

# CLINICAL AND FUNCTIONAL ASSESSMENT OF AUTONOMIC DYSFUNCTION IN PATIENTS WITH DIABETES MELLITUS

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## Abstract

Autonomic dysfunction is a common yet frequently underdiagnosed complication of diabetes mellitus that affects multiple organ systems and significantly contributes to morbidity and mortality. Diabetic autonomic neuropathy develops as a consequence of chronic hyperglycemia, oxidative stress, microvascular damage, and metabolic disturbances that impair autonomic nerve fibers. The condition may involve cardiovascular, gastrointestinal, genitourinary, sudomotor, and metabolic regulatory functions, leading to substantial impairment in quality of life. The aim of this study was to evaluate the clinical manifestations and functional characteristics of autonomic dysfunction in patients with diabetes mellitus and to determine the relationship between disease duration, metabolic control, and severity of autonomic impairment. Clinical examination, autonomic function testing, and laboratory investigations were performed in diabetic patients. The results demonstrated a high prevalence of cardiovascular autonomic abnormalities, gastrointestinal symptoms, and sudomotor disturbances, particularly among individuals with long-standing diabetes and poor glycemic control. Early detection of autonomic dysfunction and comprehensive management strategies may contribute to improved clinical outcomes and prevention of severe complications.

**Keywords:** diabetes mellitus, autonomic dysfunction, diabetic autonomic neuropathy, cardiovascular autonomic neuropathy, autonomic nervous system, glycemic control, neuropathy, heart rate variability, neurological complications, functional assessment.

## 1. Introduction

Diabetes mellitus is a chronic metabolic disease characterized by persistent hyperglycemia resulting from impaired insulin secretion, insulin action, or a combination of both mechanisms. The global prevalence of diabetes continues to increase rapidly, creating a substantial burden on healthcare systems worldwide. Long-term metabolic disturbances associated with diabetes contribute to the development of numerous microvascular and macrovascular complications, among which diabetic autonomic neuropathy represents one of the most clinically significant but often overlooked conditions.

The autonomic nervous system plays a crucial role in maintaining physiological homeostasis by regulating cardiovascular activity, gastrointestinal motility, respiratory function, thermoregulation, bladder control, and endocrine responses. Damage to autonomic nerve fibers may therefore affect multiple organ systems simultaneously and lead to a wide spectrum of clinical manifestations.

Because symptoms often develop gradually and may initially be nonspecific, autonomic dysfunction frequently remains undiagnosed until advanced stages.

Diabetic autonomic neuropathy is considered a progressive neurodegenerative complication resulting from chronic metabolic and vascular injury. Persistent hyperglycemia activates multiple pathogenic pathways, including increased production of reactive oxygen species, accumulation of advanced glycation end products, activation of inflammatory mediators, and endothelial dysfunction. These processes impair nerve blood supply, disrupt axonal transport, and contribute to progressive degeneration of autonomic fibers.

Among the various forms of autonomic dysfunction, cardiovascular autonomic neuropathy is regarded as one of the most serious manifestations due to its association with increased risk of arrhythmias, silent myocardial ischemia, orthostatic hypotension, and sudden cardiac death. Reduced heart rate variability, impaired autonomic reflexes, and abnormal blood pressure regulation may occur years before overt cardiovascular symptoms become evident.

Gastrointestinal involvement is also frequently observed in diabetic patients with autonomic neuropathy. Delayed gastric emptying, altered intestinal motility, chronic constipation, diarrhea, and abdominal discomfort may significantly affect nutritional status and glycemic control. Similarly, genitourinary dysfunction may manifest as bladder emptying abnormalities, urinary retention, recurrent infections, and sexual dysfunction.

Sudomotor abnormalities represent another important aspect of diabetic autonomic dysfunction. Impaired sweat gland activity may contribute to dry skin, reduced thermoregulatory capacity, and increased susceptibility to foot ulceration. Such changes are particularly relevant in patients with concomitant peripheral neuropathy, where protective mechanisms against injury are already compromised.

Advances in neurophysiological testing have improved the ability to detect autonomic abnormalities at earlier stages. Heart rate variability analysis, cardiovascular reflex testing, blood pressure response assessment, and quantitative sudomotor evaluations provide objective measures of autonomic nervous system function. These investigations facilitate early diagnosis and allow monitoring of disease progression.

