

Original Research Article

NEUTROPHIL / LYMPHOCYTE RATIO AND ITS CORRELATION WITH MICROVASCULAR COMPLICATIONS IN PATIENTS WITH DIABETES MELLITUS

Rahul Verma¹, R.P Pandey², K.S Kapur³, Anamika Dwivedi⁴

¹PG Resident 3rd year, Department of General Medicine, Shyam Shah Medical College, Rewa, Madhya Pradesh, India

²Associate Professor, Department of General Medicine, Shyam Shah Medical College, Rewa, Madhya Pradesh, India

³Assistant Professor, Department of General Medicine, Shyam Shah Medical College, Rewa, Madhya Pradesh, India

⁴Associate Professor, Department of Ophthalmology, Shyam Shah Medical College, Rewa, Madhya Pradesh, India

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Corresponding Author:

Dr. Rahul Verma,
PG Resident 3rd year, Department of
Medicine, Shyam Shah Medical
College, Rewa, Madhya Pradesh, India.
Email: rahul200597@gmail.com

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ABSTRACT

Background: Diabetes mellitus is a chronic metabolic disorder with a rapidly increasing prevalence and is associated with significant microvascular complications such as retinopathy, nephropathy, and neuropathy. Chronic hyperglycemia induces inflammation and endothelial dysfunction, contributing to vascular damage. The neutrophil-to-lymphocyte ratio (NLR), a simple inflammatory marker, may help in early risk stratification. This study aimed to evaluate the association between NLR and the presence and severity of microvascular complications in diabetic patients.

Materials and Methods: A cross-sectional observational study was conducted on 160 patients with type 2 diabetes mellitus at a tertiary care center. Patients were divided into two groups: with and without microvascular complications. NLR was calculated from complete blood count and a value of >3.53 was considered significant. Microvascular complications were assessed using fundoscopic examination (retinopathy), Neuropathy was assessed using vibration perception with a 128-Hz tuning fork and a 10-g Semmes-Weinstein monofilament, applied at nine different plantar sites, and urine albumin along with renal function tests (nephropathy).

Results: Among the study population ($n=160$), patients with microvascular complications showed significantly higher NLR values compared to those without complications. Elevated NLR (>3.53) was more frequently observed in patients with complications. Previous comparable observations cited in the study showed that 58.6% of patients with complications had elevated NLR compared to 33.3% without complications ($p<0.012$), indicating a significant association. Higher NLR levels were also found to correlate with increasing severity of diabetic retinopathy, progression of nephropathy (microalbuminuria to macroalbuminuria), and presence of neuropathy.

Conclusion: NLR is a simple, cost-effective, and reliable marker that correlates significantly with microvascular complications in diabetes mellitus. It can be used as an early screening and prognostic tool for early identification, risk stratification, and monitoring of complications in patients with diabetes mellitus.

Keywords: Diabetes Mellitus, Neutrophil-Lymphocyte Ratio, Microvascular Complications, Retinopathy, Nephropathy, Neuropathy

INTRODUCTION

Diabetes mellitus is a chronic metabolic disorder with a rapidly increasing global prevalence,

projected to reach 7,079 per 100,000 individuals by 2030, and is responsible for approximately 6.7 million deaths annually due to its complications.^[1,2] Persistent hyperglycemia leads to the formation of

advanced glycation end products, resulting in endothelial dysfunction and vascular damage. Microvascular complications—namely diabetic retinopathy, nephropathy, and neuropathy—are major causes of morbidity, significantly affecting quality of life and increasing healthcare burden.^[3] Chronic low-grade inflammation plays a crucial role in the pathogenesis of these complications. The neutrophil-to-lymphocyte ratio (NLR), derived from routine complete blood count, has emerged as a simple, inexpensive, and reliable marker of systemic inflammation. Elevated neutrophil counts reflect inflammatory activation, while lymphopenia indicates stress-related immune suppression, making NLR a combined indicator of immune response.^[4-6] Several studies have demonstrated higher NLR levels in diabetic patients with microvascular complications compared to those without, suggesting its potential role in early risk stratification. However, variability in study findings and lack of standardized cut-off values limit its routine clinical application.^[7,8] Therefore, evaluating NLR as a cost-effective biomarker may aid in early detection and better management of microvascular complications in diabetes mellitus.

