

**ECG abnormalities in first visit of diabetic patients in Al Sammawah Diabetic center:  
cohort study**

Saad Hallawee\*, Ali Abdulkarim Talib, Bashar Ali Saeed

**Abstract**

Diabetes mellitus is a very common progressive endocrine disease in Iraq (and our society) as part of whole world, and diabetic patients are more likely to have cardiovascular diseases than patients without diabetes. ECG is the most widely used simple noninvasive test for evaluation of cardiovascular risk, so our study was focused to assess the relation between the frequency of ECG changes with the patients glycemic control and their age group. A 600 patients with newly diagnosed diabetes mellitus were identified from diabetic center in Al Sammawah teaching hospital. All are evaluated for variables; age, gender, glycemic control (HbA1c level) and ECG abnormalities. Then they are divided in two groups those with and others without ECG changes during evaluation of their above variables. The selected patients are 294 female and 309 male with most age distribution affected are 50-59 years 189(32%) followed by 40-49 years,130(22%)then 60-69 age group119 (20%) ,30-39 years 68(11%), >70 years 52 (9%) and <30 years about 37(6%). 327 patients with normal ECG and 273 patients with abnormal ECG, female was predominant by 55%, and ECG abnormality was distributed among low voltage in 110 patients (18 %), bradycardia in 54 patients (9%), with variable percent for the other ECG abnormalities. Diabetic control for most of the patients was poor according to HbA1c level which measured in the first visit and 77% of patients with HbA1c above 8. Inconclusion; the age group distribution in Samawah city is comparable to the other population, but with very bad diabetic control which require more effective educational and advance therapeutic approaches to control this propagating challenge. ECG changes seen were predominantly low voltage, then bradycardia which may reflect other association which require more future research.

**Keyword:** Diabetes mellitus; ECG; HbA1c

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## Introduction

DM is a common collection of metabolic abnormalities that ended with hyperglycemia and resulting from interaction between familial and environmental factors manifested as defect in insulin secretion, its action or both [1]. Changes in the human environment, psychological response, and recently developed western lifestyle have resulted in rapid increase in the incidence and prevalence of diabetes in people with genetic susceptibility to diabetes. Diabetes is associated with many progressive microvascular complications including retinopathy, nephropathy and neuropathy in addition to the nonfatal and fatal macrovascular complications, coronary artery disease (CHD), stroke and peripheral vascular disease [2]. The global number of people with diabetes mellitus was 151 million in 2000, increased to 415 in 2015 and projected to increase to 642 million in 2040, which considered a great challenge against diabetes health programs [3]. Iraq is one of the 19 countries of the IDF MENA region. more than 35.4 million people in the MENA Region; by 2040 this will rise to 72.1 million. 1.2 million registered cases of diabetes in Iraq in 2015. Estimated No. of Undiagnosed cases in adults are 519.6 in 1000s, so control of diabetes require multidisciplinary activities to reduce its

prevalence and subsequent complications [4]. Diabetic patients show cardiovascular risk 2-4 times more than patients without diabetes and, also female with diabetes are affected with equal age adjusted risk for cardiovascular disease to that of male with diabetes [5]. A through history, together with a careful physical examination and simple 12 lead ECG is the most inexpensive and noninvasive way to assess the cardiovascular disease in diabetic patients [6]. DM especially T2 DM is an inevitable cardiovascular risk factor and associated with a high prevalence of ECG abnormalities which may reach as many as 73%. Overall, the prevalence of unrecognized or silent MI appears to be higher in patients with diabetes mellitus compared with non-diabetics, ranging from 2% to 7%; however, the prevalence depends largely on the age and comorbidities of the population studied [7]. Early during diabetes course ECG abnormalities as sinus tachycardia, long QT, heart rate variability, ST segment changes and LVH may be observed. Fibrotic changes involving the left ventricle mainly the basal area frequently seen in patients with diabetes even before the clinical evidence of cardiac involvement [8]. The total economic cost of patients diagnosed with diabetes in 2012 is \$ 245 billion which exceed the last estimate in 2007 which is \$ 174 billion ,that mean

increased by 41 % and 18 % of the cost required for medications prescription to treat the diabetic complications, including cardiovascular disease [9].