Despite increasing recognition of diabetic autonomic neuropathy, many patients remain undiagnosed due to limited awareness and variability of clinical presentation. Early identification is essential because timely intervention may slow progression, improve symptom control, and reduce the risk of severe complications. Contemporary management emphasizes optimization of glycemic control, lifestyle modification, pharmacological treatment of symptoms, and regular monitoring of autonomic function.

The aim of this study was to evaluate the clinical manifestations and functional characteristics of autonomic dysfunction in patients with diabetes mellitus and to assess the relationship between autonomic impairment, disease duration, and metabolic control.

## 2. Materials and Methods

This study was conducted at the Department of Neurology and Endocrinology between 2024 and 2025. A total of 130 patients diagnosed with type 1 and type 2 diabetes mellitus were enrolled in the investigation. Participants ranged in age from 30 to 75 years and had varying durations of diabetes. All patients provided informed consent before participation.

Comprehensive clinical evaluation was performed for each participant. Medical history included diabetes duration, treatment regimen, glycemic control status, cardiovascular risk factors, smoking history, and presence of diabetic complications. Particular attention was paid to symptoms suggestive of autonomic dysfunction, including dizziness, palpitations, exercise intolerance, gastrointestinal disturbances, urinary symptoms, sweating abnormalities, and sexual dysfunction.

Neurological examination assessed peripheral sensory and motor function as well as autonomic manifestations. Cardiovascular autonomic function was evaluated using standardized autonomic reflex tests. These included resting heart rate measurement, heart rate response to deep breathing, blood pressure response to standing, Valsalva maneuver testing, and assessment of orthostatic hypotension.

Heart rate variability analysis was performed to evaluate parasympathetic and sympathetic nervous system activity. Electrocardiographic monitoring was utilized to detect abnormalities in autonomic cardiac regulation. Functional cardiovascular assessment included blood pressure monitoring in

supine and standing positions.

Laboratory investigations included fasting plasma glucose, glycated hemoglobin (HbA1c), lipid profile, renal function markers, and inflammatory indicators. These parameters were analyzed to determine their relationship with autonomic nervous system dysfunction.

Patients were classified according to the severity of autonomic impairment based on clinical symptoms and functional test results. Statistical analysis was conducted using standard biomedical methods. Correlations between disease duration, glycemic control, and autonomic dysfunction severity were evaluated.

### 3. Results

Clinical evaluation revealed that autonomic dysfunction was present in a considerable proportion of diabetic patients. The prevalence and severity of symptoms increased with longer duration of diabetes and poorer metabolic control.

Cardiovascular manifestations were among the most common findings. Many patients reported episodes of dizziness, fatigue, reduced exercise tolerance, and palpitations. Orthostatic symptoms were particularly frequent among individuals with advanced autonomic neuropathy. Blood pressure measurements demonstrated significant orthostatic reductions in affected patients, indicating impaired autonomic regulation of vascular tone.

Heart rate variability analysis showed reduced parasympathetic activity and imbalance between sympathetic and parasympathetic regulation. Patients with long-standing diabetes exhibited significantly lower variability indices compared with individuals who had shorter disease duration. These findings reflected progressive autonomic nervous system involvement.

Gastrointestinal symptoms were identified in a substantial number of participants. Delayed gastric emptying, abdominal discomfort, bloating, constipation, and intermittent diarrhea were frequently reported. Such manifestations were associated with impaired autonomic control of gastrointestinal motility and contributed to reduced quality of life.

Genitourinary disturbances were also observed. Several patients experienced symptoms suggestive of bladder dysfunction, including incomplete emptying, urinary retention, and increased susceptibility to urinary tract infections. Sexual dysfunction was more frequently identified among male patients with severe autonomic impairment.

Sudomotor abnormalities represented another important clinical feature. Reduced sweating of the lower extremities, dry skin, and impaired thermoregulation were commonly observed. These changes increased vulnerability to skin injury and foot complications.

Statistical analysis demonstrated a significant relationship between elevated HbA1c levels and severity of autonomic dysfunction. Patients with poor glycemic control showed more pronounced cardiovascular, gastrointestinal, and sudomotor abnormalities than those maintaining better metabolic regulation.

