UNIT NO. 1

EPIDEMIOLOGY OF DIABETES MELLITUS & IMPORTANT EVIDENCE BASED INFORMATION

Dr Tan Chee Eng

ABSTRACT

The prevalence of DM in Singapore was 8.4% among those aged 18-69 years old in 1992. This rose to 9% in 1998. The prevalence of DM in Singapore is highest in Indians, followed by Malays and then Chinese. Genetic predisposition interacting with environmental factors could account for this observation. Diabetes mellitus is associated with increased microvascular complications (retinopathy, nephropathy and neuropath) as well as macrovascular complications (coronary heart disease). Intensive glycaemic control can reduce microvascular complications but may not reduce macrovascular complications. Use of statins has been shown to reduce coronary heart disease in diabetic patients. Multi-prong, multi-factorial intervention of risk factors in subjects with diabetes mellitus is needed to reduce the diabetic complications. Subjects with impaired fasting glycaemia and impaired glucose tolerance have increased risk of CHD and progression to DM. There are good evidence to support the hypothesis that lifestyle intervention can prevent progression from IGT to DM by up to 58%.

EPIDEMIOLOGY OF DIABETES IN SINGAPORE

The prevalence of diabetes mellitus (DM) worldwide was estimated to be around 2.8% in 2000 and this is expected to rise to 4.4% in the year 2030[1]. Although the prevalence in percentage may not appear to have greatly increased, the number of individuals afflicted with DM will rise from 171 million in 2000 to a staggering 366 million by the year 2030. Furthermore, the greatest increase in prevalence of DM is occurring in the non Europoid population[2], particularly in Asians. The prevalence of diabetes mellitus in Singapore on the other hand, has been increasing steadily. In 1992, the prevalence of DM was 8.4%[3] among those aged 18 to 69 years old but this rose to 9% in 1998[4]. Compared with other Asian countries, prevalence of DM in Singapore is among the highest in the region. What was even more alarming was the fact that the 1998 survey found that 62.1% of those with diabetes did not even know they had diabetes. This is not surprising since many Type 2 DM patients may be asymptomatic. Several factors could contribute to the increasing prevalence of DM including a changing diet, an ageing population, obesity, urbanization and increasing physical inactivity.

TAN CHEE ENG, Consultant Endocrinologist, Gleneagles Medical Centre

Singapore is unique in that we have three major ethnic groups living in a fairly homogenous society, with equal access to health care and other facilities. This offers an excellent opportunity to examine the interactions of genes and environment and its impact on prevalence of DM. In Singapore, Indians have the highest prevalence of DM (15.8%), followed by the Malays (11.3%) and then Chinese (8.0%). While it is true that for each ethnic group in Singapore, the prevalence of DM is higher than in the respective country of origin, the prevalence in the Chinese have not risen to the same level as in the Indians. One possible explanation could be that the prevalence in Chinese may not have reached its peak yet and hence trails behind the Indians. This is supported by the observation that the prevalence of DM in Chinese shows the fastest increase and doubled from 4.0% in 1984 to 8.1% in 1992[3]. A second possible reason for differences in ethnic prevalence of DM is genetic predisposition. If that was the reason, then prevalence in Chinese will continue to trail behind Indians, given similar environmental changes.

Subjects with the metabolic syndrome are also at increased risk of developing DM[5] and CVD[6]. The prevalence of the metabolic syndrome in Singapore is 17.9%[7] and comparable to those in the United States. Given the high prevalence of the metabolic syndrome in Singapore and the increased risk of progression to DM, we should expect the prevalence of DM in Singapore to continue to rise unless lifestyle intervention is instituted nationwide.

COMPLICATIONS OF DIABETES MELLITUS

Both Type 1 and Type 2 DM are associated with microvascular and macrovascular complications. Intensive glycaemic control in Type 1 DM has been shown to result in significant reduction in microvascular complications such as retinopathy[8], nephropathy and neuropathy[9] but not in macrovascular complications such as CHD or CVD[10] although there was a trend towards benefit. Similarly, intensive glycaemic control in Type 2 DM resulted in significant reduction in microvascular complication but failed to demonstrate significant benefit with regards to macrovascular complication[11]. Although DM is associated with significant complications, morbidity and mortality, we have good intervention data in both Type 1 and Type 2 DM to show us that the burdens can be reduced substantially with good glycaemic control. However, it is also clear that glycaemic control alone would be insufficient to reduce the burdens of macrovascular complications. Therefore, treatment of dyslipidaemia associated with DM with statins is necessary to reduce the burdens from macrovascular

disease[12,13]. A recent study clearly demonstrated the need for multi-prong, multi-factorial intervention of all CVD risk factors in patients with DM and showed convincingly the benefits of such aggressive approach to reduce the burdens of diabetic complications[14].

