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Prevalence and Severity of Chronic Obstructive Pulmonary Disease in People with Type 2 Diabetes: A Cross-Sectional Study

ABSTRACT

Objective: The aim of the study was to determine and evaluate the prevalence of chronic obstructive pulmonary disease (COPD) in patients with type 2 diabetes and the impact of diabetes on lung function and the severity of the COPD.

Materials and methods: This was a retrospective observational study conducted in a private clinic setup among 1200 patients and was performed according to the Strengthening the Reporting of Observational Studies in Epidemiology Statement (STROBE). Chronic Obstructive Lung Disease (GOLD) criteria, 2023 were used to diagnose COPD and for diabetes mellitus (DM) were executed according to the American Diabetes Association (ADA) and International Diabetes Federation (IDF) consensus statement.

Results: The prevalence of type 2 diabetes (T2D) was 27% among 1200 COPD patients. Among 335 patients with diabetes 37% had newly detected T2D. Prevalence in mild, moderate, severe, and very severe COPD among patients having documented T2D was 14.6%, 18.8%, 37%, and 29.5%, respectively. Furthermore, among diabetes patients 7.5% were having HbA1c < 7%, 63.9% were having HbA1c 7–10% and 28.6% were having HbA1c > 10%. As compared to people without diabetes (56.64 ± 3.55), in patients with diabetes (46.22 ± 4.19) there was a severe decline in lung function (mean FEV1) and it was statistically significant (p = 0.001). Comorbidities, as shown by multivariate Cox proportional hazards analysis, including hypertension (HR, 1.902; 95% CI, 1.261–2.403), dyslipidemia (HR, 1.391; 95% CI, 1.172–1.198), cerebrovascular disease (HR, 1.532; 95% CI, 1.132–2.008), coronary artery disease (HR, 1.427; 95% CI, 1.079–1.830), kidney disease (HR, 1.006, 95% CI, 0.833–1.397) and liver disease (HR, 1.083, 95% CI, 0.821–1.427) were independent clinical factors associated with T2D.

Conclusions: Chronic obstructive pulmonary disease is one of the comorbidities found in patients with T2D. A significant number of cases of new-onset diabetes are observed among patients with pre-existing COPD. Therefore, the outcome of this research advocates that targeted surveillance and management of diabetes are important in clinical care of the COPD population. (Clin Diabetol 2023; 12; 5: 308–314)

Keywords: COPD, type 2 diabetes, comorbidities, prevalence, screening

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Introduction

Chronic obstructive pulmonary disease (COPD) is a leading cause of morbidity and mortality across the globe and is characterized by progressive airflow obstruction and airflow limitation [1, 2]. Worldwide, COPD is considered the leading form of lung disease and is substantially increasing the economic and social burden, as per the Global Initiative for Chronic Obstructive Lung Disease (GOLD) 2020 report [3, 4]. From a global perspective, COPD is responsible for approximately 3 million deaths annually [5]. It has been projected that with the substantial increase in the prevalence of obesity, smoking, and ageing, COPD and related conditions will account for more than 5.4 million annual deaths in 2060 [6].

COPD is also associated with comorbidities such as diabetes, high blood pressure, etc., and their impact on health increases [7, 8]. At all stages of COPD, this comorbidity can occur and increase the risk of hospitalization and mortality [9, 10]. Therefore, the cost of treating the disease is growing exponentially [11]. There are few global studies that link diabetes to COPD and their impact on prognosis [12].

Diabetes mellitus (DM) is a clinical condition caused by a lack of insulin secretion or action. It is regarded as one of the most significant emerging health threats in the 21st century. In addition to the classical complications of the disease, COPD is more frequent and even more severe in patients with diabetes mellitus, which can increase morbidity and mortality. The increase in frequency of COPD in patients with diabetes may be because of hyperglycemic environment which favors chronic systemic inflammation and therefore affect their lung function and, in turn, their prognosis [13–17].

Due to the large growth in the incidence of both DM and COPD in India, as well as the rise in obesity, smoking, and environmental pollution, treating doctors face a significant problem. The purpose of this study is to determine the prevalence of COPD in individuals with type 2 diabetes (T2D), as well as the effects of diabetes on lung function and the severity of COPD.

