RESEARCH PAPER

CORRELATION OF BLOOD NEUTROPHIL FUNCTIONS WITH COMORBIDITIES AND HOSPITALIZATION IN COPD PATIENTS AT A TERTIARY HEALTHCARE HOSPITAL IN TAMIL NADU

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ABSTRACT

Background

Chronic obstructive pulmonary disease (COPD) is a chronic inflammation of the airways and lungs results in restricted airflow. Acute exacerbations and comorbiditeis along with this condition cause hospitalisation and death of the patients. This study examined neutrophil activity and hospital admission rates in COPD patients with and without comorbidities.

Methods

This was an analytical cross-sectional study carried out at St. Peter's Medical College Hospital, Tamil Nadu, India, between October 2023 and October 2024. A total of 150 patients with COPD were included. Patients were grouped by diabetes, hypertension, cardiovascular disease, and dyslipidemia. Hospital admissions were recorded from 1 to 5 events and compared between groups.

Results

Stimulated vs unstimulated neutrophil tests differed significantly in all groups. With diabetes, NBT was 46.12 ± 9.3% vs 36.05 ± 9.3%; without diabetes, 42.78 ± 11.7% vs 32.13 ± 11.2%. Phagocytosis with diabetes was 1.92 ± 0.96 vs 4.35 ± 1.32; without, 2.21 ± 0.94 vs 4.51 ± 1.14. Dyslipidemia in 5 patients showed higher NBT 51.4 ± 12.6% vs 40.00 ± 9.56% and chemotaxis 0.50 ± 0.07 mm vs 0.72 ± 0.08 mm. Admissions were significantly higher with comorbidities, $p < 0.001$. For diabetes, 47 had 3 admissions vs 2 without; for hypertension, 45 vs 4; for cardiovascular disease, 22 vs 27; for dyslipidemia, 2 vs 47.

Conclusion

Comorbidities in COPD are common and linked to changes in neutrophil function and more frequent hospitalizations. Addressing these conditions may improve patient outcomes.

Keywords: COPD, neutrophil function test, diabetes mellitus, hypertension, cardiovascular disease, dyslipidemia, hospital admission, comorbidities.

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Introduction

Chronic obstructive pulmonary disease (COPD) is a heterogeneous respiratory disorder marked by chronic and usually progressive airflow limitation. It develops due to changes in airway structure, including bronchitis or bronchiolitis, and destruction of the alveoli as seen in emphysema(1). According to the World Health Organization, COPD is expected to result in more than 3 million deaths each year by 2030, making it the third most common cause of death globally. Frequent hospital readmissions and associated complications reduce patients' quality of life and increase their risk of death. By 2050, the number of COPD cases worldwide is estimated to reach 600 million, which is a 23% increase from 2020 levels (2,3).

Chronic obstructive pulmonary disease (COPD) causes restricted airflow due to chronic inflammation of the airways and lungs. This inflammatory process causes structural changes and airway remodeling, leading to obstruction from excess mucus and

inflammatory secretions. COPD exacerbations are associated with increased hospital admissions, reduced quality of life, and higher mortality. Early identification of acute exacerbations is important to prevent serious complications. Because of this, an accessible, inexpensive, and straightforward investigative marker is needed to help predict the development, progression, and outcome of various chronic inflammatory disorders and malignancies. Neutrophils contribute more significantly than macrophages in many inflammatory states. In COPD patients, elevated neutrophil levels are observed in bronchoalveolar lavage fluid, sputum, bronchial glands, and airway smooth muscle tissue(4).

Acute exacerbations in COPD are a major cause of poor outcomes and disease progression and need careful attention. COPD is associated with systemic manifestations such as cardiovascular disorders, metabolic conditions, and depression. The coexistence of multiple conditions can influence each other and worsen the overall clinical condition. Multiple comorbidities clearly alter the body's internal environment and homeostatic balance(5). Hence in this study we correlate blood neutrophil functions with comorbidities and hospitalization among COPD patients at a tertiary healthcare hospital in Tamil Nadu.

Objective:

The main objective of this study is to determine the correlation between blood neutrophil functions and comorbidities and hospitalization patterns in COPD patients at a tertiary healthcare hospital in Tamil Nadu.

Methods and Methodology

This was an analytical cross-sectional study carried out at St. Peter's Medical College Hospital, Tamil Nadu, India, between October 2023 and October 2024. A total of 150 patients with COPD were enrolled using the consecutive sampling technique.

