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RESEARCH ARTICLE
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A CROSS-SECTIONAL OBSERVATIONAL STUDY ON THE PREVALENCE OF CARDIAC AUTONOMIC NEUROPATHY IN TYPE 2 DIABETES MELLITUS PATIENTS AT A TERTIARY CARE HOSPITAL IN EASTERN INDIA

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Abstract

Background: Cardiac autonomic neuropathy (CAN) is a serious complication of type 2 diabetes mellitus (T2DM), associated with arrhythmias, silent ischemia, and cardiovascular mortality.

Objective: To estimate the prevalence of CAN in T2DM patients across different disease durations and to explore associations with glycemic control, obesity, dyslipidemia, and autonomic symptoms.

Methodology: A cross-sectional study of 130 T2DM patients was conducted in the outpatient departments of pharmacology and endocrinology at R.G. Kar Medical College, Kolkata. CAN was assessed using cardiovascular autonomic reflex tests (CARTs) with the CANS 504 Analyzer. HbA1c, lipid profile, body mass index (BMI), abdominal circumference, autonomic symptom scores, and erectile function (IIEF-5) were evaluated.

Results: CAN was present in 41% of newly diagnosed patients, 96% of those with 3–5 years, and 93% of those with ≥5 years of diabetes. Poor glycemic control (HbA1c ≥7%) was strongly associated with parasympathetic (56%) and sympathetic (52%) dysfunction. Dyslipidemia and abdominal obesity were significant correlates. Autonomic symptoms were common, with 75% of patients reporting moderate-to-severe manifestations. Erectile dysfunction was reported by 36.5% of male patients, mostly severe.

Conclusion: CAN is highly prevalent in Indian T2DM patients, even at diagnosis. Poor glycemic control, longer disease duration, obesity, and dyslipidemia were the strongest predictors. Routine CART-based screening and early risk factor management are essential to reduce cardiovascular morbidity and mortality.

Keywords: Cardiac autonomic neuropathy, Type 2 diabetes mellitus, Cardiovascular reflex tests, CANS 504, Prevalence

Introduction

Type 2 diabetes mellitus (T2DM) is a leading global health problem, with India contributing substantially to the worldwide burden (1). Among its complications, diabetic autonomic neuropathy is under-recognized, although its cardiac manifestation, cardiac autonomic neuropathy (CAN), carries serious consequences including arrhythmias, silent myocardial ischemia, orthostatic hypotension, and sudden cardiac death (2,3).

CAN usually begins with parasympathetic dysfunction and later progresses to sympathetic involvement (4). Prevalence worldwide ranges from 20% in newly diagnosed patients to over 65% in long-standing diabetes (5). Indian data report rates between 30–50% (6,7). Risk factors include longer disease duration, poor glycemic control, obesity, dyslipidemia, and other microvascular complications (8,9).

Despite this, CAN screening is not routine in India. CARTs, using validated systems such as the CANS 504 Analyzer, provide a simple and reliable diagnostic approach (10). This study evaluated CAN prevalence across disease duration and its association with glycemic and metabolic factors in Indian T2DM patients.

Methodology

Study design and setting:

This cross-sectional study was conducted from March 2023 to August 2024 at the Departments of Pharmacology and Endocrinology, R.G. Kar Medical College, Kolkata.

Participants:

A total of 130 adults with T2DM (≥18 years) were recruited. Exclusion criteria included type 1 diabetes, gestational diabetes, prior autonomic neuropathy, arrhythmias, ischemic heart disease, chronic kidney disease, and medications affecting autonomic function.

Grouping:

- Group 1: ≤3 months duration
- Group 2: 3–5 years
- Group 3: ≥5 years

CAN assessment:

CAN was assessed using CARTs on the CANS 504 Analyzer. Tests included: heart rate variability with deep breathing, 30:15 standing ratio, Valsalva maneuver, postural fall in blood pressure, and sustained handgrip test.

Severity was graded according to Ewing's criteria (2).