Materials and methods

Study design

This is a retrospective observational study carried out in a private clinic in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement [18, 19]. About 1200 patients who participated in a COPD consultation were assessed and interviewed. In the course of the consultation and prior to the interview, each participant provided written informed consent. To diagnose COPD among participants, the questionnaire was adapted from the GOLD criteria (2023), according to which the spirometric criterion postbronchodilator value (FEV1)/ /forced vital capacity (FVC) 0.70 was taken [20]. People diagnosed with COPD were screened for DM according to the American Diabetes Association (ADA) [21] and International Diabetes Federation (IDF) consensus statement [22].

Study population/study participants

Subjects were excluded if they (1) were aged < 20 years at the time of COPD diagnosis, (2) had a diagnosis of asthma over the study period, (3) were diagnosed as having type 1 DM during the study period, (4) had a prescription of COPD-related medications for < 1 month, (5) pregnant or lactating women and (6) refused to sign written informed consent.

Ethical approval

The paper does not report on primary research. All data analyzed were collected as part of routine diagnosis and treatment. The program was not set up as a study or research project but as a treatment program; hence ethics approval was not required.

Data collection/variables

The manuscript analyses the data collected using a predesigned and standardized form from the medical records of patient visits. None of the subjects received any economic compensation. This study complies with the principles outlined in the Helsinki Declaration. Glycemic parameters and other pathological tests were carried out in a pathology laboratory accredited by the National Accreditation Board for Testing and Calibration Laboratories (NABL) for their accuracy. Based on the calculation of Epi Info Program version 7.0, the expected sample size for this study was 1200 patients, if the expected proportion of T2D patients with COPD was 60% and the confidence limit was 5%. To obtain this sample size, the significant value, α, was set at 0.05, and the desired power of the study, 1-β, was 80 %.

Statistical analysis

For all variables using percentage and frequencies descriptive statistics was performed. With the Bonferroni correction, one-way ANOVA, t-Student, Chi-Square test the differences between groups were calculated and level of significance was set at $p < 0.05$. For data analysis, the IBM software, Statistical Package for Social Sciences (SPSS), version 19.0 for Windows (SPSS Inc., Chicago, IL, USA) was used.

Table 1. Patient Demographics (n = 1200)

Parameters	People with diabetes (T2D) (n = 335)	People without diabetes (n = 865)	P
Sex (male/female)	253/82	698/167	0.34
Age [years], mean ± SD	58.8 ± 12.4	57.5 ± 10.7	
BMI [kg/m^2], mean ± SD	25.6 ± 4.2	22.8 ± 3.6	0.07
Smokers [pack-years], mean ± SD	9.5 ± 4.6	12.8 ± 3.4	0.001
Duration of COPD [years], mean±SD	7.0 ± 2.1	6.4 ± 1.9	0.005
FEV1 (percentage predicted), mean ± SD	46.2 ± 4.1	56.5 ± 3.5	0.007
HbA1c levels (mean ± SD)	8.9 ± 1.8	5.2 ± 1.3	< 0.001
Comorbidity			
Hypertension	218 (65%)	375 (43.4%)	< 0.001
Dyslipidemia	18 (5.3%)	30 (3.5%)	0.24
Cerebrovascular disease	77 (23%)	110 (12.7%)	0.01
Coronary artery disease	105 (31%)	175 (20.2%)	0.01
Kidney disease	26 (7.8%)	52 (6%)	0.23
Liver disease	23 (6.9%)	55 (6.4%)	0.78
COPD severity			
No ES or hospitalization	298 (89%)	785 (90.8%)	0.28
1 ES	24 (7.2%)	54 (6.2%)	
≥ 2 ES or hospitalization	14 (4.2%)	25 (2.9%)	

BMI — body mass index; COPD — chronic obstructive pulmonary disease; ES — epidural steroid/corticosteroid; FEV1 — forced expiratory volume; HbA1c — glycated hemoglobin; SD — standard deviation; T2D — type 2 diabetes

Results

A total of 1200 patients were assessed in this study, of whom 335 were reported with T2D and 865 were people who did not suffer from diabetes. The average age of the participants was 56.4 ± 11.6 years; the average age in patients with diabetes was 58.8 ± ± 12.4 years and the average age in people who did not suffer from diabetes was 57.58 ± 10.79 years. The average body mass index (BMI) of the participants was 23.4 ± 3.7 kg/m^2; the average age in patients with diabetes was 23.6 ± 4.2 kg/m^2 and the average age in non-diabetes patients was 22.8 ± 3.6 kg/m^2. The groups differed significantly in smoking habits, with 9.5 ± 4.6 pack-years in diabetic patients versus 12.8 ± ± 3.4 pack-years in the non-diabetic group (p = 0.001. This study showed that, as compared to people who did not suffer from diabetes (56.6 ± 3.5), in people with diabetes (46.2 ± 4.1) there was a severe decline in lung function (mean FEV1) and it was statistically significant (p = 0.001) (Tab. 1).

