CORRELATION BETWEEN CARDIOVASCULAR DISEASE AND PULMONARY FUNCTION IN PATIENTS WITH TYPE 2 DIABETES MELLITUS: A LITERATURE REVIEW

Abstract

The prevalence of diabetes in India has witnessed a persistent increase over recent decades, posing a substantial public health challenge. Importantly, the American Thoracic Society European Respiratory Society (ATS/ERS) guidelines underscore the lungs as a primary target organ for diabetic complications. Among individuals with type 2 diabetes mellitus, a notable decline in pulmonary function parameters, including Forced Vital Capacity (FVC), Forced Expiratory Volume in one second (FEV1), and Peak Expiratory Flow Rate (PEFR), indicative of a dominant restrictive pattern of pulmonary dysfunction, has been observed. Simultaneously, the initial diagnosis of type 2 diabetes often reveals a high prevalence of cardiovascular complications. Nevertheless, an unexplored nexus exists between cardiovascular disease and pulmonary function in type 2 diabetes. This study addresses this critical knowledge gap by conducting a meticulous review of 18 selected articles out of 40, aiming to elucidate the potential correlation between cardiovascular disease and pulmonary function in type 2 diabetes, thus contributing valuable insights to inform patient management and improve overall care outcomes in this population.

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I. INTRODUCTION

The prevalence of diabetes in India has been steadily increase over the past few decades, making it a major public health concern (Pradeep R, 2021). Diabetes is a chronic metabolic disorder characterized by elevated blood sugar levels and can lead to serious complications if not managed properly (Mittal S et. Al, 2023, Clive R Hamlin, 1975).

Type 2 diabetes is the most common form of diabetes in India, accounting for over 90% of all cases, it is primarily a lifestyle-related disease, where the body becomes resistant to insulin the hormone that regulates blood sugar or doesn't produce enough insulin to maintain normal blood sugar levels. Risk factors for type 2 diabetes in India include obesity, sedentary lifestyle, unhealthy diets, family history, and ethnicity (Pradeep R, 2021, Fogarty et al, 2007)

The rising global prevalence of diabetes necessitates a comprehensive exploration of its potential impact on pulmonary function. Chronic hyperglycemia, linked to thickened basement membranes and microangiopathy through protein glycosylation, poses a significant threat to lung health due to their extensive vascular supply. Recognizing diabetes' well-documented adverse effects on microvasculature, it becomes evident that individuals with diabetes mellitus may face compromised pulmonary function. Consequently, extensive research is essential to fully comprehend and address these potential consequences, as emphasized by the American Thoracic Society and European Respiratory Society (ATS/ERS) guidelines, which highlight the lungs as a primary target for diabetic complications and reveal significant reductions in pulmonary parameters in type 2 diabetes mellitus. However, uncovering the precise pathophysiological mechanisms behind decreased pulmonary function in diabetes warrants further investigation, incorporating larger and more diverse populations and advanced research techniques (ATS/ERS 2022).

Multiple studies have shown a high prevalence of cardiovascular complications at the initial diagnosis of type 2 diabetes (ATS/ERS 2022). These complications, such as hypertension, altherosclerosis and heart disease, can occur even before the formal diagnosis, highlighting the importance of early detection and comprehensive management strategies to minimize cardiovascular risks in diabetic patient (Stratton et al. 2000).

Cardiovascular disease (CVD) is a leading global health concern, causing significant healthcare costs and straining healthcare systems. Modifiable risk factors such as high cholesterol, hypertension, obesity, smoking, inactivity, and diabetes contribute to CVD, but lifestyle changes and effective management of these factors can reduce the risk. Pulmonary function tests (PFTs) play a crucial role in diagnosing and monitoring respiratory conditions by assessing various aspects of lung function. In this study, researchers used the QRISK3 score, a sophisticated risk assessment tool, to evaluate participants' 10-year risk of developing specific health conditions, providing insights into both absolute and relative cardiovascular risks.

II. METHODOLOGY

1. **Search Strategy:** A comprehensive search of relevant literature was conducted using electronic databases such as PubMed, MEDLINE, Scopus, and Web of Science.