Inclusion Criteria:

- Patients aged 40 to 80 years
- Male and female participants
- Current smokers and former smokers
- Individuals with previously diagnosed COPD as well as newly diagnosed cases
- Patients having comorbid conditions including cardiovascular disease, diabetes, hypertension, and dyslipidemia

Exclusion Criteria:

- Patients younger than 40 years or older than 80 years
- Individuals with respiratory disorders other than COPD, including acute infections, autoimmune conditions, inflammatory diseases, malignancies, and hematological disorders

In this study, COPD was diagnosed based on the Global Initiative for Obstructive Lung Disease (GOLD) criteria.

According to GOLD, COPD is defined by a post-bronchodilator FEV1/FVC ratio of less than 0.70. Disease severity is further categorized using FEV1 percent predicted:

- GOLD A (Mild): FEV1 ≥ 80% predicted
- GOLD B (Moderate): 50% ≤ FEV1 < 80% predicted
- GOLD C (Severe): 30% ≤ FEV1 < 50% predicted
- GOLD D (Very severe): FEV1 < 30% predicted

Sample size:

From the previous study expected proportion of elevated neutrophil count is 34% (6)

$$n = \frac{Z_{1-\alpha 2} \times pq}{d2}$$

q = 1-p

p = 34% (proportion)

d = precision = 10%

z=2.576for99% confidence interval

$$=\frac{2.576x2.576x0.34x0.66}{0.1x0.1}$$

=148.90

(Sample adjusted to 150)

Approval from the Institutional Ethics Committee was obtained and informed consent was taken from all participants. Baseline information was recorded using a structured proforma. Under the supervision of a trained staff nurse, 10 mL of venous blood was drawn into two vacutainers containing ethylenediamine tetra acetic acid as the anticoagulant.

Methodology

Following blood collection, each sample was assessed for neutrophil function. The tests performed included the nitroblue tetrazolium (NBT) assay, phagocytosis, intracellular killing by candidacidal assay, and chemotaxis.

Neutrophil Function Tests

Nitroblue Tetrazolium (NBT) Test

Whole blood was used for the NBT assay. Two test tubes were labeled: one for stimulated cells and one for unstimulated cells. To both tubes, 100 µL of blood, 200 µL of HBSS, and 50 µL of NBT solution (0.35% w/v prepared in 0.34% sucrose and freshly diluted with PBS) were added. In addition, 50 µL of endotoxin prepared in-house from Escherichia coli

was added to the stimulated tube. For the unstimulated tube, the endotoxin was substituted with 250 µL of HBSS. Both tubes were incubated at 37°C for 20 minutes and then at room temperature for another 20 minutes. Thin smears were prepared from each tube, stained with Giemsa, and examined under oil immersion at 100x magnification. A total of 200 neutrophils were counted. Cells containing bluish-black formazan granules were considered endotoxin-stimulated. The ratio of stimulated to unstimulated cells was expressed as a percentage.(7)

Separation of purified WBCs was required for the remaining three assays.

Procedure for WBC Separation

Two mL of EDTA blood was mixed with equal volumes of 1% phosphate-buffered saline (PBS) and 1% gelatin solution. The mixture was left undisturbed in an upright position for 45 minutes. After this period, RBCs settled at the bottom while the upper layer containing plasma and WBCs was collected. This layer was centrifuged at 3000 RPM for 3 to 5 minutes. The cell pellet was washed three times with 2 mL of PBS, pH 7.2, to eliminate residual gelatin. The final cell suspension was prepared by resuspending the pellet in 1 mL of HBSS.(8,9)

Phagocytosis Assay

Heat-killed Candida albicans was used to evaluate phagocytic function. In one test tube, 250 µL of Hank's solution, 250 µL of pooled normal human serum, 250 µL of heat-killed Candida suspension, and 250 µL of WBC suspension were mixed. A second tube served as the negative control, in which serum was replaced with 500 µL of Hank's solution. After mixing thoroughly, both tubes were incubated at 37°C for 30 minutes. The tubes were then centrifuged at 3000 rpm for 5 minutes and the supernatant was discarded. Smears were prepared from the sediment, stained with Giemsa, and examined microscopically. A total of 200 neutrophils were assessed, and the number of ingested Candida per cell was counted. Results were reported as the mean particle number (MPN).(10)