Multiple ECG changes considered early markers for diabetic autonomic neuropathy, including elevated R wave amplitude, wide QT interval and decreased heart rate variability. the presence of these changes in diabetic patient correlate with increasing morbidity and mortality rate due to non-fatal and fatal coronary artery disease together with increased risk of fatal ventricular arrhythmia especially in patient with prolonged QT and QTc intervals [10]. The role of the electrocardiogram (ECG) in predicting the cardiovascular risk in the general population is debatable [11]. Although an abnormal ECG has been shown to be associated with an increase in cardiovascular mortality in asymptomatic patients, this increase may be so small compared to the influence of cardiovascular risk factors that many authors cast doubt on whether the ECG should be used to evaluate the risk in the general population [12]. Thus, early detection, and consequently early treatment, might well reduce the burden of type 2 diabetes and its complications. However, to increase the cost-effectiveness of testing undiagnosed, otherwise healthy individuals, testing should be considered in high-risk

populations [13]. Annual screening for urinary albumin excretion is recommended in patients with diabetes mellitus, and if combined with ECG and other risk factors stratification, can improve the accuracy of target organ damage detection [14].

## Result

A total of 600 cases with diabetes mellitus were included in the study, those are diagnosed according to the ADA criteria for diabetes, and assessed according to the designed study variables which include the gender, age, diabetes control by HbA1c level and ECG changes.

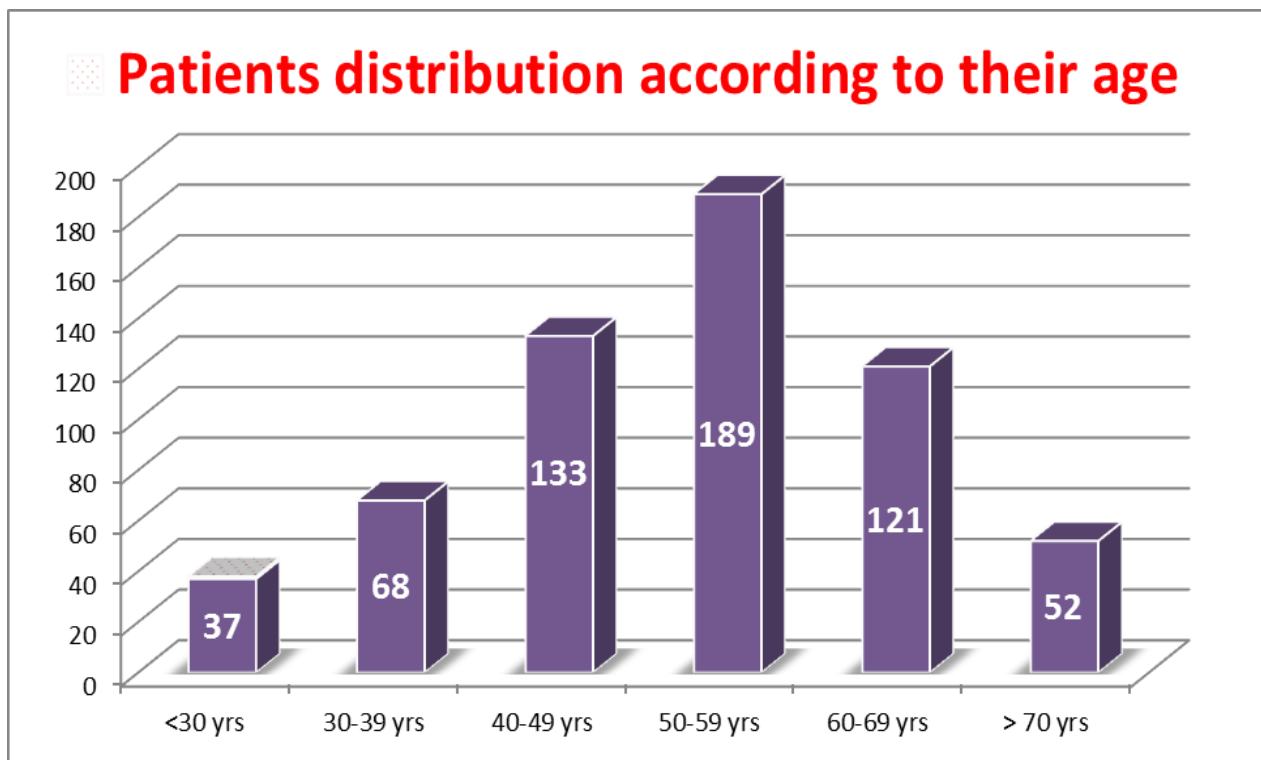
Male were more affected than female in slight difference of 306 versus 274 respectively according to figure (1). The patients age was between 25-75 years with mean value of  $50.5 \pm 9.9$ . The most commonly affected age was 50-59 years by 32% (189 cases) followed by 40-49 years age group which affected by 22% (121 cases), then other age groups according to figure (2). ECG record was done to all patients which result in variable ECG abnormalities with slightly higher female predominance than male by 152 versus 121 respectively according to figure (5). The resulting ECG abnormalities are variable and low voltage and bradycardia were the most commonly seen types in the involved patients. According to figure (4) low voltage

