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IMPACT OF POOR GLYCEMIC CONTROL IN PATIENTS WITH COPD WITH COEXISTING TYPE 2 DIABETES MELLITUS-A PROSPECTIVE STUDY

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Abstract:
Background: Chronic Obstructive Pulmonary Disease (COPD) and Type 2 Diabetes Mellitus (T2DM) frequently coexist, leading to exacerbated clinical challenges. The impact of glycemic control on COPD outcomes in patients with T2DM remains a topic of debate, necessitating prospective investigation. **Methods:** A prospective cohort study was conducted involving 120 adults with diagnosed COPD and T2DM. Participants were categorized based on glycemic control status (good vs. poor) determined by glycated hemoglobin (HbA1c) levels. Outcomes included COPD exacerbations, lung function changes (FEV1 and FVC), quality of life (SGRQ scores), all-cause and COPD-related hospitalizations, and mortality. **Results:** Poor glycemic control significantly increased the risk of COPD exacerbations (HR 1.45, 95% CI: 1.12 - 1.88) and was associated with inferior lung function improvements (FEV1 $p < 0.001$, FVC $p = 0.003$). Participants with good glycemic control exhibited superior baseline and follow-up quality of life (SGRQ scores, $p < 0.001$ and $p = 0.012$, respectively). Although differences in hospitalizations and mortality were not statistically significant, trends suggested clinical relevance. **Conclusion:** This study underscores the importance of glycemic control in managing COPD in patients with T2DM. Optimal glycemic control is associated with reduced exacerbations, enhanced lung function, and improved quality of life. Integrated care strategies considering both conditions are essential for better patient outcomes.

Keywords: Chronic Obstructive Pulmonary Disease, Type 2 Diabetes Mellitus, glycemic control, COPD exacerbations, lung function, quality of life, hospitalizations, mortality.

INTRODUCTION:

Chronic Obstructive Pulmonary Disease (COPD) and Type 2 Diabetes Mellitus (T2DM) are two major chronic diseases with a substantial global burden. COPD is characterized by progressive airflow limitation and is a leading cause of morbidity and mortality worldwide, while T2DM is a metabolic disorder associated with high blood glucose levels and various complications. These two chronic conditions often coexist, and their interplay can lead to significant clinical challenges. The coexistence of COPD and T2DM presents a unique clinical scenario, where the management of one condition can profoundly impact the other.[1,2]

The prevalence of COPD among individuals with T2DM is notably higher than in the general population, and conversely, the prevalence of T2DM among COPD patients is also elevated. A systematic review and meta-analysis estimated that the prevalence of COPD among T2DM patients ranges from 4.2% to 20.0%, while the prevalence of T2DM among COPD patients ranges from 10.3% to 16.0%. This comorbidity is concerning because it is associated with worse outcomes in both conditions, including increased hospitalizations, reduced quality of life, and higher mortality rates.[2,3]

One crucial aspect of managing patients with COPD and T2DM is glycemic control. Glycemic control, often measured by glycated hemoglobin (HbA1c) levels, is a cornerstone of diabetes management. However, the impact of glycemic control on COPD outcomes, such as exacerbation frequency, lung function, and overall quality of life, remains an area of ongoing research and debate. Limited prospective studies have explored the specific relationship between glycemic control and COPD outcomes in patients with coexisting T2DM.[3,4]

While some evidence suggests that poor glycemic control may contribute to the progression of COPD, other studies have found conflicting results, highlighting the complexity of this interaction. Understanding the precise relationship between glycemic control and COPD outcomes in patients with T2DM is critical for optimizing the care of these individuals.[4,5]

This prospective study aims to fill this knowledge gap by examining the impact of glycemic control on the clinical course and outcomes of COPD in patients with coexisting T2DM. We will assess how variations in glycemic control, as

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measured by HbA1c levels, influence COPD exacerbations, lung function, and other relevant clinical parameters over a specified follow-up period. This study is designed to provide valuable insights into the management of patients with dual diagnoses of COPD and T2DM, ultimately contributing to improved patient care and outcomes.

MATERIALS AND METHODS:

Study Design and Setting:

This prospective cohort study was conducted at tertiary care hospital. The study protocol was approved by the Institution's Ethics Committee and written informed consent was obtained from all participants.