Additional measures:

- HbA1c and lipid profile
- BMI and abdominal circumference
- Autonomic symptom scores (postural dizziness, sweating, gastrointestinal, urinary disturbances)
- Erectile dysfunction using the International Index of Erectile Function – 5 (IIEF-5) (15)

Statistical analysis:

SPSS v31 was used. Chi-square or Fisher's exact test analyzed categorical variables, ANOVA/Kruskal-Wallis for continuous data, and Pearson/Spearman methods for correlations. Significance was set at $p<0.05$.

Ethical Clearance:

Approval was obtained from the Institutional Ethics Committee. Written informed consent was taken from all participants.

Results

Baseline Characteristics

A total of 130 patients with type 2 diabetes mellitus (T2DM) were enrolled. The mean age was 46.4 ± 11.7 years, with 65.4% males and 34.6% females. The average BMI was 24.96 ± 3.49 kg/m², and the mean abdominal circumference was 33.8 ± 2.9 cm. These baseline characteristics are summarized in **Table 1**. The age distribution of participants is presented in Figure 2

Glycemic, Renal, and Lipid Parameters

Mean fasting blood sugar (FBS) was 141.2 ± 40.3 mg/dl, postprandial blood sugar (PPBS) 203.2 ± 59.0 mg/dl, and HbA1c 6.86 ± 0.99%. Renal parameters were within normal limits for most patients (**Table 2**). Lipid profile analysis demonstrated elevated total cholesterol, LDL, and triglycerides, with low HDL levels Table 3.

Prevalence of CAN

Cardiac autonomic neuropathy (CAN) was observed in 41% of newly diagnosed patients (≤3 months), 96% of those with 3–5 years, and 93% of those with ≥5 years of diabetes. The trend of increasing prevalence with longer disease duration is depicted in Figure 1.

Autonomic Dysfunction Patterns

Parasympathetic dysfunction was more frequent in patients with poor glycemic control (HbA1c ≥7%), present in 56% of cases, while sympathetic dysfunction was noted in 52%. Dyslipidemia and abdominal obesity were significantly associated with the presence of CAN. The distribution of autonomic function abnormalities is shown in Figure 3.

Autonomic Symptoms and Erectile Dysfunction

Autonomic symptoms such as postural dizziness, sweating abnormalities, gastrointestinal disturbances, and urinary complaints were reported by 75% of participants, with the majority experiencing moderate-to-severe symptoms. Erectile dysfunction, assessed in male patients, was present in 36.5%, predominantly in the severe category Figure 4.

Other Complications

Microvascular complications, particularly retinopathy and nephropathy, were observed more frequently among patients with CAN compared to those without CAN.

Figure 1. Prevalence of Cardiac Autonomic Neuropathy by Duration of T2DM

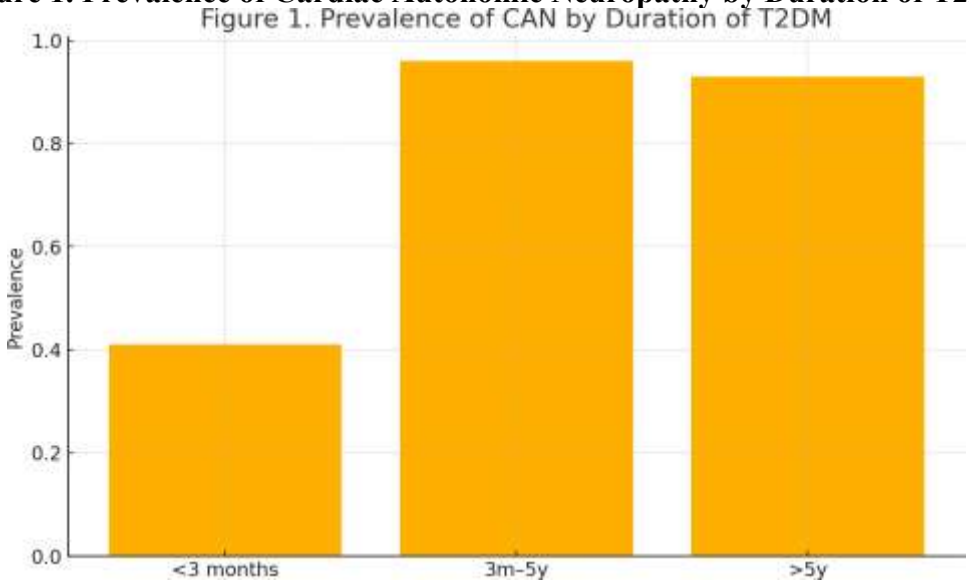

Figure 2. Age Distribution of Study Population (n=130)