ECG seen in 83 patients (30%), followed by bradycardia which affect 48 patients (17%). Diabetes control also assessed in our patients by measuring HbA1c level for all

patients to result in most of the patients were badly controlled with HbA1c level exceeding 8 in 70 % of the patients with the following distribution.

**Table (1):**

Number of the pat.	HbA1c %	Ratio
273	10	46%
118	9 – 9.9	17%
87	8 – 8.9	15%
80	7 – 7.9	13 %
43	< 7	7%



**Figure (1)**

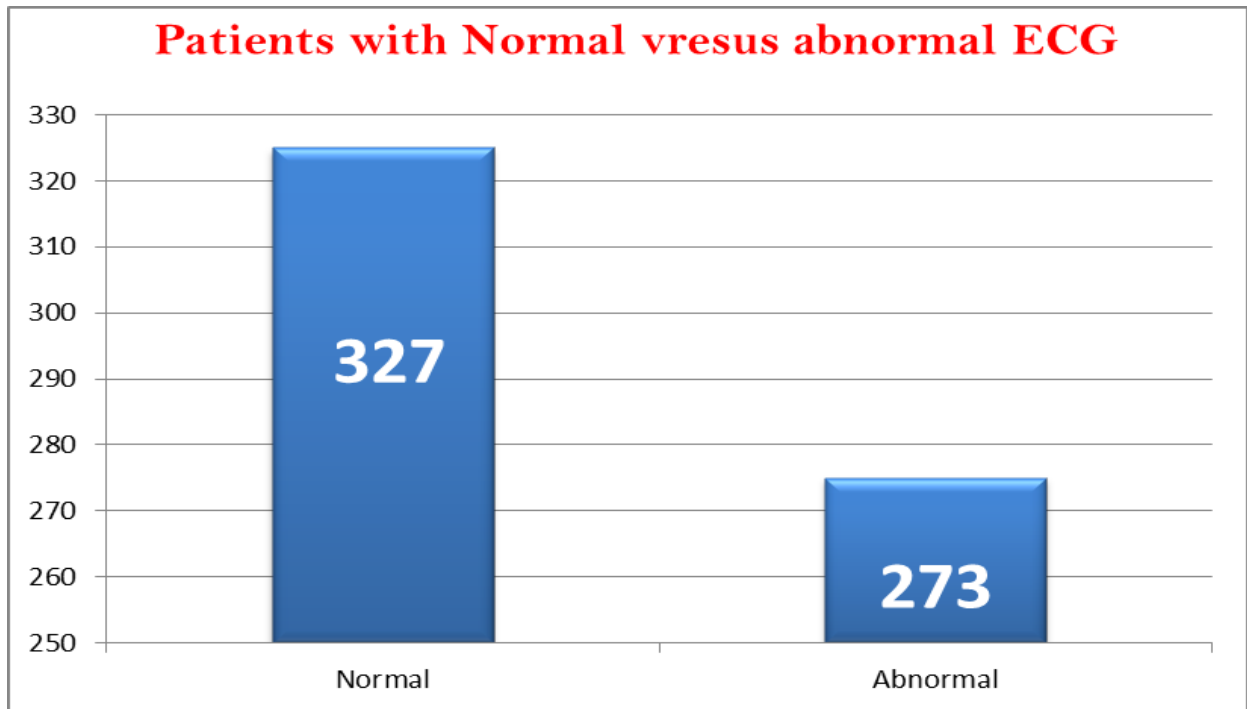


Figure (2):