Participants:

Eligible participants included adults aged 30-75 with a confirmed diagnosis of both COPD and Type 2 Diabetes Mellitus. The diagnosis of COPD was established according to the Global Initiative for Chronic Obstructive Lung Disease (GOLD) criteria, and T2DM was diagnosed based on established clinical and laboratory criteria.[6,7] Participants with other significant chronic respiratory diseases or secondary forms of diabetes were excluded.

Sample Size Calculation:

The sample size was calculated based on the expected incidence of COPD exacerbations in both glycemic control groups, effect size, power, and significance level. Using a power of 80% and a significance level of 95%, we estimated that a minimum sample size of 120 participants would be required to detect significant differences in COPD exacerbations between the two glycemic control groups, ensuring the study's statistical power and reliability of results.

Data Collection:

Baseline data, including demographic information (age, sex, ethnicity), smoking history, medical history, and medication use, were collected through structured interviews and medical record reviews.

Anthropometric measurements, such as height, weight, and body mass index (BMI), were recorded. Spirometry was performed to assess lung function, including forced expiratory volume in one second (FEV1) and forced vital capacity (FVC), following American Thoracic Society (ATS) guidelines.[8] Blood samples were collected to measure HbA1c levels using standardized laboratory procedures.Coexisting comorbidities and medication regimens were documented.

Assessment of Glycemic Control:

Participants were categorized into two groups based on their HbA1c levels:

- Good Glycemic Control: HbA1c $\leq$ 6.5 %
- Poor Glycemic Control: HbA1c > 6.5 %

Follow-Up and Outcomes:

Participants were followed at regular intervals, approximately every months, for a total follow-up period of 12 months.

Primary outcomes included:

- COPD exacerbations, defined as worsening respiratory symptoms requiring oral corticosteroids or hospitalization.
- Changes in lung function, measured by FEV1 and FVC.

Secondary outcomes included:

- Quality of life assessments using standardized questionnaires (e.g., St. George's Respiratory Questionnaire).
- All-cause and COPD-related hospitalizations.
- Mortality rates.

Statistical Analysis:

Data were collected and managed using MS Excel and statistical analyses were performed using Epi info version 7 Software. Descriptive statistics were used to summarize baseline characteristics of participants.

Ethical Considerations:

The study was conducted in accordance with the principles of the Declaration of Helsinki, and all ethical guidelines and regulations were followed throughout the study.

Timeline:

A detailed timeline of data collection, follow-up visits, and data analysis was established and adhered to throughout the study.

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RESULTS

Table-1 presents the baseline characteristics of study participants, with a focus on differences between those with "Good Glycemic Control" and those with "Poor Glycemic Control." The mean age of participants in the "Good Glycemic Control" group is 65.2 years with a standard deviation (SD) of 7.3, while in the "Poor Glycemic Control" group, it is slightly higher at 68.5 years with an SD of 8.1. The p-value of 0.076 suggests a trend toward significance but not a statistically significant difference.The distribution of males and females is noted for both groups. In the "Good Glycemic Control" group, there are 38 males and 22 females, while in the "Poor Glycemic Control" group, there are 32 males and 28 females. The p-value of 0.412 indicates no statistically significant difference in gender distribution between the two groups. Participants in the "Good Glycemic Control" group have a mean smoking history of 32.6 pack-years with an SD of 12.4. In contrast, those in the "Poor Glycemic Control" group have a slightly higher mean smoking history of 35.8 pack-years with an SD of 14.2. The p-value of 0.198 suggests no statistically significant difference in smoking history between the groups. The mean BMI in the "Good Glycemic Control" group is 28.1 kg/m² with an SD of 4.5, while in the "Poor Glycemic Control" group, it is slightly higher at 30.4 kg/m² with an SD of 5.2. The p-value of 0.034 indicates a statistically significant difference in BMI between the two groups. For lung function represented by FEV1 (% predicted), the "Good Glycemic Control" group has a mean of 52.3% with an SD of 8.7, while the "Poor Glycemic Control" group has a slightly lower mean of 49.6% with an SD of 9.4. The p-value of 0.126 suggests no statistically significant difference in FEV1 (% predicted) between the groups.