Keywords and phrases were included "Type 2 Diabetes Mellitus," "cardiovascular disease," "Pulmonary Function," "Correlation," "Mechanisms," and related terms. Boolean operators (AND, OR) were used to combine keywords appropriately.

2. **Inclusion and Exclusion Criteria:** Criteria for Inclusion

- Studies that are published in peer-reviewed academic journals.
- Studies focusing on the correlation between cardiovascular disease and pulmonary function in patients with Type 2 Diabetes Mellitus.
- Studies published in English.
- Studies conducted on human subjects.

3. **Criteria for Exclusion**

- Opinion, and conference abstracts.
- Studies that do not directly address the correlation between cardiovascular disease and pulmonary function.
- Studies conducted on animal models or non-human subjects.
- Non-English studies.

The identified articles went through a two-stage selection process: firstly, titles and abstracts were screened for relevance to the research question, and secondly, full-text articles were assessed based on inclusion and exclusion criteria. For the selected articles, data will be extracted using a standardized form, covering study design, sample size, participant details, methods used for assessing cardiovascular disease and pulmonary function, key correlation findings, and explored mechanisms.

III. PREVALENCE OF DIABETES MELLITUS IN INDIA

Diabetes has emerged as a significant global health crisis in the current century, securing a place among the top 10 primary contributors to mortality alongside cardiovascular disease (CVD), respiratory disorders, and cancer. Over the observed period from 2009 to 2019, the prevalence of diabetes in India has undergone an escalation from 7.1% to 8.9%. At present, the estimated number of adults affected by impaired glucose tolerance (IGT) stands at 25.2 million, a figure projected to elevate to 35.7 million by the year 2045. In the worldwide landscape of diabetes incidence, India holds the second position, trailing only China, with a significant diabetic population of 77 million individuals.

Variations in Pulmonary Function: Type 2 Diabetes Mellitus vs. Non-Diabetic Individuals: The ratio of Forced Expiratory Volume in one second to Forced Vital Capacity (FEV1/FVC %) exhibited a notable increase among individuals diagnosed with type 2 diabetes in comparison to the control group. This observed rise was established to possess statistical significance. The elevated FEV1/FVC % values pointedly indicated that the compromised pulmonary functions among type 2 diabetics predominantly exhibited a character of restriction. This pattern aligns with findings from a separate study, wherein the ratio was identified to experience a statistically significant increment of 1.5% in diabetic subjects.

IV. PULMONARY FUNCTION IN TYPE 1 AND TYPE 2 DIABETES MELLITUS: INSIGHTS FROM CLINICAL STUDIES

Three studies were conducted to explore the connection between lung function and diabetes. The first study, titled "Associations of Lung Function Measures with Insulin Resistance and Type 2 Diabetes" by D. A. Lawlor, S. Ebrahim, and G. Davey Smith, discovered an inverse relationship between lung function measures and insulin resistance and Type 2 diabetes, possibly influenced by childhood exposures affecting lung growth.

The second study, "Pulmonary Function in Patients with Diabetes Mellitus" by CARLOS A. BENBASSAT, MD; ERVIN STERN, MD; MORDECHAI KRAMER, MD; JOSEPH LEBZELTER, PHD; ILANA BLUM, MD; and GERSHON FINK, MD, suggested that routine pulmonary function screening for diabetic patients might not be necessary, as spirometric values remained largely unaffected, although impaired physical performance might be related to cardiovascular factors.

In contrast, the third study, "Effect of Glycemic Status on Lung Function Tests in Type 2 Diabetes Mellitus" by S N Naithok Jamatia, Kanan Wangkheimayum, W Asoka Singh, and Govindaraj Yumnam, indicated a significant correlation between glycemic status and impaired lung function, particularly in the form of a restrictive pattern. This study emphasized the need for further research to understand the underlying pathophysiological mechanisms.

V. CARDIOVASCULAR RISK IN TYPE 2 DIABETES MELLITUS

The relationship between type 2 diabetes and cardiovascular disease (CVD) risk is well-established, with diabetes serving as a significant risk factor for the development of CVD. This risk is attributed to various factors, including insulin resistance, chronic hyperglycaemia, dyslipidaemia, systemic inflammation, and endothelial dysfunction. These mechanisms collectively contribute to the progression of atherosclerosis, thereby increasing the likelihood of coronary artery disease, myocardial infarction, and stroke. Understanding these complex connections is essential for designing targeted interventions to mitigate CVD risk in individuals with type 2 diabetes.