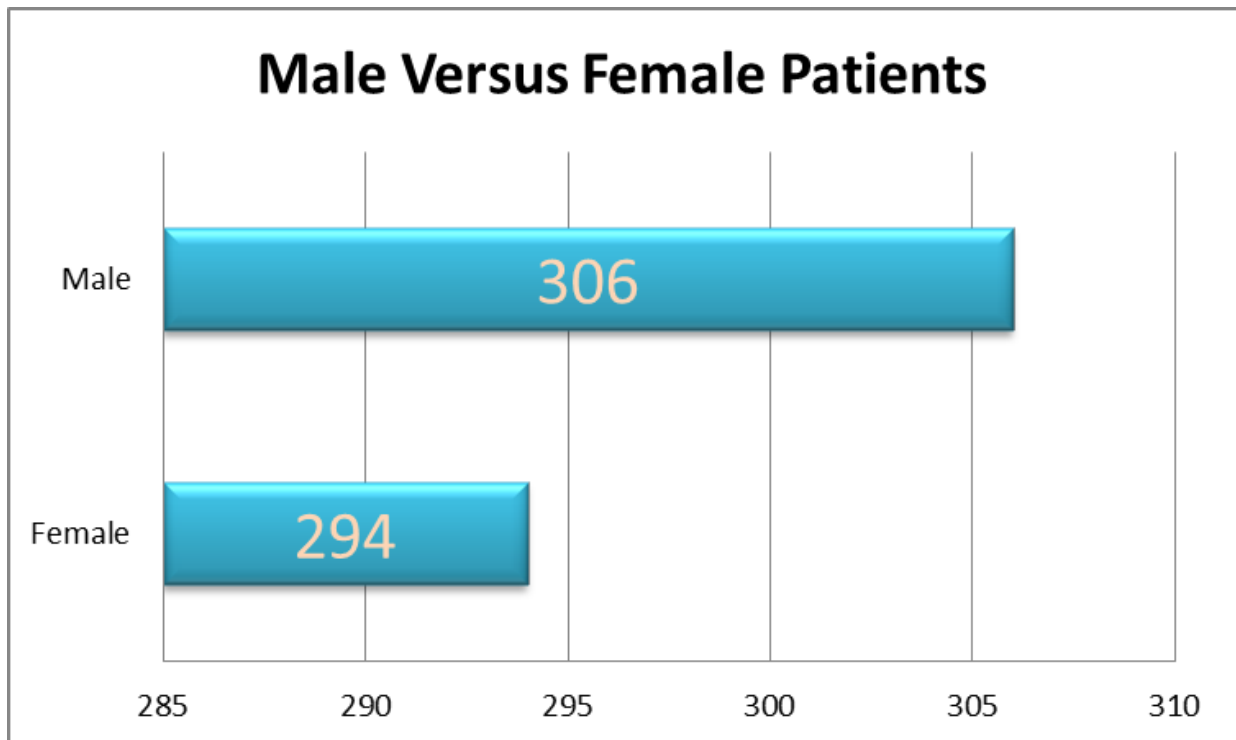


Figure (3):