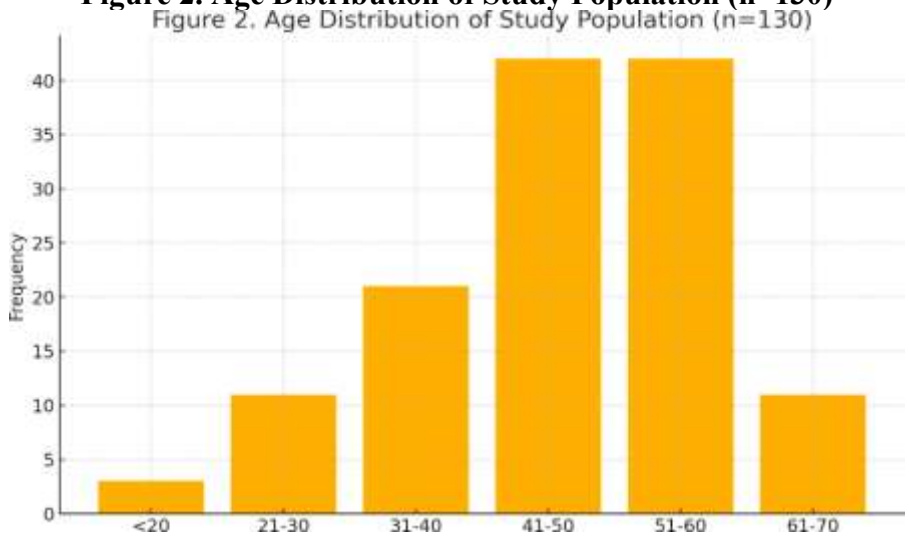

Figure 3. Distribution of Autonomic Function Reports

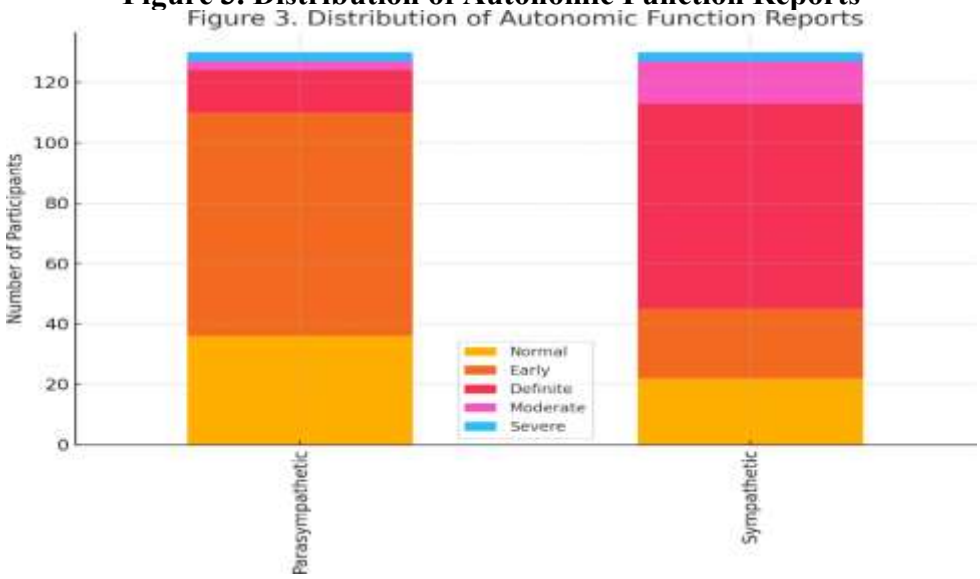

Figure 4. Erectile Dysfunction Distribution among Male Patients (n=85)