### 4. Discussion

The findings of this study confirm that autonomic dysfunction is a frequent and clinically significant complication of diabetes mellitus. The disorder affects multiple organ systems and contributes substantially to morbidity, reduced quality of life, and increased cardiovascular risk.

Cardiovascular autonomic neuropathy emerged as one of the most important manifestations identified during the investigation. Reduced heart rate variability and impaired blood pressure regulation indicate disruption of autonomic control mechanisms responsible for maintaining cardiovascular stability. These abnormalities may remain asymptomatic for prolonged periods but are associated with increased risk of serious cardiac events.

The observed relationship between chronic hyperglycemia and autonomic impairment supports current understanding of diabetic neuropathy pathogenesis. Persistent metabolic disturbances contribute to oxidative stress, endothelial dysfunction, and microvascular injury, leading to progressive degeneration of autonomic nerve fibers.

Gastrointestinal and genitourinary manifestations further illustrate the systemic nature of autonomic neuropathy. Alterations in smooth muscle regulation and autonomic signaling may significantly affect digestive and urinary functions, often resulting in chronic symptoms that impair daily activities and overall well-being.

Functional autonomic testing proved valuable for detecting abnormalities even in patients with relatively mild clinical symptoms. Objective assessment methods such as heart rate variability analysis and cardiovascular reflex testing facilitate early diagnosis and may help identify individuals at increased risk of complications.

The study highlights the importance of comprehensive diabetic care. Effective management of autonomic dysfunction requires optimization of glycemic control, modification of cardiovascular risk factors, patient education, and regular monitoring. Early therapeutic intervention may slow disease progression and improve functional outcomes.

Modern treatment approaches emphasize individualized care based on the severity and distribution of autonomic involvement. Pharmacological therapies targeting specific symptoms, combined with lifestyle interventions and rehabilitation strategies, can contribute significantly to symptom relief and improved quality of life.

## 5. Conclusion

Autonomic dysfunction is a common and progressive complication of diabetes mellitus that affects cardiovascular, gastrointestinal, genitourinary, and sudomotor functions. The severity of autonomic impairment is closely associated with disease duration and long-term glycemic control.

Clinical assessment combined with functional autonomic testing provides valuable information for early detection and monitoring of diabetic autonomic neuropathy. Cardiovascular autonomic abnormalities, particularly reduced heart rate variability and orthostatic hypotension, represent important indicators of disease progression and increased clinical risk.

Comprehensive management involving strict glycemic control, regular neurological evaluation, symptomatic treatment, and multidisciplinary care can significantly reduce complications and improve patient outcomes. Early recognition of autonomic dysfunction should be considered an essential component of diabetes management strategies aimed at preserving functional capacity and enhancing quality of life.

## References

- [1] Feldman EL, Callaghan BC, Pop-Busui R, et al. Diabetic neuropathy. *Nat Rev Dis Primers*. 2019;5(1):41.
- [2] Pop-Busui R, Boulton AJM, Feldman EL, et al. Diabetic neuropathy: A position statement by the American Diabetes Association. *Diabetes Care*. 2017;40(1):136–154.
- [3] Tesfaye S, Boulton AJM, Dyck PJ, et al. Diabetic neuropathies: update on definitions, diagnostic criteria, estimation of severity, and treatments. *Diabetes Care*. 2010;33(10):2285–2293.
- [4] Callaghan BC, Cheng HT, Stables CL, Smith AL, Feldman EL. Diabetic neuropathy: clinical manifestations and current treatments. *Lancet Neurol*. 2012;11(6):521–534.
- [5] Sloan G, Selvarajah D, Tesfaye S. Pathogenesis, diagnosis and clinical management of diabetic neuropathy. *BMJ*. 2021;374:n1786.
- [6] Vinik AI, Nevoret ML, Casellini C, Parson H. Diabetic neuropathy. *Endocrinol Metab Clin North Am*. 2013;42(4):747–787.
- [7] Dyck PJ, Albers JW, Andersen H, et al. Diabetic polyneuropathies: clinical and neuropathological aspects. *Diabetes Metab Res Rev*. 2011;27(7):620–628.
- [8] Malik RA. Current understanding of the pathophysiology of diabetic neuropathy. *Neurol Clin*. 2020;38(4):787–799.
- [9] Selvarajah D, Kar D, Khunti K, et al. Diabetic peripheral neuropathy: advances in diagnosis and screening. *BMJ*. 2019;366:l5405.
- [10] Perkins BA, Bril V. Electrophysiologic testing in diabetic neuropathy. *Handb Clin Neurol*. 2014;126:235–248.
- [11] England JD, Gronseth GS, Franklin G, et al. Evaluation of distal symmetric polyneuropathy: role of

laboratory and neurophysiological studies. *Neurology*. 2009;72(2):177–184.

