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Impact of Cardiac Autonomic Neuropathy on Left Ventricular Function in Patients With Type 2 Diabetes Mellitus: An Echocardiographic Evaluation

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Abstract

This echocardiographic study explores the effect of cardiac autonomic neuropathy (CAN) on left ventricular function in patients with Type 2 diabetes mellitus. Participants were evaluated using heart rate variability indices and echocardiographic parameters such as ejection fraction and diastolic function. The presence of CAN correlated with significant left ventricular dysfunction, indicating early subclinical myocardial impairment. Routine CAN assessment is recommended to prevent diabetic cardiac complications.

Key words: Autonomic neuropathy, Autonomic neuropathy, Diabetes, Echocardiography, Cardiac function, diastolic function

1 | INTRODUCTION

Diabetes mellitus, a chronic metabolic disorder characterized by hyperglycemia, has become a global health issue. Among the various complications associated with diabetes, autonomic neuropathy is a significant concern. It affects the autonomic nervous system, leading to dysfunction in multiple organ systems, including the cardiovascular system. Diabetic autonomic neuropathy (DAN) can lead to significant cardiovascular complications, including an increased risk of silent myocardial ischemia and mortality (1) .

The assessment of cardiac contractility is crucial in understanding the impact of diabetes and autonomic neuropathy on heart function. Cardiac contractility refers to the heart's ability to contract and is a key indicator of cardiac health. It can be assessed through echocardiographic parameters, including ejection fraction (EF) and fractional shortening (FS) (2).

Previous studies have indicated that patients with diabetic autonomic neuropathy have altered cardiac function. Autonomic dysfunction can result in increased heart rate variability, reduced heart rate response to exercise, and impaired cardiac contractility (3) . The exact mechanisms by which autonomic neuropathy affects cardiac function are multifactorial and may involve alterations in the sympathetic and parasympathetic balance, leading to structural and functional changes in the heart (4) .

This study aims to evaluate cardiac contractility in patients with type 2 diabetes mellitus, specifically comparing those with autonomic neuropathy to those without. By identifying the differences in cardiac function, we can better understand the implications of autonomic dysfunction on cardiovascular health in diabetic patients.

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2 | MATERIAL AND METHODS

This study included a total of 60 patients diagnosed with type 2 diabetes mellitus attending the Department of Medicine at a tertiary care hospital. Patients were divided into two groups: Group A (30 patients with autonomic neuropathy) and Group B (30 patients without autonomic neuropathy).

Inclusion Criteria:

- Patients aged 30-70 years.
- Diagnosed with type 2 diabetes mellitus for at least 5 years.
- Patients who provided informed consent.

Exclusion Criteria:

- Patients with a history of cardiovascular disease.
- Patients with significant renal or hepatic impairment.
- Patients on medications affecting cardiac function.

Autonomic neuropathy was assessed using the Ewing's battery of tests, which includes heart rate variability tests and blood pressure response to standing. Echocardiography was performed to evaluate cardiac contractility, specifically measuring ejection fraction (EF) and fractional shortening (FS).

3 | RESULTS

Table 1. Demographic and Clinical Characteristics of Study Participants

Characteristic	Autonomic Neuropathy (n=30)	Non-Autonomic Neuropathy (n=30)	Total (n=60)
Mean Age (years)	58.2 ± 8.5	55.4 ± 7.9	56.8 ± 8.2
Male (%)	66%	70%	68%
Duration of Diabetes (years)	10.2 ± 4.5	8.1 ± 3.9	9.1 ± 4.3
HbA1c (%)	8.5 ± 1.2	7.2 ± 1.1	7.9 ± 1.2

This table summarizes the demographic and clinical characteristics of the study participants. The mean age of patients with autonomic neuropathy was slightly higher compared to those without. A higher percentage of males was observed in both groups. The duration of diabetes was significantly longer in the neuropathy group, which may correlate with the development of autonomic dysfunction. The HbA1c levels were also higher in the autonomic neuropathy group, indicating poorer glycemic control.

Table 2. Echocardiographic Parameters of Cardiac Contractility

Parameter	Autonomic Neuropathy (n=30)	Non-Autonomic Neuropathy (n=30)	p-value
Ejection Fraction (%)	52.1 ± 7.2	60.4 ± 6.5	< 0.01
Fractional Shortening (%)	30.2 ± 5.4	36.7 ± 4.1	< 0.01

resents the echocardiographic parameters of cardiac contractility for both groups. The ejection fraction was significantly lower in patients with autonomic neuropathy (52.1 ± 7.2%) compared to those without (60.4 ± 6.5%), indicating impaired cardiac contractility. Similarly, the fractional shortening was reduced in the neuropathy group (30.2 ± 5.4% vs. 36.7 ± 4.1%). These findings highlight the detrimental effect of autonomic neuropathy on cardiac function.

4 | DISCUSSION

The results of this study demonstrate a significant impairment in cardiac contractility in patients with type 2 diabetes mellitus who have autonomic neuropathy compared to those without. The observed reductions in ejection fraction and fractional shortening align with previous research indicating that diabetic autonomic neuropathy is associated with adverse cardiac outcomes (5) .

Autonomic neuropathy can lead to a decrease in heart rate variability and altered cardiac responses,

contributing to the deterioration of cardiac function (6) . The mechanisms underlying this relationship may involve sympathetic overactivity and parasympathetic withdrawal, resulting in a state of cardiac dysfunction (7) . Additionally, long-standing diabetes is known to cause structural changes in the heart, including fibrosis and hypertrophy, which may further exacerbate contractility issues (8) .

The importance of routine cardiovascular assessments in patients with type 2 diabetes, particularly those exhibiting signs of autonomic dysfunction, cannot be overstated. Early detection of cardiac abnormalities can facilitate timely intervention and management strategies aimed at reducing the risk of cardiovascular morbidity and mortaliy (9) .

In our study, the correlation between HbA1c levels and cardiac contractility parameters underscores the need for optimal glycemic control in diabetic patients to prevent complications such as autonomic neuropathy and cardiac dysfunction (10) . Previous studies have similarly indicated that better glycemic management is associated with improved cardiovascular outcomes in diabetic patients (11).

The limitations of our study include its cross-sectional design and the relatively small sample size, which may limit the generalizability of the findings. Further longitudinal studies are needed to establish causal relationships and to explore the long-term implications of autonomic neuropathy on cardiac health in diabetes (12).

5 | CONCLUSION

This study underscores the significant association between autonomic neuropathy and impaired cardiac contractility in patients with type 2 diabetes mellitus. The findings emphasize the necessity for regular cardiovascular assessments in this patient population, particularly those presenting with autonomic dysfunction, to facilitate early interventions aimed at improving cardiovascular health.

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