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Explore the Relationship and Mechanism of Diabetes and Heart Disorders

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Abstract

Objective: Internal relations and explore the mechanism of diabetes in patients with arrhythmia.

Methods: Retrospective analysis of 239 cases of type 2 diabetes, according to the presence or absence of ECG arrhythmia detection, divided into 66 cases of arrhythmia diabetes, diabetes without arrhythmia group 173 cases, while 70 cases selected purely as arrhythmia patients without diabetes group clinical data related to the above three groups of patients, blood glucose, ECG results were analyzed and compared.

Results: Patients with diabetes and arrhythmia was 27.6%. In atrial contraction most common; Type 2 diabetes and hypertension, coronary heart disease more arrhythmias (P<0.01 or P<0.05 occurred; Age arrhythmia, weight, body mass index, duration of diabetes, duration of hypertension, coronary heart disease duration, systolic blood pressure, fasting insulin, LDL-C, insulin resistance index than those without arrhythmia group P<0.01 or P<0.05); diabetic patients with arrhythmia group and the control group, the incidence of arrhythmia 93.9%, respectively, 52.9%, including sinus arrhythmia, atrial arrhythmias, functional arrhythmias, conduction block, ventricular arrhythmias were significantly higher, the difference was statistically significant (P<0.01).

Conclusion: Other patients with type 2 diabetes, cardiovascular disease and diabetes alone without arrhythmia patients and non-diabetic patients with cardiovascular disease alone are more likely to arrhythmia compared may be associated with longer duration of disease, insulin resistance weight, with other diseases caused by cardiovascular, cardiomyopathy, and neuropathy.

Keywords: Diabetes; Arrhythmia; Cardiovascular disease

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Introduction

As our country steadily enters a well-off society, the people's material living standards continue to improve, the prevalence of diabetes and the number of patients are increasing, and it has become an important disease that affects the physical and mental health of the people. The World Health Organization (WHO) estimates that by 2025, 380 million people worldwide will suffer from diabetes. The correlation between diabetes and cardiovascular disease is being paid attention to in clinical practice, but the current research mainly focuses on the relationship between diabetes and myocardial and cardiovascular disease, and the relationship between diabetes and arrhythmia and the relationship between the two there are not many reports. This article retrospectively analyzed patients with type 2 diabetes who were admitted to the endocrinology department of our hospital from January 2018 to June 2020, and selected 70 patients with arrhythmia without diabetes for comparison, aiming to study the incidence and rhythm of arrhythmia in patients with type 2 diabetes types of arrhythmia and related factors, and compare the effects of diabetes on the occurrence of arrhythmia, and explore its clinical significance.

Clinical Data

In 309 hospitalized patients, the diagnosis of type 2 diabetes met the diagnostic criteria of WH0 1999. Exclude patients with other types of diabetes, acute complications of diabetes, and hypoglycemia. The diagnosis of hypertension complies with the 2004 Chinese guidelines for diagnosis. Coronary heart disease is diagnosed when the patient has undergone coronary angiography. Among them, there were 209 males and 100 females, aged 26 to 91 years, 82 cases of diabetes mellitus >5 years, 97 cases of hypertension, 11 cases of coronary heart disease. According to the results of routine electrocardiogram examination, 309 patients were divided into 3 groups: 1. Diabetes arrhythmia

group: A total of 66 cases, 48 males, 18 females, 34 cases of diabetes duration >5 years. 2. Diabetes without arrhythmia group: a total of 173 cases, 109 males and 64 females, 48 cases of diabetes duration >5 years. 3. Arrhythmia without diabetes group: A total of 70 cases, 52 males and 18 females. Basic data of 307 patients were collected, including general information, biochemical indicators, etc.

Method

Record the medical history in detail, auscultate the heart more than 2 times a day. Every time >3 min, if arrhythmia is found, record the bedside ECG in time.

Checking method for arrhythmia.

Conventional 12-lead ECG.