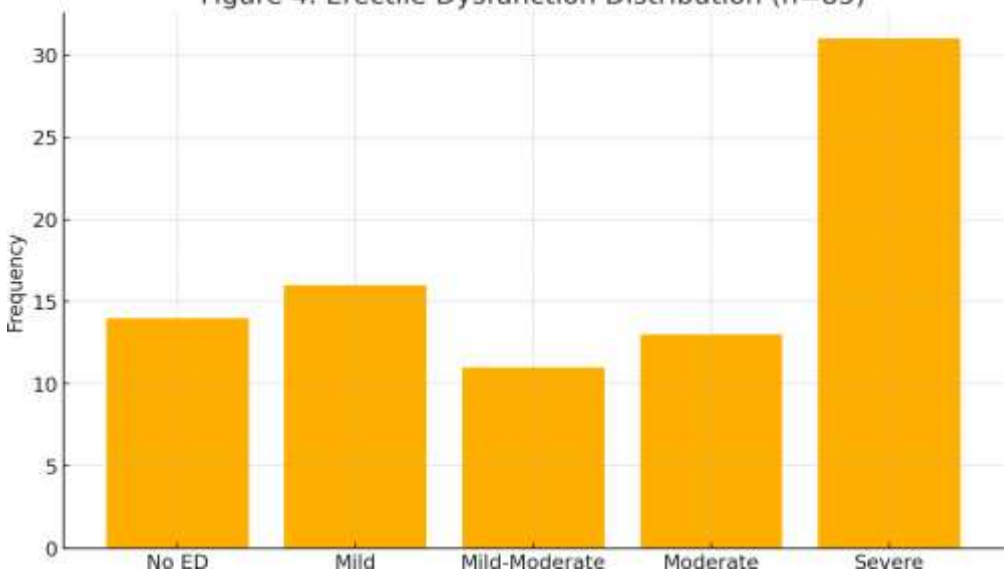

Table 1. Baseline Characteristics of Study Population (n=130)

Characteristic	Value
Age (years)	46.4 ± 11.7
Male	85 (65.4%)
Female	45 (34.6%)
BMI (kg/m²)	24.96 ± 3.49
Abdominal Circumference (cm)	33.8 ± 2.9
Weight (kg)	68.5 ± 9.2
Height (cm)	166.0 ± 9.0

Table 2. Glycemic and Renal Parameters

Parameter	Mean ± SD
FBS (mg/dl)	141.2 ± 40.3
PPBS (mg/dl)	203.2 ± 59.0
HbA1c (%)	6.86 ± 0.99
Uric Acid (mg/dl)	34.7 ± 12.2
Creatinine (mg/dl)	0.88 ± 0.23

Table 3. Lipid Profile of Study Population

Parameter	Mean ± SD
Total Cholesterol (mg/dl)	202.6 ± 32.1
LDL (mg/dl)	122.9 ± 25.1
HDL (mg/dl)	40.1 ± 7.0
Triglyceride (mg/dl)	198.6 ± 53.7

Discussion

This study demonstrated a high prevalence of cardiac autonomic neuropathy among patients with T2DM in Eastern India. Importantly, CAN was present in a substantial proportion of newly diagnosed patients (41%), and its prevalence increased with disease duration. These findings are in line with earlier Indian studies (Sharma et al., 2003; Deepak et al., 2002) and comparable to international reports (Vinik & Ziegler, 2007; Eleftheriadou et al., 2024).

The high rate of CAN in newly diagnosed cases may reflect delayed detection of diabetes or early autonomic involvement in this population. However, selection bias and methodological differences in testing could also contribute to the elevated rates and should be considered as a limitation.

Poor glycemic control (HbA1c ≥7%) was strongly associated with both parasympathetic and sympathetic dysfunction. This supports previous research showing that chronic hyperglycemia is a major factor linked with autonomic impairment (Ziegler et al., 2015). Dyslipidemia and abdominal obesity were also significantly associated with CAN, emphasizing the role of metabolic risk factors, consistent with the concept of metabolic syndrome contributing to autonomic dysfunction (Tesfaye et al., 2010).