The prevalence of diabetes among COPD patients as evaluated in the study was 27%. Total duration of diabetes among pre-diagnosed diabetes patients was 8.0 ± 3.5 years. Among the patients with diabetes, 34% were newly diagnosed. Furthermore, among diabetes patients, 7.5% had HbA1c < 7%, 63.9% had HbA1c 7–10% and 28.6% had HbA1c > 10%. In patients who presented with severe COPD, 37% were newly diagnosed with T2D, and 29.5% had an established T2D history.

Comorbidities, as shown by multivariate Cox proportional hazards analysis. including hypertension (HR, 1.902; 95% CI, 1.261–2.403), dyslipidemia (HR, 1.391; 95% CI, 1.172–1.198), cerebrovascular disease (HR, 1.532; 95% CI, 1.132–2.008), coronary artery disease (HR, 1.427; 95% CI, 1.079–1.830), kidney disease (HR, 1.006, 95% CI, 0.833–1.397) and liver disease (HR, 1.083, 95% CI, 0.821–1.427) were independent clinical factors associated with T2D (Tab. 2).

Discussion

The study assessed the combination of diabetes and COPD in Indian patients. In India, COPD is one of the major health burden due to increasing obesity, smoking and biomes fuel exposure and, as compared to USA and Europe, the mortality due to COPD in India is fourfold higher [23]. Due to the cumulative presence of oxidative stress, weight gain, chronic inflammation, insulin resistant and dysfunction of fat metabolism, COPD is considered as one of the major risk factor for developing new onset of diabetes. The mechanism by which diabetes has adverse effects on the prognosis of COPD is likely to be multifactorial and is not fully understood. Likewise, direct exposure to hyperglycemia

Table 2. Clinical conditions associated with new-onset T2D among patients with COPD. Multivariate Cox Proportional Hazards Model (n=335)

Variables	Hazard ratio (HR)	95% confidence interval (CI)
Hypertension	1.90	1.26–2.41
Dyslipidemia	1.39	1.17–1.19
Cerebrovascular Disease	1.53	1.13–2.00
Coronary artery disease	1.42	1.07–1.83
Kidney disease	1.00	0.83–1.39
Liver disease	1.08	0.82–1.42

COPD — chronic obstructive pulmonary disease; T2D — type 2 diabetes

in DM patients results in impaired lung function [24, 25]. The impact of hyperglycemia on the respiratory system, as proven in a rat study, is characterized by structural changes in the lung tissue, increased oxidative stress and changed gas exchange [26]. Several studies have shown that inflammatory responses can be caused by hyperglycemia [27], which could lead to restrictive abnormalities in lung tissue and reduced lung function. Therefore, limiting airflow and reducing lung volumes may be considered chronic complications of uncontrolled blood glucose levels in diabetes mellitus. Hyperglycemia can directly promote impaired phagocytic function of polymorphonuclear leukocytes and support bacterial growth in the airways, which has been observed in patients with DM [28, 29]. Thus, the worse outcomes in COPD patients with DM may result from susceptibility to bacterial infection.

The prevalence of T2D in the current study was 27%. The results of this study were consistent with those of other Indian studies carried out in various regions of India. In COPD patients, Mahishale et al. [30] found the prevalence of DM to be 23.63%, whereas Ajit et al. [31] found the similar prevalence at 23.05%. It has been shown in a few previous worldwide studies that 50% of patients hospitalized with acute COPD exacerbations also had abnormal blood glucose levels [32–34].

Newly detected diabetes was found to be 37% in patients with diabetes and 10.3% of the population as a whole. These patients were unfamiliar with their blood glucose levels prior to detection. This result confirms once again that COPD allows the development of a new start of T2D. In new T2D cases, patients with COPD displayed a multivariate relative risk of 1.38 (95% CI: 1.14–1.67), as observed by Rana et al. [35]. Moreover, Feary et al. [36] showed development of new-onset diabetes in COPD patients, with a n odds ratio of 2.04 (95% CI: 1.97–2.12).

