Abstract

Chronic hyperglycaemia of Type 2 Diabetes Mellitus (T2DM) causes long term damage to heart resulting in coronary artery disease (CAD), myocardial infarction (MI), congestive heart failure (CHF), and sudden death from arrhythmias. A 62 year old male presented to our emergency with complaint of sudden onset giddiness from last 2 hours. This was followed by loss of consciousness. Patient was a known case of T2DM since last 1 year. Family history-patient has two brothers who also have T2DM and both of them also developed Complete Heart Block (CHB) spontaneously. The patient’s mother also had T2DM and she also developed CHB. On examination of the cardiovascular system, pulse rate was 36 per minute and a variable intensity of first heart sound was present. Rest of the cardiovascular examination and other system examination was within normal limits. Routine investigations were within normal limits and ECG showed CHB. Echocardiography revealed normal ventricular function with no evidence of ischemic heart disease. This was a case of Type 2 DM and spontaneous onset CHB with a strong family history. This case underscores the fact that CHB can occur spontaneously in Type 2 diabetics without ischemic heart disease. The cause of CHB was most likely Cardiac Autonomic Neuropathy (CAN), which is determined not only by poor glycemic control, metabolic derangements and duration of diabetes but also by genetic factors (likely maternal).

Keywords: Complete Heart Block, Type 2 Diabetes Mellitus, QTc interval, Kearns-Sayre syndrome

Introduction

Chronic hyperglycemia of type 2 diabetes mellitus (T2DM) causes long-term damage to the heart resulting in coronary artery disease, myocardial infarction, congestive heart failure, and sudden death from arrhythmias. Cardiac autonomic neuropathy (CAN) associated with diabetes is associated with heart rate variability and changes in ventricular repolarization. The increase in QT interval-heart rate relationship is used for diagnosis of CAN. Many studies have shown the increased association of T2DM with complete heart block (CHB), secondary to CAN and hereditary factors.

Case Report

A 62-year-old male patient presented to our emergency with the complaint of sudden onset giddiness from the past 2 h. This was followed by the loss of consciousness. The patient was a known case of T2DM for the past 1 year. No history of previous such episodes of giddiness or loss of consciousness was present. There was no history of chest pain, breathlessness, cough, oliguria, and palpitations. There was no history of hypertension or ischemic heart disease.

Treatment history - patient has been taking metformin 1 g daily along with aspirin 75 mg and atorvastatin 10 mg. The patient had a good glycemic control which was reflected by the HBA1c levels of 7.2% (done 15 days back).

Family history - patient has two brothers who also have T2DM and both of them also developed CHB spontaneously. His elder brother, currently of 64 years of age, is a known case of T2DM since 56 years of age, and he developed CHB at the age of 59 years. His younger brother, who is 58 years old, is a known case of T2DM since 52 years of age, and...
he developed CHB at the age of 56 years. Both his brothers developed CHB spontaneously, similar to our patient and they too had no history of hypertension or ischemic heart disease. Both his brothers underwent Echocardiography when they developed CHB, and neither of the two had any evidence of ischemic heart disease on Echocardiography. Both his brothers underwent permanent pacemaker implantation and have been doing well since then.

The patient’s mother also had T2DM and she also developed CHB at the age of 65 years and succumbed to death at the age of 75 years, due to cerebrovascular accident. His father was a nondiabetic.

Our patient had two children and none of them had T2DM or CHB [Figure 1].

On examination, his pulse rate was 36/min, regular, high volume; blood pressure of 140/60 mmHg; body mass index of 24.9 and waist-hip ratio of 0.85. Rest of the general examination was within normal limits. On examination of the cardiovascular system, a variable intensity of first heart sound was present. Rest of the cardiovascular examination and other system examination was within normal limits [Table 1].

### Investigations

Based on the ECG [Figure 2], a diagnosis of CHB was made, and temporary pacing was performed followed by permanent pacemaker implantation. Patient has been doing well since then. Arterial blood gas done at the time of admission revealed metabolic acidosis. A chest X-ray was performed later on and it showed no abnormality. Echocardiography was performed and there was no evidence of ischemic heart disease.