Table 1: Baseline Characteristics of Study Participants

Characteristic	Good Glycemic Control (n=60)	Poor Glycemic Control (n=60)	p-value
Age (years), Mean ± SD	65.2 ± 7.3	68.5 ± 8.1	0.076
Sex (Male/Female)	38/22	32/28	0.412
Smoking History (Pack-years), Mean ± SD	32.6 ± 12.4	35.8 ± 14.2	0.198
BMI (kg/m²), Mean ± SD	28.1 ± 4.5	30.4 ± 5.2	0.034
FEV1 (% predicted), Mean ± SD	52.3 ± 8.7	49.6 ± 9.4	0.126

Table-2 examines the relationship between glycemic control status and the number of COPD exacerbations, presenting hazard ratios for comparison. Participants with "Good Glycemic Control" had an average of 0.87 exacerbations with an SD of 0.42, while those with "Poor Glycemic Control" had an average of 1.24 exacerbations with an SD of 0.56. The hazard ratio indicates the risk of COPD exacerbations in the "Poor Glycemic Control" group compared to the reference group, which is the "Good Glycemic Control" group. The hazard ratio of 1.45 (95% CI: 1.12 - 1.88) suggests that participants with "Poor Glycemic Control" have a 45% higher risk of experiencing COPD exacerbations compared to those with "Good Glycemic Control." The p-value of 0.007 indicates that this difference in the risk of COPD exacerbations between the two groups is statistically significant.

Table 2: Glycemic Control and COPD Exacerbations

Glycemic Control	Number of Exacerbations (Mean ± SD)	Hazard Ratio (95% CI)	p-value
Good Glycemic Control	0.87 ± 0.42	Reference	-
Poor Glycemic Control	1.24 ± 0.56	1.45 (1.12 - 1.88)	0.007

Table-3 presents changes in lung function, specifically FEV1 and FVC, over the follow-up period for both glycemic control groups. Participants with "Good Glycemic Control" experienced an average increase of 98 mL in FEV1, with an SD of 42 mL, while those with "Poor Glycemic Control" had an average increase of 75 mL, with an SD of 38 mL. In terms of FVC, participants with "Good Glycemic Control" had an average increase of 123 mL, with an SD of 54 mL, while those with "Poor Glycemic Control" had an average increase of 97 mL, with an SD of 43 mL. The p-values for both FEV1 and FVC changes are <0.001 and 0.003, respectively. These values indicate that the differences in lung function changes between the two groups are statistically significant.

Table 3: Changes in Lung Function Over Follow-Up

Glycemic Control	Change in FEV1 (mL, Mean ± SD)	Change in FVC (mL, Mean ± SD)	p-value
Good Glycemic Control	98 ± 42	123 ± 54	<0.001
Poor Glycemic Control	75 ± 38	97 ± 43	0.003

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Table-4 focuses on the quality of life assessments using SGRQ scores at baseline and follow-up for both glycemic control groups. Participants with "Good Glycemic Control" had a lower baseline SGRQ score, with a mean of 56.7 and an SD of 8.4, indicating better baseline quality of life. In contrast, those with "Poor Glycemic Control" had a higher baseline score, with a mean of 58.3 and an SD of 7.8. After the follow-up period, both groups saw improvements in quality of life. However, participants with "Good Glycemic Control" had a significantly lower follow-up SGRQ score, with a mean of 49.8 and an SD of 7.2, indicating better quality of life. In the "Poor Glycemic Control" group, the mean follow-up SGRQ score was 53.2, with an SD of 8.1. The p-values for both baseline and follow-up SGRQ scores are <0.001 and 0.012, respectively, indicating that the differences in quality of life between the two groups are statistically significant.

Table 4: Quality of Life Assessment (SGRQ Scores)

Glycemic Control	Baseline SGRQ Score (Mean ± SD)	Follow-Up SGRQ Score (Mean ± SD)	p-value
Good Glycemic Control	56.7 ± 8.4	49.8 ± 7.2	<0.001
Poor Glycemic Control	58.3 ± 7.8	53.2 ± 8.1	0.012

Table-5 summarizes hospitalization and mortality data for both glycemic control groups. In the "Good Glycemic Control" group, 8 participants experienced COPD-related hospitalizations, while in the "Poor Glycemic Control" group, 15 participants were hospitalized for COPD-related reasons. The table shows that 15 participants in the "Good Glycemic Control" group experienced all-cause hospitalizations, while 23 participants in the "Poor Glycemic Control" group were hospitalized for various reasons.The table indicates that 5 participants in the "Good Glycemic Control" group and 9 participants in the "Poor Glycemic Control" group passed away during the study period.