Aim and Objectives

Aim:

To evaluate the association of neutrophil-to-lymphocyte ratio (NLR) with the presence and severity of microvascular complications in patients with diabetes mellitus.

Objectives:

1. To determine NLR in patients with diabetes mellitus and compare it between patients with and without microvascular complications (retinopathy, nephropathy, neuropathy).
2. To assess the correlation between NLR values and the severity of individual microvascular complications using clinical and laboratory parameters.

MATERIALS AND METHODS

This cross-sectional observational study was conducted in the Department of Medicine at Shyam Shah Medical College and Sanjay Gandhi Memorial

Hospital, Rewa (Madhya Pradesh), after obtaining approval from the Institutional Ethics Committee. The study was carried out over a period of one year. A total of 160 patients diagnosed with type 2 diabetes mellitus were included in the study. Patients were recruited from both outpatient (OPD) and inpatient (IPD) services and were divided into two groups: Group A (patients with microvascular complications) and Group B (patients without microvascular complications). Written informed consent was obtained from all participants prior to enrollment.

Inclusion criteria included patients aged >18 years with diagnosed diabetes mellitus who consented to participate. Exclusion criteria comprised pregnant women, patients with malignancy, autoimmune diseases, or recent infections.

A detailed clinical history and examination were performed. Laboratory investigations included fasting and postprandial blood glucose, HbA1c, renal function tests, and complete blood count. The neutrophil-to-lymphocyte ratio (NLR) was calculated by dividing absolute neutrophil count by absolute lymphocyte count, with NLR >3.53 considered significant.

Microvascular complications were assessed as follows: diabetic retinopathy was evaluated by fundoscopic examination and graded using ETDRS criteria; diabetic neuropathy was diagnosed using clinical examination and sensory testing including monofilament and vibration perception; clinical sensory tests vibration perception test using a 128-Hz tuning fork 10-gram Semmes-Weinstein monofilament test, applied at nine different plantar sites (neuropathy) and diabetic nephropathy was assessed by urine albumin estimation and renal function tests, categorized into microalbuminuria and macroalbuminuria.

Data were collected using a predesigned proforma and analyzed using SPSS version 20. Quantitative variables were expressed as mean $\pm$ standard deviation, while categorical variables were presented as frequencies and percentages. Independent t-test and Chi-square test were applied as appropriate, and logistic regression analysis was used to determine associations. A p-value <0.05 was considered statistically significant.

RESULTS

Table 1: Baseline Characteristics and Study Distribution (n=160)

Parameter	With Complications (n=102)	Without Complications (n=58)	p-value
Percentage (%)	63.8%	36.2%	—
Age (Mean $\pm$ SD)	57.06 $\pm$ 13.20	55.12 $\pm$ 14.08	0.3847

Table 2: Demographic and Clinical Factors Associated with NLR

Parameter	High NLR (n=96)	Normal NLR (n=64)	p-value
Male	54 (56.25%)	37 (57.81%)	0.8455
Female	42 (43.75%)	27 (42.19%)	
HbA1c <7	15 (15.62%)	22 (34.37%)	< 0.0013
HbA1c 7–9	39 (40.63%)	30 (46.87%)	
HbA1c >9	42 (43.75%)	12 (18.75%)	

Duration >10 yrs	58 (60.42%)	18 (28.12%)	< 0.0001
BMI ≥25	56 (58.33%)	22 (34.37%)	< 0.001

Table 3: Association of NLR with Overall Microvascular Complications

Microvascular Complications	High NLR	Normal NLR	Total	p-value
Present	81 (84.38%)	21 (32.81%)	102	<0.0001
Absent	15 (15.63%)	43 (67.19%)	58	
Total	96	64	160	