Candidacidal Assay

This assay was used to evaluate intracellular killing capacity. The test tube contained 250 µL of WBC suspension, 250 µL of Hank's solution, 250 µL of autologous plasma, and 250 µL of live Candida cells. The control tube contained 250 µL of WBC suspension, 250 µL of live Candida cells, and 500 µL of Hank's solution. Both tubes were incubated at 37°C for 1 hour with intermittent shaking. After incubation, 250 µL of 2.5% sodium deoxycholate was added to each tube and mixed thoroughly. Then 2 mL of 0.01% methylene blue was added, mixed, and centrifuged at 2000 rpm for 10 minutes. The supernatant was discarded, and a small drop of the sediment was loaded into a Neubauer counting chamber. At least 300 Candida cells were counted. The proportion of dead cells, stained blue by methylene blue, was determined relative to unstained viable cells.(11)

Chemotactic Activity

A clean glass slide (25 mm × 75 mm) was coated with 5 mL of 1.2% agarose prepared in MEM medium containing pooled human serum and sodium bicarbonate, then allowed to solidify. Three wells, each 3 mm in diameter and spaced 3 mm apart, were cut into the agarose. The central well was filled with Formyl-Methionyl-Leucyl-Phenylalanine (FMLP), a known chemoattractant. The peripheral wells were loaded with WBC suspensions as test samples. In the control setup, FMLP was replaced with the subject's serum. Slides were incubated at 37°C for 2 hours. They were then immersed in methanol for 30 minutes and fixed with formalin for 30 minutes. After removing the agarose layer, the slide was stained with Giemsa. The linear distance migrated by cells was measured microscopically using an oculometer. Spontaneous migration toward the buffer-containing well was also recorded to determine the chemotactic index.(11)

Statistical Analysis

Data were analyzed using SPSS version 16. Categorical variables were presented as frequencies and percentages. Neutrophil function tests were compared across personal habits of COPD patients using one-way ANOVA, and between acute exacerbation of COPD and newly diagnosed COPD patients using the Student's t-test. A p-value of less than 0.05 was considered statistically significant.

Results

Table 1: Frequency distribution of Co morbidity status among COPD patients

Co morbidity Status	Present N (%)	Nil N (%)	Total N (%)
Sustained Hypertension	117 (78.0)	33 (22.0)	**150 (100.0)**
Diabetes Mellitus	113 (75.4)	37 (24.6)	**150 (100.0)**
Dyslipidemia	5 (3.3)	145 (96.7)	**150 (100.0)**
Cardiovascular diseases	45 (30.0)	105 (70.0)	**150 (100.0)**

Table 1 shows the distribution of comorbid conditions in the 150 COPD patients studied. Sustained hypertension was the most common comorbidity, reported in 117 patients (78.0%), while 33 patients (22.0%) had no history of hypertension. Diabetes mellitus was present in 113 patients (75.4%) and absent in 37 patients (24.6%). Dyslipidemia was observed in only 5 patients (3.3%), with 145 patients (96.7%) showing no dyslipidemia. Cardiovascular diseases were documented in 45 patients (30.0%), whereas 105 patients (70.0%) had no cardiovascular comorbidity.

Table 2: Comparison of Neutrophil Function Test in COPD patients with and without Diabetes Mellitus

Neutrophil Functions Test	**COPD without Diabetes Mellitus**		**COPD with Diabetes Mellitus**		**p value**
	Test / Stimulated Mean ± SD N =37	**Control / Un-stimulated Mean ± SD N= 37**	**Test / Stimulated Mean ± SD N = 113**	**Control / Un-stimulated Mean ± SD N = 113**	
NBT Test (% Cells)	42.78 ± 11.7	32.13 ± 11.2	46.12 ± 9.3	36.05 ± 9.3	**1-2***, 1-3^{+}, **1-4***, **2-3***, 2-4^{+}, **3-4***
Phagocytosis (Mean Particle Number)	2.21 ± 0.94	4.51 ± 1.14	1.92 ± 0.96	4.35 ± 1.32	**1-2***, 1-3^{+}, **1-4***, **2-3***, 2-4^{+}, **3-4***
Chemotaxis (mm)	0.427 ± 0.17	0.616 ± 0.15	0.41 ± 0.14	0.59 ± 0.14	**1-2***, 1-3^{+}, **1-4***, **2-3***, 2-4^{+}, **3-4***
Candidacidal assay (% of Dead Candida)	19.48 ± 3.6	34.81 ± 6.55	18.9 ± 3.06	35.21 ± 4.56	**1-2***, 1-3^{+}, **1-4***, **2-3***, 2-4^{+}, **3-4***