[12] Ang L, Jaiswal M, Martin C, Pop-Busui R. Glucose control and diabetic neuropathy. *Curr Diab Rep*. 2014;14(9):528.

[13] Ziegler D, Papanas N, Vinik AI, Shaw JE. Epidemiology of diabetic polyneuropathy. *Handb Clin Neurol*. 2014;126:3–22.

[14] American Diabetes Association. Standards of Care in Diabetes—2025. *Diabetes Care*. 2025;48(Suppl 1):S1–S350.

[15] International Diabetes Federation. *IDF Diabetes Atlas*. 11th ed. Brussels: IDF; 2024.

[16] World Health Organization. *Diabetes Fact Sheet*. Geneva: WHO; 2025.

[17] Bril V, England J, Franklin GM, et al. Evidence-based guideline: treatment of painful diabetic neuropathy. *Neurology*. 2011;76(20):1758–1765.

[18] Tesfaye S, Selvarajah D. Advances in epidemiology, pathogenesis and management of diabetic peripheral neuropathy. *Diabetes Metab Res Rev*. 2012;28(Suppl 1):8–14.

[19] Med1.uz. Diabetik periferik neyropatiya: klinik belgilari va diagnostikasi. Available from: <https://med1.uz/articles/nevrologiya/dia-betik-periferik-neyropatiya>

[20] Med1.uz. Qandli diabetning nevrologik asoratlari. Available from: <https://med1.uz/articles/nevrologiya/dia-bet-asoratlari>

[21] Med1.uz. Elektroneymyografiya va periferik nerv tizimi kasalliklari. Available from: <https://med1.uz/articles/diagnostika/enm-g>

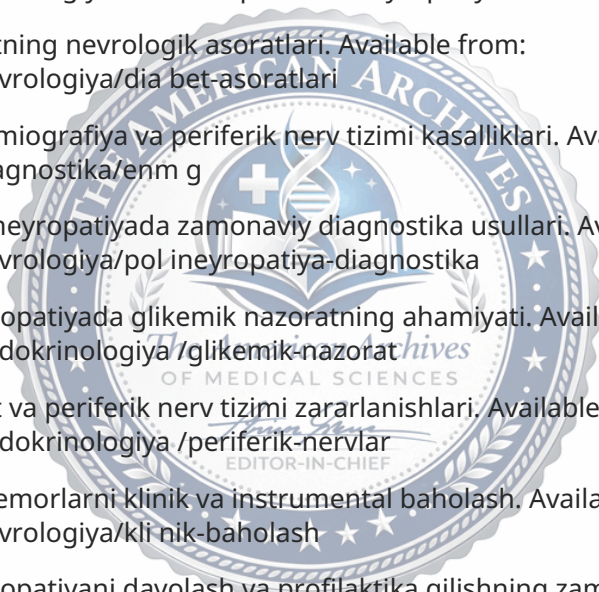
[22] Med1.uz. Diabetik polinevropatiyada zamonaviy diagnostika usullari. Available from: <https://med1.uz/articles/nevrologiya/pol-inevropatiya-diagnostika>

[23] Med1.uz. Diabetik neyropatiyada glikemik nazoratning ahamiyati. Available from: <https://med1.uz/articles/endokrinologiya/glikemik-nazorat>

[24] Med1.uz. Qandli diabet va periferik nerv tizimi zararlanishlari. Available from: <https://med1.uz/articles/endokrinologiya/periferik-nervlar>

[25] Med1.uz. Nevrologik bemorlarni klinik va instrumental baholash. Available from: <https://med1.uz/articles/nevrologiya/klinik-baholash>

[26] Med1.uz. Diabetik neyropatiyani davolash va profilaktika qilishning zamonaviy usullari. Available from: <https://med1.uz/articles/nevrologiya/neyropatiya-davolash>



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