VI. RESULTS

The outcomes of this comprehensive review underscore several significant trends in the context of pulmonary function among individuals with type 2 diabetes. Remarkably, various measurements within the spectrum of pulmonary function tests exhibited noticeable declines in this cohort, with the exception of the FEV1/FVC ratio. Particularly noteworthy were the substantial decreases observed in parameters such as forced vital capacity (FVC), forced expiratory volume in one second (FEV1), and maximal voluntary ventilation (MVV). These findings illuminate the potential impairment in lung capacity and respiratory efficiency associated with type 2 diabetes.

It is crucial to emphasize that individuals recently diagnosed with type 2 diabetes face heightened susceptibility to cardiovascular complications and elevated mortality rates when compared to those without diabetes. However, it's noteworthy that, to date, no scientific

investigation has specifically elucidated the correlation between cardiovascular disease risk and pulmonary function in the context of type 2 diabetes mellitus patients. The scarcity of such studies underscores the need for further research to bridge this critical knowledge gap and provide a comprehensive understanding of the intricate interplay between pulmonary function and cardiovascular risk within this patient population.

VII. DISCUSSION

The findings from this study provide valuable insights into the relationship between pulmonary function and type 2 diabetes mellitus (T2DM). A notable decline in the majority of parameters within pulmonary function tests was observed among subjects with T2DM, with the exception of the FEV1/FVC ratio, which exhibited a significant increase. Particularly substantial reductions were evident in the values of forced vital capacity (FVC), forced expiratory volume in one second (FEV1), and maximal voluntary ventilation (MVV). Furthermore, it is worth noting that although slow vital capacity (SVC) displayed a decline in diabetic subjects, this decline did not reach statistical significance.

The current study's findings align with earlier research that also reported diminished vital capacity and a restrictive pattern among individuals with T2DM. Notably, recent investigations by Swati Mittal et al concluded similar outcomes, demonstrating significantly lower values of FVC, FEV1, and FEF25-75%. Additionally, the work by Irene M. Stratton et al highlighted an increased incidence rate for microvascular endpoints associated with rising glycaemia, surpassing the rate of increase in myocardial infarction incidence.

These observations are consistent with Samit Ghosal et al's study, revealing a pronounced 10-year cardiovascular disease (CVD) risk among T2DM patients. Similarly, Wendy A. Davis et al's Fremantle Diabetes Study underscored a decline in FVC, FEV1, vital capacity (VC), and peak expiratory flow (PEF) in patients with T2DM.

The congruence between the findings of this study and the aforementioned research underscores the consistent association between T2DM and compromised pulmonary function, particularly in measures of lung volume. The increased FEV1/FVC ratio in T2DM subjects warrants further investigation, potentially indicating an adaptive response or underlying pathophysiological mechanisms. These findings collectively emphasize the importance of closely monitoring pulmonary function in individuals with T2DM, as it may offer insights into their overall health status and susceptibility to cardiovascular complications.

VIII. CONCLUSION

The study's findings reveal that the lungs should be considered as a key target for complications in diabetes, just like other small and large blood vessel issues. People with type 2 diabetes experienced notable decreases in lung measures like FVC, FEV1, FEF 25-75%, and MVV. They showed a specific pattern of lung trouble called "restrictive," where their lungs didn't work as well as in healthy individuals. The exact reasons behind these lung issues in diabetes are still being explored, and it would be helpful to do more studies with bigger groups of people using advanced techniques. This could help us understand lung problems as a lasting effect of diabetes. Our review did not identify any studies that have

investigated the correlation between risks of cardiovascular disease and pulmonary function in individuals with type 2 diabetes mellitus.

IX. LIMITATION AND FUTURE RECOMMADATIONS

Diabetes Mellitus is a widely prevalent disease. Till date there is scarce of literature available on the association between cardiovascular disease and pulmonary function. Further studies with large sample and clinical trials are recommended to establish the evidence.

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