Table 4: Association of NLR with Individual Microvascular Complications

Complication	High NLR	Normal NLR	p-value
Nephropathy	58 (60.41%)	14 (21.87%)	<0.0001
Neuropathy	54 (56.25%)	14 (21.87%)	<0.0001
Retinopathy	52 (54.16%)	12 (18.75%)	<0.0001

Table 5: Severity of Microvascular Complications and NLR

A. Nephropathy Severity (n=72)

Parameter	High NLR	Normal NLR	p-value
Microalbuminuria	25 (43.10%)	9 (64.28%)	<0.0001
Macroalbuminuria	33 (56.90%)	5 (35.72%)	

B: Retinopathy Severity (n=64)

Stage	High NLR	Normal NLR	p-value
Mild NPDR	19.23%	61.53%	0.0188
Moderate NPDR	28.84%	23.07%	
Severe NPDR	23.07%	7.69%	
PDR	28.84%	7.69%	

Table 6A: Association of NLR with Presence of All Three Microvascular Complications

NLR Category	All Three Complications Present	All Three Complications Absent	Total	p-value
High NLR (n=96)	26 (27.08%)	70 (72.92%)	96	0.003
Normal NLR (n=64)	4 (6.25%)	60 (93.75%)	64	
Total (n=160)	30 (18.75%)	130 (81.25%)	160	

Table 6B: Association Between Diabetic Retinopathy and Nephropathy

Diabetic Retinopathy	Nephropathy Present	Nephropathy Absent	Total	p-value
Present	50 (69.44%)	14 (15.90%)	64 (40.0%)	<0.0001
Absent	22 (30.56%)	74 (83.10%)	96 (60.0%)	
Total	72 (100%)	88 (100%)	160	

Table 6C: Summary of Combined Microvascular Burden Across NLR Groups

Parameter	High NLR (n=96)	Normal NLR (n=64)
Any complication present	81 (84.38%)	21 (32.81%)
All three complications	26 (27.08%)	4 (6.25%)
Multiple (≥2) complications (approx.)	Higher prevalence	Lower prevalence

DISCUSSION

In the present study [Table 1], 63.8% of patients had microvascular complications, indicating a high disease burden. The mean age of patients with complications (57.06 ± 13.20 years) was comparable to those without complications (55.12 ± 14.08 years), with no statistically significant difference (p=0.3847). Similar findings were reported by Venguidesvarane AG et al,^[9] Shera AS et al,^[10] and Agrawal RP et al,^[11] who observed no significant association between age and microvascular complications. Likewise, Kamalarathnam SR et al,^[12] and Karthiksaravanan K et al,^[13] also demonstrated comparable age distribution between groups. Thus, the present study suggests that age alone may not be an independent

determinant of microvascular complications in diabetes mellitus. [Table 1]

As shown in [Table 2], gender distribution was similar across NLR categories (p = 0.8455), indicating no association between gender and NLR levels. Comparable findings were reported by Mahajan M et al,^[3] Wan H et al,^[14] and Li L et al,^[15] who found no significant gender-based differences in NLR. Chittawar S et al.¹⁶ also highlighted NLR as an independent marker unaffected by demographic variables. However, a strong association was observed between NLR and glycemic control, duration of diabetes, and BMI. Patients with HbA1c >9% (43.75%), longer disease duration (>10 years, 60.42%), and obesity (58.33%) had significantly higher NLR (p < 0.001). These findings are consistent with studies by Dayama N et al,^[17] Upadhyayula SK et al,^[4] and Subramani M et al,^[6] who reported significantly elevated NLR in

poorly controlled diabetes. Similarly, Bhattacharyya S et al,^[18] and Fawwad A et al,^[19] demonstrated higher NLR in patients with longer duration and higher BMI. [Table 2]

[Table 3] shows a highly significant association between elevated NLR and microvascular complications ($p < 0.0001$). Among patients with complications, 84.38% had high NLR compared to 32.81% with normal NLR. Similar observations were reported by Bhattacharyya S et al,^[18] Fawwad A et al,^[19] and Moursy EY et al,^[20] who demonstrated significantly higher NLR levels in patients with diabetic complications. Wan H et al,^[14] further showed increased odds of complications in higher NLR quartiles. These findings confirm that NLR is a strong inflammatory marker associated with microvascular complications.