Table 2 shows neutrophil function tests in 150 COPD patients, comparing 37 without diabetes and 113 with diabetes. Across all four tests, stimulated and unstimulated conditions differed significantly. Diabetic patients had slightly higher NBT values but lower phagocytosis, chemotaxis, and candidacidal activity compared to non-diabetic patients. The p-value column indicates significant differences between most groups and conditions.

Table 3: Comparison of Neutrophil Function Test in COPD patients with and without Sustained Hypertension

Neutrophil Functions Test	**COPD without Sustained Hypertension**		**COPD with Sustained Hypertension**		**p value**
	Test / Stimulated Mean ± SD N =33	**Control / Un-stimulated Mean ± SD N= 33**	**Test / Stimulated Mean ± SD N = 117**	**Control / Un-stimulated Mean ± SD N = 117**	
NBT Test (% Cells)	45.60 ± 12.11	36.33 ± 12.81	45.21 ± 9.4	34.73 ± 8.9	**1-2***, 1-

					3+, **1-4***, **2-3***, 2-4+, **3-4***
Phagocytosis (Mean Particle Number)	2.18 ± 0.91	4.33 ± 0.92	1.94 ± 0.97	4.40 ± 1.37	**1-2***, 1-3+, **1-4***, **2-3***, 2-4+, **3-4***
Chemotaxis (mm)	0.424 ± 0.16	0.59 ± 0.15	0.41 ± 0.14	0.60 ± 0.14	**1-2***, 1-3+, **1-4***, **2-3***, 2-4+, **3-4***
Candidacidal assay (% of Dead Candida)	18.51 ± 3.90	34.18 ± 6.90	19.20 ± 2.9	35.37 ± 4.46	**1-2***, 1-3+, **1-4***, **2-3***, 2-4+, **3-4***

Table 3 compares neutrophil function in 150 COPD patients, 33 without sustained hypertension and 117 with sustained hypertension. For all four assays, stimulated samples differed significantly from unstimulated samples in both groups. NBT, phagocytosis, chemotaxis, and candidacidal activity showed similar trends between hypertensive and non-hypertensive patients, with significant pairwise differences indicated in the p-value column.

Table 4: Comparison of Neutrophil Function Test in COPD patients with and without Cardiovascular Diseases

Neutrophil Functions Test	**COPD without Cardiovascular Diseases**		**COPD with Cardiovascular Diseases**		**p value**
	Test / Stimulated Mean ± SD N =105	**Control / Un-stimulated Mean ± SD N= 105**	**Test / Stimulated Mean ± SD N = 45**	**Control / Un-stimulated Mean ± SD N = 45**	
NBT Test (% Cells)	44.40 ± 9.97	34.50 ± 10.04	47.4 ± 10.0	36.44 ± 9.62	**1-2***, 1-3+, **1-4***, **2-3***, 2-4+, **3-4***
Phagocytosis (Mean Particle Number)	1.97 ± 0.88	4.27 ± 1.22	2.06 ± 1.13	4.66 ± 1.38	**1-2***, 1-3+, **1-4***, **2-3***, 2-4+, **3-4***
Chemotaxis (mm)	0.421 ± 0.15	0.60 ± 0.14	0.40 ± 0.15	0.59 ± 0.15	**1-2***, 1-3+, **1-4***, **2-3***, 2-

					4+, **3-4***
Candidacidal assay (% of Dead Candida)	19.49 ± 3.40	35.34 ± 5.47	18.02 ± 2.4	34.57 ± 4.11	**1-2***, 1-3+, **1-4***, **2-3***, 2-4+, **3-4***