Based on recent evidence, COPD constitutes an important risk factor the development of T2D [37, 38]. In COPD patients who also had T2D, our study documented that these patients also had other clinical comorbidities such as hypertension, cerebrovascular disease, and coronary artery disease, and these patients were at high risk of developing other metabolic syndrome and cardiovascular disease [39, 40]. This process is exacerbated by increasing risk factors such as physical inactivity, systemic inflammation and smoking [41, 42]. Thus, COPD-affected patients who also have associated comorbidities such as cerebrovascular disease, hypertension and coronary artery disease are subject to the T2D incident. Several studies have also confirmed that COPD itself emerges as one of the main risk factors for the development of T2D [43]. Current guidelines for COPD do not recommend systematic screening for DM in patients with COPD [2]. Results from the current study suggest that when patients present with some warning co-morbidities, a blood glucose survey in patients with COPD should be conducted.

A statistically significant decline in FEV1 was observed in COPD patients with T2D in this study. These results also match few other results. Comparison with people who do not suffer from diabetes, in people with diabetes the third National Health and Nutrition Review Survey [44] observed a decline in lung function. It is the fact that in uncontrolled diabetes, impaired lung function is susceptible to rapid deterioration. Lower values for maximum expiratory flow (PEL), FEV1, FVC and VC were associated with comorbid diabetes in the Fremantle Diabetes Study [38]. El-Habashy et al. [45] demonstrated that, compared with healthy controls, there was a significant decrease in pulmonary function tests in patients with T2D (forced expiratory flow –25–75%, maximal voluntary ventilation, FEV1, FEV1/ /FVC%, and PEF), and further proved that in poorly controlled DM this decline was exaggerated.

For patients with T2D, cardiovascular disease is a major and significant co-morbidity. We found that the survival of patients with COPD was severely affected by co-morbid heart failure. Furthermore, because of common symptoms of shortness of breath, wheezing, coughing, COPD and heart failure (HF) can be confounded [45]. Thus, the diagnosis and management of HF in COPD required the prudence and attention of physicians. The current study also demonstrated the presence of cerebrovascular disease in patients with COPD and T2D. There was little or no documentation on its impact on COPD on the prognosis for cerebrovascular disease available.

Strengths and limitations

This was probably the first study in Eastern India to compare lung function between people with diabetes and COPD patients who did not suffer from T2D. This is one of the highlights of the study. There were a few limitations of our research. First, we did not evaluate the factors that may influence glucose levels like stress reaction and steroid administration etc., and these factors may cause acute transient hyperglycemia. Important pharmacological therapies for patients with COPD, such as much more frequent use of theophylline and fewer inhaled corticosteroid prescriptions, may affect the generalizability of our study results. Second, another limitation is observational nature of the study. Third, because of under-reporting on clinical records, the actual prevalence of certain co-morbidities may be underestimated. This study can provide a starting point for future research on the interaction of COPD with diabetes.

Conclusions

Chronic obstructive pulmonary disease is one of the comorbidities found in patients with DM. A substantial number of new cases of diabetes is observed among patients with COPD. These newly diagnosed T2D patients had no knowledge of their uncontrolled glucose status. Therefore, the results of the study recommend periodic screening for blood glucose in patients with COPD, because the clinical progression of COPD significantly affects DM. Patients with COPD who have uncontrolled blood glucose levels and who also have poor lung function may experience more severe COPD and exacerbations. We documented that in COPD survival, pre-existing diabetes and incident diabetes had an unfavorable prognostic effect. Therefore, the results of this research indicate that in clinical care of the COPD population, targeted surveillance and management of diabetes are important.

Article information

Data availability statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to restrictions e.g. their containing information that could compromise the privacy of research participants.

Ethics statement

The paper does not report on primary research. All data analysed were collected as part of routine diagnosis and treatment. The program was not set up as a study or research project but as a treatment program; hence ethics approval was not required.

Author contributions

Mridul Bera: retrieved patient's data, drafted and reviewed the paper. Rishad Ahmed: retrieved patient's data, drafted and reviewed the paper. Arjun Baidya: retrieved patient's data, drafted and reviewed the paper. Amit Gupta: retrieved patient's data, drafted and reviewed the paper. Mrinal Kanti Guha: retrieved patient's data, drafted and reviewed the paper. All authors meet the International Committee of Medical Journal Editors (ICMJE) criteria for authorship for this manuscript, take responsibility for the integrity of the work as a whole, and have given final approval for the version to be published.

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Conflict of interest

The authors declare that there is no conflict of interest.

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