All three complications—nephropathy, neuropathy, and retinopathy—were significantly associated with elevated NLR ($p < 0.0001$). For nephropathy, findings were consistent with Chittawar S et al,^[16] Singh A et al,^[21] and Murughesh ME et al,^[22] who reported significantly higher NLR in affected patients. For neuropathy, studies by Garg R et al,^[23] and Rezaei Shahrabi A et al,^[24] demonstrated similar elevations in NLR among neuropathy patients. For retinopathy, comparable results were reported by Abdullah M et al,^[25] Tang Y et al,^[26] and Rajendrakumar AL et al,^[7] confirming a strong association between inflammation and retinal damage. Thus, elevated NLR reflects involvement of individual microvascular beds. [Table 4]

[Table 5] demonstrates that higher NLR is associated with increased severity of complications. Macroalbuminuria was more common in high NLR patients (56.90%), while microalbuminuria predominated in normal NLR ($p < 0.0001$). Similar findings were reported by Upadhyayula SK et al,^[4] Chollangi S et al,^[5] and Subramani M et al,^[6] who showed progressive increase in NLR with worsening renal function. Regarding retinopathy severity, advanced stages such as PDR and severe NPDR were more common in high NLR patients ($p = 0.0188$). Abdullah M et al,^[25] also reported higher NLR in proliferative stages, though variability in statistical significance exists across studies. Thus, NLR may reflect progression and severity of microvascular damage. [Table 5]

[Table 6] highlights that 27.08% of high NLR patients had all three complications compared to only 6.25% in the normal NLR group ($p = 0.003$), indicating a strong association between NLR and cumulative disease burden. Similar findings were reported by Gokul R et al,^[8] Sahi D et al,^[27] and Mohammed AM et al,^[28] who demonstrated higher NLR in patients with multiple complications. Additionally, a strong association was observed between retinopathy and nephropathy ($p < 0.0001$), suggesting coexistence of complications. This is consistent with studies by Chittawar S et al,^[16] Fawwad A et al,^[19] and Moursy EY et al,^[20] who

reported overlapping microvascular involvement. [Table 6]

CONCLUSION

The present study demonstrates that the neutrophil-lymphocyte ratio (NLR) is a significant and reliable marker of systemic inflammation in patients with type 2 diabetes mellitus and is strongly associated with microvascular complications. Elevated NLR showed a significant correlation with the presence of diabetic retinopathy, nephropathy, and neuropathy, as well as their combined occurrence, indicating its role as a marker of cumulative microvascular disease burden. Higher NLR values were also associated with poor glycemic control, longer duration of diabetes, and increased body mass index, reflecting an enhanced inflammatory state. Additionally, NLR correlated with the severity of complications, particularly diabetic nephropathy, where higher levels were linked with macroalbuminuria, while its association with retinopathy severity was less consistent. Demographic factors such as age and gender were not significantly associated with NLR, suggesting its independence as an inflammatory marker. Overall, NLR, being a simple, cost-effective, and readily available parameter, can serve as a useful tool for early identification, risk stratification, and monitoring of microvascular complications in patients with diabetes mellitus, thereby aiding in timely intervention and improved clinical outcomes.