Table 4 presents neutrophil function results for 150 COPD patients, including 105 without cardiovascular diseases and 45 with cardiovascular diseases. Four assays were performed under stimulated and unstimulated conditions.In the NBT test, stimulated cells showed higher percentages than unstimulated cells in both groups. Patients with cardiovascular diseases had 47.4 ± 10.0% vs 36.44 ± 9.62%, while those without had 44.40 ± 9.97% vs 34.50 ± 10.04%.Phagocytosis mean particle numbers were lower in stimulated samples compared to controls. The cardiovascular disease group recorded 2.06 ± 1.13 vs 4.66 ± 1.38, and the non-cardiovascular group recorded 1.97 ± 0.88 vs 4.27 ± 1.22.Chemotaxis values were reduced under stimulation in both groups: 0.40 ± 0.15 mm vs 0.59 ± 0.15 mm with cardiovascular diseases and 0.421 ± 0.15 mm vs 0.60 ± 0.14 mm without.For the candidacidal assay, stimulated samples showed lower percentages of dead Candida than controls. Values were 18.02 ± 2.4% vs 34.57 ± 4.11% in patients with cardiovascular diseases and 19.49 ± 3.40% vs 35.34 ± 5.47% in those without.The p-value column denotes significant differences for most pairwise comparisons between groups and test conditions.

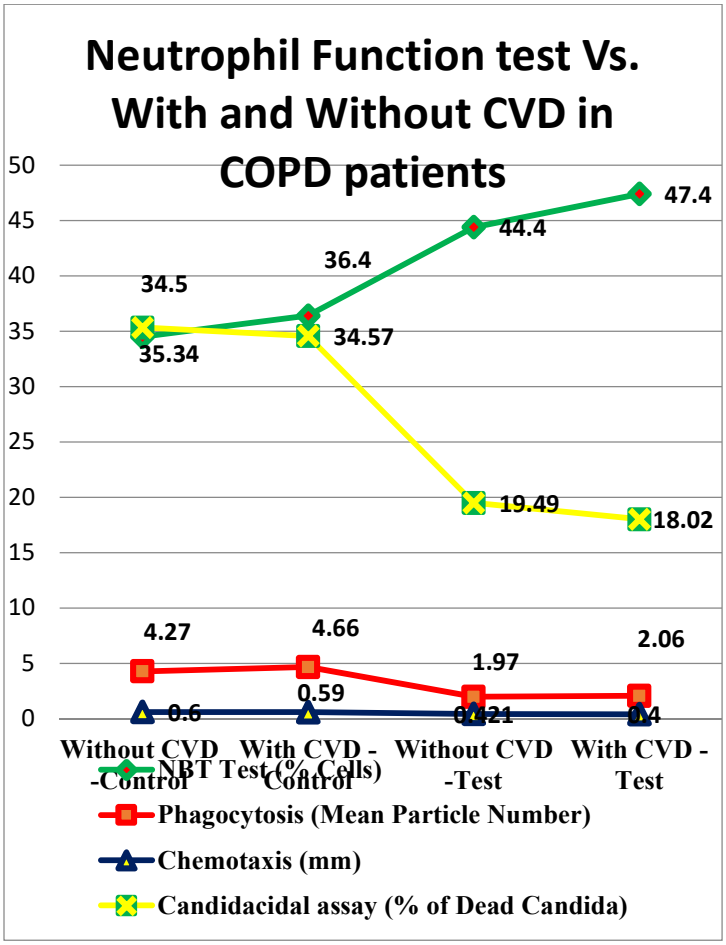

Table 5: Comparison of Neutrophil Function Test in COPD patients with and without Dyslipidemia

Neutrophil Functions Test	COPD without Dyslipidemia		COPD with Dyslipidemia		p value
	Test / Stimulated Mean ± SD N =145	Control / Un-stimulated Mean ± SD N= 145	Test / Stimulated Mean ± SD N =5	Control / Un-stimulated Mean ± SD N = 5	
NBT Test (% Cells)	45.08 ± 9.95	34.91 ± 9.92	51.4 ± 12.6	40.00 ± 9.56	**1-2***, 1-3+, 1-4+, **2-3***,

					2-4+, 3-4+
Phagocytosis (Mean Particle Number)	1.96 ± 0.93	4.38 ± 1.29	3.00 ± 1.22	4.60 ± 1.14	**1-2***, 1-3+, **1-4***, **2-3***, 2-4+, 3-4+
Chemotaxis (mm)	0.415 ± 0.152	0.598 ± 0.147	0.50 ± 0.07	0.72 ± 0.08	**1-2***, 1-3+, **1-4***, 2-3+, 2-4+, 3-4+
Candidacidal assay (% of Dead Candida)	19.10 ± 3.23	34.98 ± 4.94	17.6 ± 2.07	38.8 ± 8.43	**1-2***, 1-3+, **1-4***, **2-3***, 2-4+, **3-4***