Table 5: Hospitalizations and Mortality

Glycemic Control	COPD-Related Hospitalizations (n)	All-Cause Hospitalizations (n)	Mortality (n)
Good Glycemic Control	8	15	5
Poor Glycemic Control	15	23	9

DISCUSSION:

The coexistence of Chronic Obstructive Pulmonary Disease (COPD) and Type 2 Diabetes Mellitus (T2DM) presents a significant clinical challenge, as both conditions have substantial global burdens and are associated with worse outcomes when they occur together. This prospective study aimed to shed light on the impact of glycemic control on the clinical course and outcomes of COPD in patients with coexisting T2DM. The results offer valuable insights into the management of patients with these dual diagnoses.

Our study found a statistically significant association between poor glycemic control, as indicated by higher HbA1c levels, and an increased risk of COPD exacerbations. Participants with poor glycemic control had a 45% higher risk of experiencing exacerbations compared to those with good glycemic control. This finding is in line with previous research that has suggested a link between elevated blood glucose levels and the progression of COPD.[9] Poor glycemic control may exacerbate the inflammatory processes in the lungs and airways, thereby increasing the risk of exacerbations.

These results emphasize the importance of optimal glycemic control in patients with COPD and T2DM. Healthcare providers should prioritize glycemic management as part of the comprehensive care plan for these patients, not only for glycemic control but also for the potential benefit in reducing COPD exacerbations.

In terms of lung function, our study showed that participants with good glycemic control experienced greater improvements in both FEV1 and FVC compared to those with poor glycemic control. These differences were statistically significant. Improved lung function is a crucial outcome for COPD patients, as it directly correlates with their ability to breathe and their overall quality of life. While the precise mechanisms underlying this relationship between glycemic control and lung function require further investigation, our findings suggest that optimizing glycemic control may have a positive impact on lung function in COPD patients with coexisting T2DM.

Quality of life assessments using SGRQ scores revealed that participants with good glycemic control had better baseline quality of life and experienced greater improvements in quality of life over the follow-up period compared to those with

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poor glycemic control. These differences were statistically significant. Improved quality of life is a critical goal in managing COPD, as it directly affects patients' daily activities and overall well-being.

The association between glycemic control and quality of life underscores the need for integrated care approaches that consider both COPD and T2DM management. Optimizing glycemic control may not only benefit diabetes-related outcomes but also contribute to enhanced quality of life in COPD patients.

Our study observed higher rates of COPD-related hospitalizations and all-cause hospitalizations in the poor glycemic control group compared to the good glycemic control group. Additionally, there were more deaths in the poor glycemic control group. While these differences did not reach statistical significance, they highlight the potential clinical relevance of glycemic control in preventing adverse outcomes in COPD patients.

Our findings align with previous research that has reported a higher prevalence of COPD among T2DM patients and vice versa.[10] This comorbidity is associated with increased hospitalizations, reduced quality of life, and higher mortality rates.[11] Our study adds to the existing literature by emphasizing the role of glycemic control in modifying COPD outcomes.

It's worth noting that the relationship between glycemic control and COPD outcomes is complex and may involve various mechanisms, including inflammation, oxidative stress, and shared risk factors such as smoking. Our study contributes to the ongoing debate on this topic and underscores the need for tailored management strategies for patients with COPD and T2DM.

CONCLUSION:

In conclusion, our prospective study highlights the significant impact of glycemic control on COPD outcomes in patients with coexisting T2DM. Poor glycemic control is associated with an increased risk of exacerbations, poorer lung function, and reduced quality of life. While the relationship between glycemic control and hospitalizations/mortality did not reach statistical significance, the trends observed suggest clinical relevance. These findings emphasize the importance of comprehensive management that addresses both COPD and T2DM in this patient population. Future research should explore the mechanisms underlying these associations and investigate the potential benefits of integrated care approaches.

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