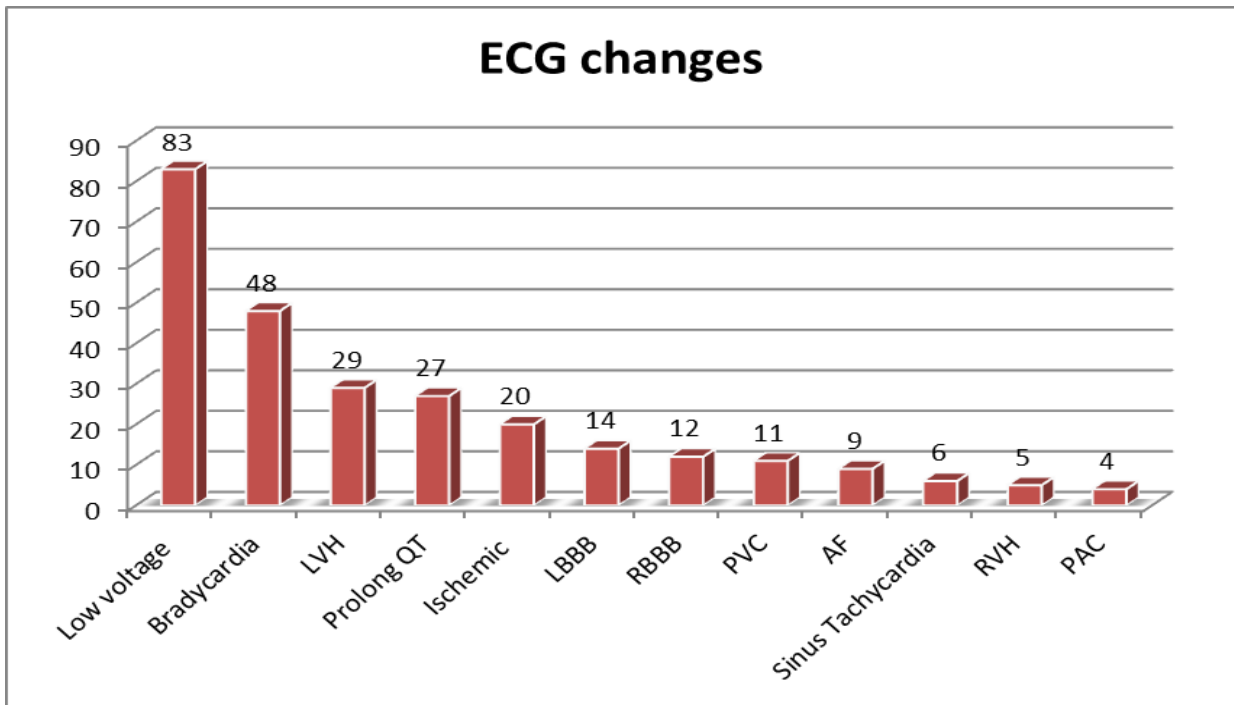


Figure (4):