REFERENCES

1. Saeedi P, Petersohn I, Salpea P, et al.: Global and regional diabetes prevalence estimates for 2019 and projections for 2030 and 2045: results from the International Diabetes Federation Diabetes Atlas, 9(th) edition. *Diabetes Res Clin Pract.* 2019, 157:107843.
2. Sun H, Saeedi P, Karuranga S, et al.: IDF Diabetes Atlas: global, regional and country-level diabetes prevalence estimates for 2021 and projections for 2045. *Diabetes Res Clin Pract.* 2022, 183:109119.
3. Mahajan M, Prasad MK, Ashok C, Guria RT, Marandi S, Subrat S, Chowdhury A, Guria R. The correlation of the neutrophil-to-lymphocyte ratio with microvascular complications in patients with diabetes mellitus. *Cureus.* 2023 Sep 3;15(9).
4. Upadhyayula SK, Ubaru S, Raajeshwi P, Ajavindu CN, Rao AB, Prasad AC. Neutrophil-Lymphocyte Ratio and Urine Albumin-Creatinine Ratio As Indicators of Microvascular Complications in Type 2 Diabetes Mellitus: A Cross-Sectional Study. *Cureus.* 2024 Dec 6;16(12).
5. Chollangi S, Rout NK, Patro S. A Study on Correlation of Neutrophil to Lymphocyte Ratio and Red Cell Distribution Width with Microalbuminuria in Type 2 Diabetes Mellitus. *The Journal of the Association of Physicians of India.* 2022 Apr 1;70(4):11-2.
6. Subramani M, Anbarasan M, Shanmugam D, Muthumani LN, Vasudevan P. Role of neutrophil-lymphocyte ratio as a prognostic marker for type 2 diabetic nephropathy among Indians. *Bioinformation.* 2023 Apr 30;19(4):375.
7. Rajendrakumar AL, Hapca SM, Nair AT, Huang Y, Chourasia MK, Kwan RS, Nangia C, Siddiqui MK, Vijayaraghavan P, Matthew SZ, Leese GP. Competing risks analysis for neutrophil to lymphocyte ratio as a predictor of