Holter Examination: The Meigao Holter detection system is used, and the leads are 1 cm, 3 cm, 5 cm. All patients undergo 24 h Holter examination; keep normal daily life, and record life log. Record the heart rhythm and heart rate data of 239 patients.

Blood glucose determination oxidize method, all patients measured fasting blood glucose.

Statistical processing: Measurement data conforming to the normal distribution are expressed as x- ± s, and statistical analysis is carried out with SPSSl3.0 statistical software. The mean comparison between the two groups was performed by independent sample t test, and the count data was tested by χ^2 test.

Results

Heart rate

The average 24-h heart rate of 309 diabetic patients was 75 ± 8.5 bpm, ranging from 52 bpm to 111 bpm, the highest heart rate was 175 bpm, and the lowest heart rate was 35 bpm.

Comparison of clinical features

Comparison of patient count data: There was no statistical difference in height, diastolic blood pressure, Fasting Blood Glucose (FBG), 2h Postprandial Blood Glucose (2hPBG), glycosylated Hemoglobin (HbAlC), TC, TG, and HDL-C in the first and second groups of patients. Learning significance (P>0.05). However, there were statistically significant differences in age, weight, Body Mass Index (BMI), diabetes course, hypertension course, coronary heart disease course, systolic blood pressure, fasting INS, LDL-C, and insulin Resistance Index (HOMA-IR) (P<0.05), the arrhythmia group was higher than the no arrhythmia group (Table 1).

Comparison of the measurement data of the first and second groups of patients: Among the 239 patients with type 2 diabetes, 97 (40.6%) with hypertension and 11 (4.6%) with coronary heart disease. The concomitant rates of the two diseases in the arrhythmia group were higher than those in the no arrhythmia group (P<0.05). Among 239 patients with type 2 diabetes, 82 cases (34.3%) had diabetes duration >5 years. The number of people in the arrhythmia group with diabetes course >5 years was higher than that in the arrhythmia group (P<0.05). In terms of the proportion of male patients, the difference between the two groups was not statistically significant (P>0.05) (Table 2).

Analysis of the occurrence of arrhythmia

Analysis of the occurrence of arrhythmia in diabetic patients 239 cases of type 2 diabetic patients developed arrhythmia in 66 cases, the incidence rate was 27.6% (66/239), of which premature atrial contraction was the most, followed by sinus tachycardia (Table 3).

Analysis of the occurrence of arrhythmia with different diseases: In 140 patients with simple diabetes, the incidence of arrhythmia were 19.3% (27/140), of which atrial premature contraction was the most. The incidence of arrhythmia in patients with diabetes mellitus and hypertension is 40.2% (39/97), published in core journals of professional nursing, pay after checking the manuscripts on the website, and publish strongly! Advertisement published in core journals of nursing has established a long-term cooperative relationship with us, all manuscripts priority for employment. View details >3 sinus tachycardia is the most. The incidence of arrhythmia in patients with diabetes and coronary heart disease was 72.7% (8/11), and atrial fibrillation and atrial premature contractions were more common (Table 4).

Comparison of arrhythmia types in patients with diabetes combined with arrhythmia and simple arrhythmia. The incidence of arrhythmia in the diabetes combined with arrhythmia group and the simple arrhythmia control group were 93.9% (62/66) and 52.9% (37/70), respectively), of which sinus arrhythmia, atrial arrhythmia, borderline arrhythmia, conduction block, ventricular arrhythmia were significantly higher than the control group, the difference was statistically significant (P<0.01). Some patients have multiple types of arrhythmias at the same time. The types and incidence of arrhythmia in the 2 groups are shown in Table 5.

Discussion

With the transformation of social economy and lifestyle, the improvement of material living standards, chronic non-communicable diseases such as diabetes have become the main public problems affecting the health of the elderly. Epidemiological

Table 1: Comparison of clinical characteristics between the first group and the second group.