* Significant, + Not Significant, 1- Test without co –morbidities , 2 - Control without co –morbidities, 3- Test with co –morbidities , 4- Control with co –morbidities

Table 5 shows neutrophil function in 145 COPD patients without dyslipidemia and 5 with dyslipidemia, tested under stimulated and unstimulated conditions.NBT test: Dyslipidemia group had higher values, 51.4 ± 12.6% vs 40.00 ± 9.56%, compared to non-dyslipidemia group, 45.08 ± 9.95% vs 34.91 ± 9.92%.Phagocytosis: Stimulated counts were 3.00 ± 1.22 with dyslipidemia and 1.96 ± 0.93 without. Unstimulated counts were 4.60 ± 1.14 vs 4.38 ± 1.29.Chemotaxis: Distances were greater with dyslipidemia: stimulated 0.50 ± 0.07 mm vs 0.415 ± 0.152 mm; unstimulated 0.72 ± 0.08 mm vs 0.598 ± 0.147 mm.Candidacidal assay: Stimulated values were 17.6 ± 2.07% with dyslipidemia vs 19.10 ± 3.23% without. Unstimulated values were 38.8 ± 8.43% vs 34.98 ± 4.94%.Differences between stimulated and unstimulated states were mostly significant. Most comparisons between groups with and without dyslipidemia were not significant.

Table 6: Frequency of Hospital Admissions in COPD Patients According to Presence of Co morbidities

COPD- Co morbidities		Number of Admission					p value
		1	**2**	**3**	**4**	**5**	
Diabetes Mellitus	**Without**	19	16	2	0	0	**<0.001***
	With	17	34	47	14	1	
Hypertension	**Without**	20	9	4	0	0	**<0.001***
	With	16	41	45	14	1	
CVD	**Without**	36	38	27	4	0	**<0.001***
	With	0	12	22	10	1	
Dyslipidemia	**Without**	36	48	47	14	0	**<0.001***
	With	0	2	2	0	1	

Table 6 shows admission patterns in 150 COPD patients by comorbidity. Diabetes, hypertension, cardiovascular disease, and dyslipidemia were all associated with more frequent hospitalizations ($p < 0.001$). Non-diabetic and non-hypertensive patients mostly had 1-2 admissions, while those with these conditions commonly had 2-4 admissions. Patients with cardiovascular disease had no single admissions and mostly 2-4 stays. Dyslipidemia was seen in only 5 patients, yet they had multiple admissions, including one with 5. Overall, comorbidities significantly increased admission frequency.

Discussion

This study found the prevalence of comorbidities in COPD patients and the duration of hospitalization in COPD patients. The most common comorbities among the COPD patients includes diabetes, hypertension, cardiovascular diseases, and dyslipidemia.(12)

Divo et al. found that comorbidities play an important role in COPD patients that how affecting both

outcomes and mortality.(13) In our study, 150 COPD patients were assessed for comorbidities and found that the hypertension was the leading condition at 78.0%, with diabetes mellitus close behind at 75.4%. Cardiovascular disease was present in 30.0% of patients. Dyslipidemia was seen in only 5 patients, 3.3%. Vinay Mahishale et al. found that the prevalence of comorbidities among 2432 COPD patients and reported diabetes in 25.94%, hypertension in 37.25%, and cardiovascular disease in 13.93%..(14)

We compared neutrophil function in COPD patients with and without diabetes mellitus in this present study. In the NBT test, the percentage of stimulated cells were higher percentage than unstimulated cells in both groups($p<0.05$). For phagocytosis, the mean particles number were lower in stimulated neutrophils from diabetics ($p<0.05$), while unstimulated phagocytosis showed no significant difference. Stimulated chemotaxis was significantly reduced in diabetic patients ($p<0.05$).In the candidacidal assay, stimulated neutrophil killing was significantly lower in diabetics ($p<0.05$), with no significant difference in unstimulated conditions.