The high frequency of autonomic symptoms and the substantial burden of erectile dysfunction underscore the broader clinical impact of CAN on quality of life. Similar trends have been reported in other Asian cohorts (Sethi et al., 2022; Lee & Kim, 2025).

Our results support the utility of CARTs with the CANS 504 Analyzer for identifying subclinical CAN. While this tool is validated, reliance on device-specific criteria may limit comparability with

other studies. Furthermore, as this was a cross-sectional study, **associations—not causation—can be inferred**. Longitudinal studies are needed to establish temporal and causal relationships.

Conclusion

CAN is highly prevalent among Indian patients with T2DM, including those in the early stages of disease. Longer duration, poor glycemic control, obesity, and dyslipidemia are major determinants. Routine CART-based screening and preventive interventions are essential in diabetes management.
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Limitations

This was a single-center cross-sectional study with a relatively modest sample size, which may limit generalizability. The design precludes causal inference, and lifestyle factors such as diet and physical activity were not comprehensively assessed.

Recommendations

Routine CAN screening with CARTs should be implemented in diabetes care from the time of diagnosis. Early control of glycemia, obesity, and dyslipidemia may delay progression. Larger multicenter longitudinal studies are recommended to confirm these findings and support integration into national diabetes programs.

Declarations

Conflict of Interest: None declared
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References

1. International Diabetes Federation. IDF Diabetes Atlas, 10th Edition. Brussels: IDF; 2021.
2. Ewing DJ, Clarke BF. Diagnosis and management of diabetic autonomic neuropathy. BMJ. 1982;285:916–918.
3. Vinik AI, Ziegler D. Diabetic cardiovascular autonomic neuropathy. Circulation. 2007;115:387–397.
4. Maser RE, Lenhard MJ. Cardiovascular autonomic neuropathy due to diabetes mellitus: clinical manifestations and treatment. J ClinEndocrinolMetab. 2005;90:5896–5903.
5. Eleftheriadou A, Williams S, Nevitt S, et al. Cardiovascular autonomic neuropathy in diabetes: an update. Diabetologia. 2024;67:1–15.
6. Sharma A, Deepak KK, Sinha S, et al. Prevalence of cardiac autonomic neuropathy in newly diagnosed type 2 diabetes patients. J Assoc Physicians India. 2003;51:1030–1033.
7. Deepak KK, Venkatesan S, Tandon OP. Assessment of autonomic dysfunction in diabetes mellitus. Indian Heart J. 2002;54:434–439.
8. Ziegler D, Strom A, Perz S, et al. Predictors of cardiac autonomic neuropathy in type 2 diabetes mellitus. Diabetologia. 2015;58:968–978.
9. Pop-Busui R, Boulton AJ, Feldman EL, et al. Diabetic neuropathy: a position statement by the American Diabetes Association. Diabetes Care. 2017;40:136–154.
10. Diabetik Foot Care India Pvt Ltd. CANS 504 Cardiac Autonomic Neuropathy System Analyzer: User Manual and Validation Report. Chennai: Diabetik; 2023.
11. Sethi PP, Jatteppanavar B, Kant R, et al. Spectrum of cardiac autonomic neuropathy in T2DM: North India perspective. J Cardio-Diabetes MetabDisord. 2022;2(1):23–28.
12. Dhumad MM, Hamdan FB, Khudhair MS, et al. Risk factors and staging of cardiac autonomic neuropathy in type 2 diabetes mellitus. Sci Rep. 2021;11:3576.
13. Tesfaye S, Boulton AJ, Dyck PJ, et al. Diabetic neuropathies: update on definitions, diagnostic criteria, estimation of severity, and treatments. Diabet Med. 2010;27:544–552.
14. Lee SJ, Kim CH. Clinical characteristics of cardiovascular autonomic neuropathy in long-duration diabetes. J Korean Med Sci. 2025;40:e154.

15. Rosen RC, Cappelleri JC, Smith MD, Lipsky J, Peña BM. Development and evaluation of an abridged 5-item version of the International Index of Erectile Function (IIEF-5) as a diagnostic tool for erectile dysfunction. Int J Impot Res. 1999;11(6):319–326.