	Diabetic arrhythmia group (n=66)	Diabetes without arrhythmia group (n=173)
Age/years	63.35 ± 13.23	54.83 ± 12.81
Weight/kg	68.83 ± 12.98	64.95 ± 11.42
BMI	26.05 ± 4.22	24.22 ± 3.46
Diabetes course/year	7.42 ± 6.61	4.34 ± 5.65
Course of hypertension/year	5.61 ± 6.85	2.59 ± 5.86
Course of coronary heart disease/year	1.26 ± 4.17	0.03 ± 0.31
FINS/(mU/L)	10.59 ± 4.82	9.17 ± 4.26
LDL-C/(mmol/L)	3.14 ± 0.94	2.77 ± 0.86
HOMA-IR	4.13 ± 1.96	3.19 ± 2.09

Table 2: Comparison of clinical characteristics between the first group and the second group cases (%).

Group	Cases	With hypertension		With coronary heart disease		Diabetes course		Gender	
		Yes	No	Yes	No	>5 years	≤ 5 years	male	female
Diabetes	66	38 (57.6)	28	8 (12.1)	58	34 (51.5)	32	48 (72.7)	18 (27.2)
Arrhythmia Group									
Diabetes	173	59 (31.4)	114	3 (1.7)	170	48	125 (27.7)	109 (63.0)	64 (37.0)
No heart rhythm									
Abnormal group									
X2	10.915	9.493	11.976	2.003					
P value	0.001	0.002	0.001	0.157					

Table 3: The occurrence of various types of arrhythmia in 66 patients with type 2 diabetes %.

	Cases	Atrial Fibrillation Ventricular Sinus	Sinus Atrioventricular Occurrence	Several periods before the heartbeat	Before the heartbeat	Heartbeat	Heartbeat Conduction rate	Contraction too fast	contraction too fast too slow	too fast block	block
Diabetes	66	25.8	3.0	15.2	15.2	1.5	10.6	24.2	13.6	18.2	27.6

Table 4: The occurrence of various arrhythmia with different diseases case..

	Cases	Heart Rhythm Atrial	Atrial Ventricular Sinus	Sinus Atrioventricular Indoor	Number arrhythmia Prephase	Fibrillation Prephase Heartbeat	Cardiac conduction Slowness	Overspeed Block	Block
Contraction Simple diabetes	140	27	9	2	2	4	7	3	7
Diabetes with high blood pressure	97	39	8	7	7	3	9	6	4
Diabetes with coronary heart disease	11	8	3	3	2	-	1	1	

Table 5: Comparison of the types and incidence of arrhythmia in the first and third groups.

Type of arrhythmia	Arrhythmia without diabetes group (n=66)	Arrhythmia with diabetes group (n=70)
Sinus Arrhythmia	8 (12.1%)	35 (50%)
Sinus tachycardia	5 (7.5%)	24 (34.3%)
Sinus bradycardia	3 (4.5%)	11 (15.7%)
Atrial arrhythmia	20 (30.3%)	57 (81.4%)
Atrial premature beats	16 (24.2%)	42 (60%)
Atrial tachycardia	3 (4.5%)	12 (17.1%)
Atrial fibrillation or atrial flutter	1 (1.5%)	3 (4.3%)
Borderline arrhythmia	5 (7.5%)	18 (25.7%)
Premature beats	4 (6.1%)	14 (20%)
Tachycardia	1 (1.5%)	4 (5.7%)
Conduction block	8 (12.1%)	37 (52.9%)
Atrioventricular block	3 (4.5%)	17 (24.3%)
Bundle branch block	4 (6.1%)	19 (5.7%)
Indoor block	1 (1.5%)	1 (1.4%)
Ventricular arrhythmia	22 (33.3%)	56 (80%)
Premature ventricular contractions	21 (31.8%)	54 (77.1%)
Ventricular tachycardia	1 (1.5%)	2 (2.9%)