DIABETES AND CORONARY HEART DISEASE

One of the most feared complications of DM is coronary heart disease (CHD) and almost 60% of individuals with DM in Singapore die as a consequence of cardiovascular disease (CVD)[15]. Furthermore, case-fatality is higher in those with DM. As many as 50% of persons suffering their first myocardial infarction die during that episode and will never become eligible for measures intended for secondary prevention[16]. Several prospective studies have also documented increased mortality associated with DM. Our own population data have clearly demonstrated that diabetes, impaired fasting glycaemia (IFG) and impaired glucose tolerance (IGT) states are all associated with increased mortality among all three major ethnic groups[15]. This is not surprising as we have previously found that subjects with IFG and IGT had cardiovascular risk profile that were similar and subjects who had both IFG and IGT had features consistent with the metabolic syndrome[17]. However, it was again interesting to note that mortality from CVD in diabetic subjects differed among ethnic groups. Indians and Malays with DM have mortality that was almost twice that seen in the Chinese population[15]. It is possible that Indians and Malays have more prolonged exposure to cardiovascular risk factors associated with DM such as insulin resistance, low HDL cholesterol and obesity[3]. Therefore the mortality associated with DM continues to be higher among Malays and Indians compared with Chinese.

As there is increased mortality among those with previously undiagnosed DM as well as IGT and IFG, more attention is needed to identify such individuals. The combined prevalence of IGT or IFG is 16.2% and is twice the prevalence of DM. Therefore, the number of individuals afflicted with CVD from undiagnosed DM, IFG or IGT will be substantially more than subjects with known DM.

PROGRESSION FROM IGT TO DM

Of particular concern for us in Singapore is the fact that of the 15% with IGT, a substantial proportion will eventually progress to DM. The rate of progression from IGT to DM is 4.3% per year[18] and this is another factor indicating that the prevalence of DM in Singapore will continue to climb. However, we must also take note that not all IGT progress to DM and 41.4% in fact reverted to a normal glucose tolerance state. When the glucose tolerance state improves, the dyslipidaemia and insulin resistance associated with IGT also reverted to normal. The amount of weight changes appear to be critical in determining whether one progresses or reverts to a normal state. Subjects with IGT who reverted to a normal glucose tolerance state had the least amount of weight gain compared with others who remained as IGT or progressed to DM[18]. Therefore, we would need to focus on preventing excessive weight gain in subjects with either IFG or IGT if we are to contain the epidemic of DM in Singapore. There are good evidence to support the hypothesis that lifestyle intervention such as increasing physical activity and dietary change can prevent progression from IGT to DM by up to 58%[19-21].

IMPLICATIONS OF CHANGING CRITERIA FOR DIAGNOSING IFG

The American Diabetes Association had previously recommended the recognition of IFG as a category of glucose tolerance analogous to IGT if fasting glucose fell between 6.1 and 6.9 mmol/l[22]. Experts felt that it was important to identify both IFG and IGT since they carry increased risk for CHD. Furthermore, as mentioned previously, several randomized controlled trials have shown that lifestyle interventions could significantly reduce the risk of progression from IGT to DM. However, recently, the ADA recommended that the lower limit for diagnosis of IFG be changed from 6.1 mmol/l to 5.6 mmol/l[23]. Lowering the criterion for diagnosing IFG will increase the prevalence of from 9.5% to 32.3% in the 1998 National Health Survey. This lower cut-off will identify more subjects are risk of DM and CHD but the risk was lower than subjects with IGT.

CONCLUSION

Diabetes was the 6th leading cause of death in Singapore. The greatest impact of diabetes however is not from mortality but the morbidity arising from diabetic complications. The burdens on health care cost resulting from complications of diabetes are tremendous. The emotional burdens arising from diabetic complications cannot be measured by dollars and cents but affects patients and their family members severely.

The prevalence of DM will continue to rise, particularly in our part of the world. We have good epidemiological evidence, both from cross-sectional as well as prospective data that poor glycaemic control will lead to diabetic complications. We also have good interventional data that good glycaemic control can reduce the burdens of diabetic complications substantially. Therefore, primary health care physicians can and must play a pivotal role in managing DM and prevention of its associated complications.

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LEARNING POINTS

- **High prevalence of DM in Singapore, highest in Indians, followed by Malays and then Chinese. Genetic predisposition interacting with environmental factors could account for this observation.**
- **Diabetes mellitus is associated with increased microvascular complications (retinopathy, nephropathy and neuropath) as well as macrovascular complications (coronary heart disease).**
- **Intensive glycaemic control can reduce microvascular complications but may not reduce macrovascular complications.**
- **Use of statins have been shown to reduce coronary heart disease in diabetic patients.**
- **Multi-prong, multi-factorial intervention of risk factors in subjects with diabetes mellitus is needed to reduce the diabetic complications.**
- **Subjects with impaired fasting glycaemia and impaired glucose tolerance have increased risk of CHD and progression to DM.**