- diabetic retinopathy incidence in the Scottish population. *BMC medicine*. 2023 Aug 10;21(1):304.
8. Gokul R, Yoganathan C, Dhas CP, Abilash N, Velammal P, Kumar B, Kumar SS. Correlation of leucocyte and platelet indices in patients with type 2 diabetes mellitus with microvascular complications at a tertiary care hospital in south India—A prospective cross-sectional study. *Endocrine Regulations*. 2023;57(1):235-41.
 9. Venguidesvarane AG, Jasmine A, Varadarajan S, Shriram V, Muthuthandavan AR, Durai V, et al. Prevalence of Vascular Complications Among Type 2 Diabetic Patients in a Rural Health Center in South India. 2020.
 10. Shera AS, Jawad F, Maqsood A, Jamal S. Prevalence of Chronic Complications and Associated Factors in Type 2 Diabetes. *J Pak Med Assoc*. 2004;(54):54–9.
 11. Agrawal RP, Ranka M, Beniwal R, Sharma S, K. Prevalence of micro and macro vascular complications in Type 3 Diabetes Mellitus and their risk factors. Vol. 24, *Int. J. Diab. Dev. Countries*. 2004.
 12. Kamalarathnam SR, Varadarajan S. Diabetic peripheral neuropathy in diabetic patients attending an urban health and training centre. *Journal of family medicine and primary care*. 2022 Jan 1;11(1):113-7.
 13. Karthiksaravanan K, Meriton AS. A study on prevalence of diabetic peripheral neuropathy in diabetic patients attending a rural health and training centre. *Journal of Family Medicine and Primary Care*. 2024 Feb 1;13(2):726-9.
 14. Wan H, Wang Y, Fang S, Chen Y, Zhang W, Xia F, Wang N, Lu Y. Associations between the neutrophil-to-lymphocyte ratio and diabetic complications in adults with diabetes: a cross-sectional study. *Journal of diabetes research*. 2020;2020(1):6219545.
 15. Li L, Wang M, Jia T, Jiang X, Yang F, Wang Z, Zhang X. Neutrophil-to-lymphocyte ratio in type 2 diabetes patients combined with Lower Extremity Peripheral Artery Disease. *Frontiers in endocrinology*. 2024 Aug 30;15:1434580.
 16. Chittawar S, Dutta D, Qureshi Z, Surana V, Khandare S, Dubey TN. Neutrophil-lymphocyte ratio is a novel reliable predictor of nephropathy, retinopathy, and coronary artery disease in Indians with type-2 diabetes. *Indian journal of endocrinology and metabolism*. 2017 Nov 1;21(6):864-70.
 17. Dayama N, Yadav SK, Saxena P, Sharma A, Kashnia R, Sharda K. A Study of Relationships between the HbA1c Level and Inflammatory Markers, Neutrophil-to-Lymphocyte Ratio, and Monocyte-to-Lymphocyte Ratio in Controlled and Uncontrolled Type 2 Diabetes Mellitus. *The Journal of the Association of Physicians of India*. 2024 Mar 1;72(3):24-6.
 18. Bhattacharyya S, Jain N, Verma H, Sharma K. A Cross-sectional Study to Assess Neutrophil Lymphocyte Ratio as a Predictor of Microvascular Complications in Type 2 Diabetes Mellitus Patients. *Journal of Clinical & Diagnostic Research*. 2021 Aug 1;15(8).
 19. Fawwad A, Butt AM, Siddiqui IA, Khalid M, Sabir R, Basit A. Neutrophil-to-lymphocyte ratio and microvascular complications in subjects with type 2 diabetes: Pakistan's perspective. *Turkish journal of medical sciences*. 2018;48(1):157-61.
 20. Moursy EY, Megallaa MH, Mouftah RF, Ahmed SM. Relationship between neutrophil lymphocyte ratio and microvascular complications in Egyptian patients with type 2 diabetes. *Am J Intern Med*. 2015 Nov;3(6):250-5.
 21. Singh A, Jha AK, Kalita BC, Jha DK, Alok Y. Neutrophil lymphocyte ratio: a reliable biomarker for diabetic nephropathy?. *International Journal of Diabetes in Developing Countries*. 2022 Jul;42(3):523-8.
 22. Murughesh ME, Holay M, Patil P, Tayade P. Clinical profile of diabetic nephropathy and its correlation with neutrophil-lymphocyte ratio in type 2 diabetes mellitus. *Vidarbha J Indian Med*. 2022;32(2):108–114.
 23. Garg R, Thakre A. Inflammatory footprints: Neutrophil-to-lymphocyte ratio and platelet-to-lymphocyte ratio as novel biomarkers for diabetic peripheral neuropathy. *Journal of Hematology and Allied Sciences*.:1-8.
 24. Rezaei Shahrabi A, Arsenault G, Nabipoorashrafi SA, Lucke-Wold B, Yaghoobpoor S, Meidani FZ, Rahmati R, Ghaedi A, Khanzadeh S. Relationship between neutrophil to lymphocyte ratio and diabetic peripheral neuropathy: a systematic review and meta-analysis. *European journal of medical research*. 2023 Nov 16;28(1):523.
 25. Abdullah M. Comparative study on neutrophil-lymphocyte ratio (NLR) among diabetic cases with and without diabetic retinopathy. *Indian J Clin Exp Ophthalmol*. 2021;7(1):153-6.
 26. Tang Y, Li L, Li J. Association between neutrophil-to-lymphocyte ratio and diabetic retinopathy in patients with type 2 diabetes: a cohort study. *Frontiers in Endocrinology*. 2024 Jul 11;15:1396161.
 27. Sahi D. Study of Neutrophil-Lymphocyte ratio (NLR) in diabetes mellitus. *Tropical Journal of Pathology and Microbiology Учредители: Siddharth Health Research and Social Welfare Society*. 2020;6(4):298-302.
 28. Mohammed AM, Khaleel M, Jalily QA, Dhanekula K, Eshwar MD, RM P, Dhanekula Jr K. Neutrophil-to-lymphocyte ratio as a potential biomarker to managing type 2 diabetes Mellitus and Predicting Disease Progression. *Cureus*. 2024 Feb 29;16(2).