data show that the risk of cardiovascular disease in diabetic patients is 3 times higher than that of non-diabetics. Heart disease becomes one of the main causes of death in the late stage of diabetes, accounting for more than 40% [1]. The mechanism is: (1) Diabetic microangiopathy can cause thickening of myocardial capillary basement membrane and focal myocardial fibrosis, which in turn affects the cardiac conduction system to cause arrhythmia; 2) Diabetic cardiac autonomic neuropathy can cause sympathetic nerve disorders. Vagus nerve involvement can also cause arrhythmia; (3) Diabetes is prone to coronary atherosclerosis, myocardial ischemia, and myocardial infarction [2]. At present, there are different reports on the incidence of diabetes and various arrhythmias: Sinus tachycardia is reported to be the most common, and there are also reports that supraventricular premature contractions are the most common,

of which atrial premature contractions are the most common. The results of this study indicate that the incidence of atrial premature contraction is the highest in patients with type 2 diabetes, followed by sinus tachycardia. The impact of diabetes on the heart is due to the occurrence of macrovascular disease, microvascular disease, cardiomyopathy, cardiac autonomic neuropathy, and arrhythmia on the basis of metabolic disorders of sugar, fat, protein and other substances. Microangiopathy is manifested by more glycoproteins in myocardial cells and lipid deposits in myocardial capillaries, leading to thickening of the basement membrane of myocardial capillaries, focal myocardial fibrosis around the vessels, and diabetic cardiomyopathy, which affects the cardiac conduction system Arrhythmia. Due to microangiopathy and polyol bypass metabolism, the concentration of sorbitol and fructose in cells increases, which further causes diabetic neuropathy. Among them, autonomic neuropathy is more common, mainly due to decreased vagus nerve activity, and sympathetic nerves are in a relatively excited state. The balance between the vagus nerve and the sympathetic nerve plays an important role in maintaining the normal heart rate and conduction of the heart. Under unbalanced conditions, it causes persistent tachycardia, and at the same time, the inhibitory effect of the vagus nerve on malignant arrhythmias is weakened. Autonomic neuropathy is also related to ventricular structure and function. Studies have shown that early diabetic patients mainly suffer from left ventricular diastolic function impairment, and those with autonomic neuropathy have more obvious damage to left ventricular structure and function, and as the disease worsens, the damage becomes more serious [3]. Under the dual stimulation of abnormal glucose metabolism and tachycardia, left ventricular hypertrophy is aggravated, leading to tachycardia cardiomyopathy. The pathological basis of large vessel disease in diabetic patients is large vessel atherosclerosis; vascular endothelial cell damage causes dysfunction, lipid metabolism, etc. to directly or indirectly participate in the occurrence and development of large vessel atherosclerosis, and the invasion of coronary arteries causes' coronary heart disease. Myocardial ischemia, myocardial infarction, myocardial ischemia and hypoxia make myocardial cells in a state of unstable electrocardiography, which promotes the occurrence of arrhythmia. The incidence of coronary heart disease in patients with type 2 diabetes is 2 to 4 times that of the general population without diabetes [4]. In this study, the sample size of patients with type-2 diabetes and coronary heart disease was small, with a total of 11 cases. This may be due to the excessively strict diagnostic criteria for coronary heart disease in the sample and the possibility of missed diagnosis. Arrhythmia occurred in 8 of 11 cases. Studies have shown that after acute myocardial infarction in diabetic patients, the hospital mortality rate is significantly increased, and diabetes is an independent risk factor for the patient's prognosis. For diabetic patients with coronary heart disease, on the one hand, long-term abnormal glucose metabolism can easily lead to cardiac autonomic nerve damage, which is harmful to malignancy. The inhibitory effect of arrhythmia declines and coronary heart disease itself is easy to merge with malignant arrhythmia; on the other hand, angina pectoris or myocardial infarction in this type of patients is mostly painless, so the incidence of sudden cardiac death is relatively high and should be paid enough attention in clinical practice.