Z. Yasar et al in their study they included 140 COPD patients, 63 with metabolic syndrome, and 50 healthy controls. Neutrophil-to-Lymphocyte Ratio (NLR) was significantly higher in stable COPD patients compared to controls ($p < 0.001$). Among COPD patients, NLR was significantly elevated in those with metabolic syndrome compared to those without it ($p < 0.001$).(15) Vaidyanathan A et al observed that the NBT dye technique demonstrated altered metabolic activity in neutrophils from COPD patients. With this test, COPD patients had a significantly greater proportion of activated neutrophils than healthy volunteers (55.8% vs 18.6%).(16)

In this present study, neutrophil function in COPD patients with and without sustained hypertension was noted. In the NBT test, the percentage of stimulated neutrophil cella were higher in hypertensive COPD patients than in non-hypertensives ($p>0.05$). In phagocytosis the mean particle numbers were significantly lower in hypertensive patients compared to non-hypertensives (1.94 ± 0.97 vs 2.18 ± 0.91, $p<0.05$), though unstimulated phagocytosis showed no difference. Chemotaxis and candidacidal activity did not differ significantly between groups for both stimulated and unstimulated conditions.

In Western countries, cardiovascular disease is the second leading cause of death in COPD patients, following respiratory failure. Cardiovascular deaths account for about 20–30% of total mortality in this group, and sudden death occurs in up to 17% of men and 11% of women. Ischemic heart disease is common in COPD, though reported rates vary widely from 4.7% to 60%. In 1998, among hospitalized COPD patients, 24.4% had congestive heart failure and 14.3% had atrial fibrillation. Hypertension is the most common comorbidity among COPD patients and influences prognosis.(17)

In this study, we noted the neutrophil function in COPD patients with and without cardiovascular disease. The NBT test, stimulated cells showed higher percentages than unstimulated cells in both groups ($p<0.05$). Phagocytosis the mean particles numbers was lower in stimulated cells, while unstimulated phagocytosis was significantly higher with cardiovascular disease (4.66 ± 1.38 vs 4.27 ± 1.22, $p<0.05$). Chemotaxis was slightly reduced in the cardiovascular disease group, but the changes were not significant for either stimulated or unstimulated cells. In the candidacidal assay, stimulated killing was significantly lower with cardiovascular disease ($18.02 \pm 2.4\%$ vs $19.49 \pm 3.40\%$, $p<0.05$), while unstimulated killing showed no significant difference.

In the present study, we demonstrated neutrophil function in COPD patients with and without dyslipidemia. In the NBT test, stimulated activity was higher in the dyslipidemia group ($p>0.05$). Phagocytosis by stimulated neutrophils was significantly higher with dyslipidemia ($p<0.05$). Chemotaxis was also significantly higher in dyslipidemia. For the candidacidal assay, stimulated killing was lower in dyslipidemia, while unstimulated killing was higher.

Ghafil NY et al reported that dyslipidemia was significantly more frequent in COPD patients compared to controls, 37% versus 19% ($p=0.007$, Fisher's exact test). COPD was associated with an unadjusted odds ratio for dyslipidemia of 2.5 (95% CI 1.3, 4.8). Dyslipidemia prevalence was highest in patients with GOLD stage 4. Atherosclerotic cardiovascular disease was also significantly more common in COPD patients than controls, 31% versus 15% ($p<0.05$; OR 2.6, 95% CI 1.3, 5.1). The highest prevalence of cardiovascular disease occurred in GOLD stage 4 patients compared with other stages.(18)

The present study assessed hospital admission frequency in COPD patients with and without co-morbidities.All four comorbidities were significantly associated with more frequency of hospital admission in COPD patients($p<0.001$ for all).

Similar to our study, Ball et al reported that concurrent cardiopulmonary disease increased the risk of hospitalization. In our study, almost 50% of patients had at least one comorbidity. Cardiovascular conditions were present in 15% of patients, and 11% had two or more comorbidities.(19). Osman IM et al

reported that diabetes may be a key risk factor for COPD exacerbations that lead to extended hospital stays and are linked with more aggressive bacterial infections.(20)

Conclusion

This study examined neutrophil activity and hospital admission rates in COPD patients with and without comorbidities at a tertiary care hospital in Tamil Nadu. The Frequency of hospital admissions was higher in COPD patients with comorbidities such as diabetes, hypertension, cardiovascular disease, and dyslipidemia. These findings showed that neutrophil dysfunction is more marked in COPD patients with comorbidities contribute to increased hospitalization. Assessing neutrophil function together with comorbidity status may help in evaluating disease severity and planning management for COPD patients in Tamil Nadu.

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