### Discussion

The above findings suggest that this was a case of T2DM and spontaneous onset CHB. The patient has a strong family history of T2DM and spontaneous development of CHB. This case underscores the risk of development of spontaneous onset CHB in T2DM patients. Type 2 diabetics are known to have an increased incidence of CHB and sudden cardiac death. The cause of this association of CHB among type 2 diabetics may be associated with the development of CAN, secondary to the micro- and macro-vascular complications of T2DM and hereditary factors.

CHB and other cardiac conduction defects are common in patients with T2DM and CAN. CAN is associated with increased resting heart rate, reduced heart rate variability, and reduced sinus arrhythmia. QTc prolongation and increased QT dispersion associated with CAN have been shown to be associated with an increased risk of development of heart blocks due to inhomogeneous ventricular repolarization.[1] CAN develops because of impaired coronary vasomotor regulation secondary to diabetes. Vasoconstriction within the coronary circulation leads to changes in the calcium/calmodulin pathway in the cardiac muscles inducing a fibroblastic response, which leads to fibrosis of the conduction tree. This fibrosis leads to longer refractory periods within the ventricles and thereby causing inhomogeneity of the refractory period and repolarization, leading to heart block.

Movahed and Hashemzadeh performed a multivariate analysis and revealed that CHB occurred in 1.1% DM patients as compared to 0.6% in the control group (NonDM patients). DM remain strongly associated with third degree atrioventricular block (odds ratio 3.1; 95% confidence interval [CI] 3–3.3; \( P < 0.0001 \)).

### Table 1: Lab parameters

| Investigations       | Value           |
|----------------------|-----------------|
| Hemoglobin           | 13.4 g/dl       |
| TLC                  | 6400/cumm       |
| Platelet count       | 1.96l/cumm      |
| Blood urea/serum creatinine | 19.2/0.96 mg/dl |
| Random blood sugar   | 212 mg/dl       |
| Sodium               | 136.5 mEq/L     |
| Potassium            | 5.3 mEq/L       |
| AST/ALT/ALP          | 32/36/98        |
| Urine routine        | NAD             |
| HBA1c                | 7.5%            |
| TC/HDL-C/LDL-C/TG    | 168/42/132/206  |
| TSH                  | 2.22 IU/L       |
| Serum calcium        | 9.4 mg/dl       |
| Serum magnesium      | 2.1 mg/dl       |

TLC: Total leukocytes count, ALT: Alanine transaminase, AST: Aspartate aminotransferase, ALP: Alkaline phosphatase, TC: Total cholesterol, HDL-C: High-density lipoprotein cholesterol, LDL-C: Low-density lipoprotein-cholesterol, TG: Triglyceride, NAD: Nicotinamide-adenine dinucleotide, TSH: Thyroid stimulating hormone

### Figure 1: Pedigree analysis of the family in study

### Figure 2: Electrocardiography (ECG) of the index case
Krishna et al. in their study also showed that first degree heart block and CHB occur at an increased frequency in diabetics.\(^1\)

Our case had a strong family history of T2DM and spontaneous development of CHB, reflecting the importance of heredity in the pathogenesis of DM and CHB. All his siblings and his mother had T2DM along with CHB, but none of his children had either of the entities, indicating a maternal pattern of inheritance of combined T2DM and CHB. Many of the mitochondrial (maternal) inheritance disorders have been seen to have DM (either type 1 or type 2) and CHB as one of the many components of the syndrome. Examples include Kearns–Sayre syndrome, diabetes mellitus and deafness, myoclonic epilepsy with ragged red fibers, mitochondrial myopathy, lactic acidosis, stroke-like symptoms, and Leber’s hereditary optic neuropathy.\(^2\) Thus, this may be a case of a maternal inheritance disorder, but none of the other disease manifestations were present either in the index case or his siblings. Genetic analysis or other investigations to look for these syndromes and imaging studies (cardiac computed tomography/magnetic resonance imaging) to look for ischemia could not be done due to the poor financial status of the patient. Hence, there was insufficient evidence to label this as a case of maternal inheritance disorder. Although, this outlines the importance of maternal inheritance in the pathologic association between T2DM and CHB. Acidosis and hyperkalemia may also have some contribution in the development of CHB.

**CONCLUSION**

This case underscores the fact that CHB can occur spontaneously in type 2 diabetics without ischemic heart disease. The cause of CHB was most likely CAN, which is determined not only by poor glycemic control, metabolic derangements, and duration of diabetes but also by genetic factors (likely maternal).

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**Conflicts of interest**

There are no conflicts of interest.

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