In addition, the observation results also showed that among 66 patients in the 1 diabetes combined with arrhythmia group, the incidence of arrhythmia was 93.9% (62/66), 52.9% (37/70), and the incidence of different arrhythmia types ranged from high to low. The order is: Atrial arrhythmia (81.4%), ventricular arrhythmia (80%), conduction block (52.9%), sinus arrhythmia (50%), and borderline arrhythmia (25.7%). Compared with the simple arrhythmia group without diabetes, except for ventricular tachycardia, there was no significant difference, and the other comparisons had statistical differences ($P<0.01$). Diabetes is a high-risk factor that aggravates various types of arrhythmias in patients with heart disease.

The possible mechanisms are:

(1) Cardiomyopathy: Diabetes damages the microvessels more prominently than the large blood vessels, and can cause cardiomyopathy and form diabetes. Cardiomyopathy delays the conduction of the myocardium and increases autonomy;

(2) Autonomic nerve damage: Diabetes can not only damage the peripheral nerves of the body, but more importantly, damage the autonomic nerves, especially the autonomic nerves that innervate the heart, which can lead to arrhythmia. Diabetes patients have abnormal heart rate variability, 60% of autonomic neuropathy, which reduces the stability of ventricular myoelectricity and promotes arrhythmia, and the incidence of sudden cardiac death is as high as 28% [5];

(3) Hyperglycemia: The biochemical characteristics of diabetes the most important thing is the increase in blood glucose. When the fasting blood glucose is between 5.6 and 8.4 mmol/L, the abnormal ECG rate is 43%, and the fasting blood glucose rises to 22.4 mmoL/L, and the abnormal ECG rate is 100%;

(4) Metabolic abnormalities: The metabolism of sugar, fat, acid and base in diabetic patients can be disordered, and trace element deficiency will affect the depolarization and repolarization of conduction tissues and myocardial cells, which can cause various arrhythmias;

(5) Blood flow abnormal dynamics: Vascular sclerosis in diabetic patients, most of which are accompanied by high blood pressure, which increases the burden on the heart;

(6) Abnormal hemorheology: Diabetes causes increased blood viscosity, aggravates myocardial ischemia and hypoxia, and induces arrhythmia;

(7) Blood vessels active substances: decreased adiponectin and increased tumor necrosis factor can promote myocardial cell apoptosis, myocardial remodeling and arrhythmia [1];

(8) Diabetic microangiopathy can cause myocardial capillary basement membrane thickening, focal myocardial fibrosis affects the cardiac conduction system and causes arrhythmia;

(9) The impact of comorbidities: Diabetic patients often have high blood pressure, coronary heart disease, sleep apnea syndrome, etc., making arrhythmia more likely to occur [6].

(10) The role of hypoglycemia: In the course of diabetes treatment, a small number of patients cause hypoglycemia due to untimely monitoring of blood glucose or excessive drug doses [7]. At this time, arrhythmia is mostly caused by non-heart itself. Myocardial energy supply is insufficient when hypoglycemia occurs, and the autonomy, excitability, and conductivity of the heart are disordered, reentry is formed, and arrhythmia is promoted. Correcting hypoglycemia in time can often make the arrhythmia disappear quickly.

In this study, the occurrence of arrhythmia was not found to be significantly related to blood sugar and blood lipids. This may be due

to the fact that the subjects in the two groups are based on diabetic patients, so there may be little difference in the occurrence of abnormal glucose and lipid metabolism. Moreover, blood sugar and blood lipids can be controlled in a short period of time in clinical treatment, and the occurrence of arrhythmia is a slow and long-lasting process, and the synchronization between the two is poor. At present, there are few studies on the mechanism of diabetes complicated with arrhythmia. The occurrence of arrhythmia is affected by a combination of many factors. From the results of this study, it can be found that the types of arrhythmia in diabetes have "diversified" characteristics, so its mechanism is complex and changeable, and the specific mechanism is not clear. A large number of multi-center randomized controlled clinical and experimental studies are needed to explore the exact effects and mechanisms of various factors of diabetes on the occurrence of arrhythmia, so as to provide scientific basis for the clinical prevention and treatment of diabetes with arrhythmia, and reduce the mortality of cardiovascular diseases.

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