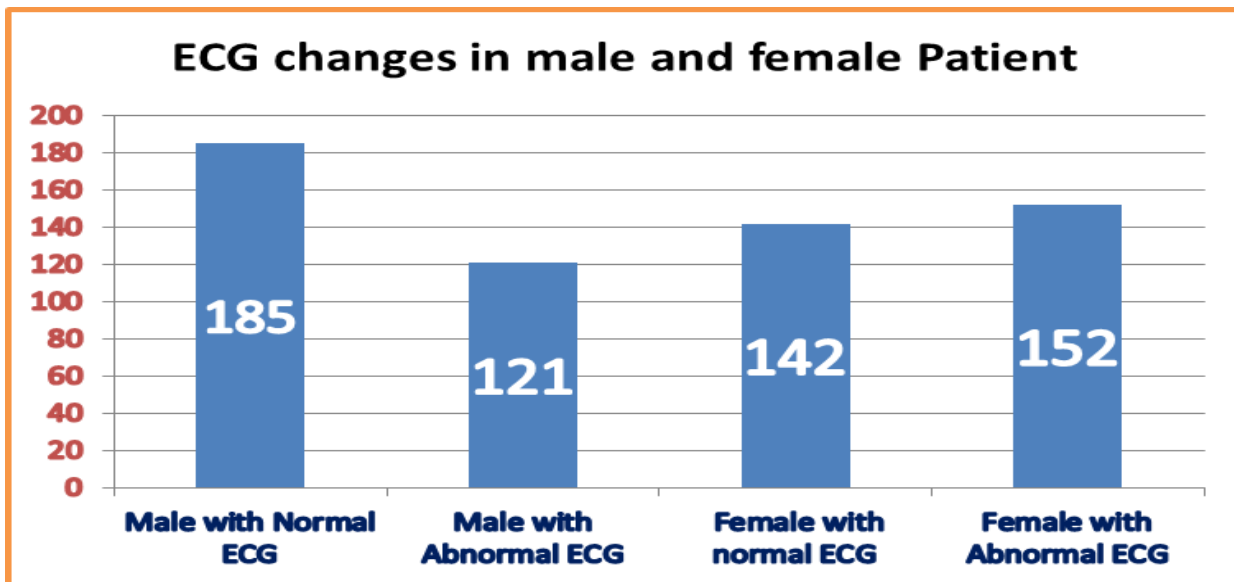
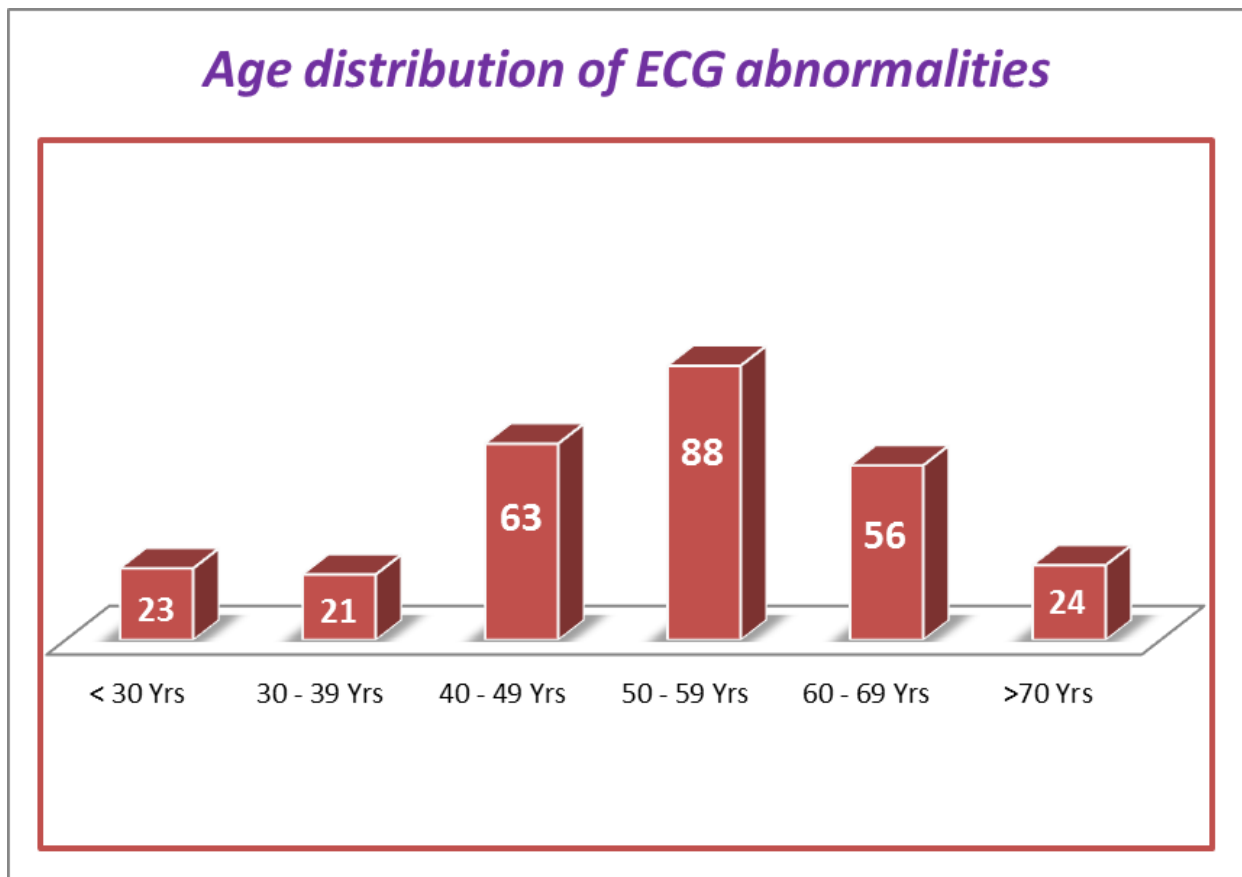


Figure (5):



**Figure (6):**

**Table (2):**

ECG Abnormalities distribution in male and female patients			
ECG Abnormalities	Male	Female	
Low Voltage	21	62	
Bradycardia	23	25	
LVH	17	12	
RVH	2	3	
Prolong PR	3	2	
RBBB	5	7	
LBBB	6	8	
PAC	1	3	
PVC	10	1	
Ischemia	14	6	
AF	4	5	
Sinus tachycardia	4	2	
Prolong QT	11	16	



