not conclude that poor glycaemic control results in chronic complications through a cross-sectional study, it still triggers a warning to the health authority that there is an urgent need for glycaemic management, and the chronic complications of T2DM may be worsened under current poor glycaemic status.

Strict treatment of dyslipidemia with lipid-lowering drugs has also been shown to reduce secondary cardiovascular events in diabetic patients with past clinical CAD [56,57]. The Heart Protection Study provided evidence that cholesterol-lowering therapy is beneficial for people with DM even if they do not already have manifest CAD or high cholesterol concentrations [58]. In spite of the strong evidence in favour of aggressive treatment of lipids in the diabetic population, this study revealed a high prevalence of dyslipidemia in the type 2 diabetic patients, and a large proportion of patients did not achieve the recommended levels for lipid profiles. This is in agreement with a local study which found a relatively high prevalence of dyslipidemia (93.7%) among their type 2 diabetic patients [54]. There is a consensus that improved control of blood pressure has a major impact on the reduction of both cardiovascular and renal risk, particularly so in diabetic patient groups [59,60]. In our study, a larger number of the patients reached the systolic and diastolic blood pressure targets. Angiotensin-converting enzyme inhibitors (ACEIs) or angiotensin II receptor blockers (ARBs) have been shown to reduce cardiovascular death and the incidence of cardiovascular events in diabetic patients [61,62]. In line with these data, the majority of our patients with CVD were treated with ACEIs (55.8%) and ARBs (26.5%). The control of coexisting DM and the risk factors does not appear to be optimal, reflecting on one hand the severity of DM, hypertension and dyslipidaemia in those patients, and on the other hand an overall pattern of management that is often inadequate. Yet these morbidities represent only the tip of the cardiovascular iceberg. A far larger proportion of individuals postulated to have asymptomatic disease and target organ damage secondary to undetected vascular complications and the presence of other risk factors, such as DM, hypertension, and hypercholesterolemia [1]. To this end, a stricter adherence to the existing guidelines and a much stronger attention to the attainment of the desirable therapeutic goals will allow a decrease in morbidity and mortality related to DM. These facts are of particular paramount for the patients in this study and medical personnel.

Obesity is a great public health concern. It is a significant determinant of hyperinsulinaemia/insulin resistance, high total triglycerides and low HDL cholesterol, suggesting that the achievement of normal weight is desirable [63]. The results of this study highlight the undesirable mean values of obesity indices among the patients. Particularly the BMI reported in the present study being greater than that of DiabCare Malaysia 2008 (27.8

kg/m^2) [51] and Singapore DiabCare Singapore 1998 (25.1 kg/m^2) [50]. This provides a clear indication of the need to orient diabetes care towards the control of diabesity, one of the global cardiovascular risks.

Despite the difficulties involved in controlling the cardiovascular risk factors, the results of the present study show that a more comprehensive, appropriate and rigorous approach to patient management should be prompted urgently. The published recommendations are required to be more stringently complied, in terms of weight management, treatment strategy, and targets for blood glucose, blood pressure and lipid levels as well as early screening for diabetic vascular complications. From the research point of view, we hope that further prospective cohort studies could be carried out to assess the causal relationships of diabetic vascular complications and cardiovascular risk factors among Malaysian type 2 diabetic patients. This is of utmost vital to uncover gaps in routine diabetes care, planning of future Interventions and monitoring of outcomes.

This study is not without limitations. The study subjects were tertiary hospital-based patients with DM of a relatively long duration, so it is likely that they have more diabetic complications and a more difficult metabolic control and treatment than expected in a group of patients with T2DM followed up by general practitioners in primary care settings. Thus, inferences beyond a similar group cannot be made. Moreover, this study was focused mostly in the study population and hence it might not be possible to extrapolate these results to other ethnicities or countries.

5. CONCLUSION

In conclusion, a high prevalence of diabetic vascular complications was found among the type 2 diabetic patients, with a predominance of cardiovascular and neuropathic conditions. Majority of the studied patients suffered from at least one cardiovascular risk factors (dyslipidemia, hypertension and obesity), and these modifiable risk factors were sub-optimally controlled. All these findings point to an imperative need for efforts at establishing and maintaining effective diabetes management. This includes combination of pharmacotherapy, patient empowerment and self-management, diabetes education programs and therapeutic lifestyle modifications to effectively combat diabetic vascular complications and ameliorate the current clinical status of type 2 diabetic patients.

CONSENT

All authors declare that written informed consent was obtained from the patient (or other approved parties) for publication of this research article and accompanying images.

ETHICAL APPROVAL

All authors hereby declare that all experiments have been examined and approved by the appropriate ethics committee and have therefore been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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