## Discussion

DM is a challenging impact on the patient life expectancy and a middle-aged patient discovered to be diabetic stands to lose as much as a 10 year of his life expectancy [15]. The resulting view about the ECG changes in patient with diabetes Mellitus, is that, the underlying abnormality extend beyond ischemic heart disease as a sole etiology [16]. Glycemic control: HbA1c is the test of choice for monitoring the efficacy of the treatment in patient with diabetes according to the ADA guidelines and its use not reach to the target level due to lack of request by some of the physicians and patient ignorance [17]. Despite the presence of many new oral hypoglycemic drugs and continuous organized guidelines, the prevalence of inadequate glycemic control was high reaching to 60% of patients with diabetes in UK [18]. In 2010 cross sectional study among Chinese patients, resulting in only 26% of diabetes patients received treatment and adequate control seen in 40% of those patients [19]. In our study HbA1c evaluation was done in the all included patients reflecting a very bad glycemic control in comparison to the others, and about 75% of patients have HbA1c level above 8 which indicate a very poor glycemic control which need multifactorial solution involving our health institutes, health

program especially that concerning about diabetes and patient's education which is the most important in our city due low socio-economic state for most of local diabetic patients. Age distribution; according to Figure (1), about 73 % of our patients age lie between 40-69 years with peak age distribution 50-59 years which reach to 35%. These results are slightly different than the age distribution in Saudi Arabia at 2015, as the peak age of distribution was in 64-69 years with similar overall age distributions [21]. Patient gender was assessed, and male patients were slightly higher than female patients with nearly similar age distribution in both groups.

ECG changes; 83 patients and 48 patients respectively showed low voltage and bradycardia which were the more abundant ECG abnormalities in the involved study patients.

Recent findings have been explained the complex association between subclinical hypothyroidism and diabetes mellitus that may contribute to the serious diabetic complication such as neuropathy. So, it is important to discover thyroid dysfunction in diabetic patient and this practice require should be enriched by multiple clinical studies to facilitate the understanding this complex relation [22]. In patient with diabetes mellitus, there is compromised glucose uptake by the myocardial cell as

energy source in association with reduced serum carotene causing decreased myocardial fatty acid metabolism, which explain the non-ischemic cardiac involvement in uncontrolled diabetes mellitus presenting as abnormal heart systolic and diastolic function and bradycardia [23]. So, the bad control of our involved patient may explain the wide range of electrocardiographic changes. Diabetic patient has low level of carotene due to: First, the restricted carotene rich diet in diabetic patient as red meat and whole milk and, Secondly, the affected renal and hepatic (carotene sources) function in diabetic cases result in reduced carotene production. This potential problem can be prevented by oral carotene supplementation and parenteral in case of acute cardiac crisis, if the physicians are aware about this remote diabetes effect [24]. Left ventricular hypertrophy seen in 29 patients according to ECG criteria for diagnosis of LVH. LVH is frequently seen in diabetic patient even without hypertension which often cause by depolarization disorders [13] and according to a Russian study the prevalence of LVH in diabetic patients may reach to 7% which may be expanded by the increasing prevalence of hypertension in patient with diabetes mellitus due to remote nephropathic complication [25]. Long QT changes seen in 27 patients and it is

considered prolong if the corrected value exceed 440 ms. This ECG abnormality is discussed by several studies due to its serious predisposing to potential fatal cardiac arrhythmias like Torsades de pointes and sudden death [26].

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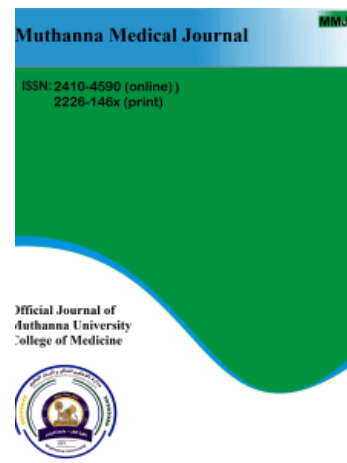
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