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ENHANCING CHRONIC OBSTRUCTIVE PULMONARY DISEASE MANAGEMENT THROUGH OPTIMIZED PEAK INSPIRATORY FLOW RATE AND INHALER STRATEGIES: LITERATURE REVIEW

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Chronic Obstructive Pulmonary Disease (COPD) is a prevalent and progressive respiratory condition that significantly impacts the quality of life of affected individuals. The management of COPD, particularly through bronchodilator inhalers, is critical for controlling symptoms and improving lung function. This literature review aims to explore various facets of COPD management, with a focus on Peak Inspiratory Flow Rate (PIFR) and the efficacy of Dry Powder Inhalers (DPIs). The key points derived from the review are as follows:

The review was designed to address three primary questions related to COPD management: the relationship between suboptimal PIFR and lung function, the modifiability of PIFR, and the impact of a preliminary dose of pressurized Metered Dose Inhalers (pMDI) on the efficacy of DPIs and lung function.

Suboptimal PIFR in COPD patients can adversely affect the progression of the disease and the outcomes of treatment. Addressing suboptimal PIFR through personalized inhaler selection and patient education is crucial for improving disease management and treatment effectiveness.

Administering a preliminary dose of pMDI can enhance the effectiveness of DPIs in COPD patients with suboptimal PIFR.

Conclusion and Future Directions: The review concludes that further research is needed to explore the potential benefits of addressing suboptimal PIFR and the role of preliminary pMDI doses in improving DPI efficacy.

This literature review underscores the importance of comprehensive assessments and tailored treatment approaches in managing COPD, particularly for patients with suboptimal PIFR. It highlights the need for ongoing research to optimize inhaler therapy and improve patient outcomes.

Keywords: *Chronic Obstructive Pulmonary Disease; Peak Inspiratory Flow Rate; Dry Powder Inhaler; Preliminary Dose*

INTRODUCTION

Chronic Obstructive Pulmonary Disease (COPD) is a distinctive respiratory condition defined by airflow limitation that is not totally reversible. It includes chronic bronchitis and emphysema[2]. COPD is currently one of the most serious global health issues, affecting the lives of many individuals worldwide[3]. It is a degenerative respiratory condition defined by persistent airflow restriction, which results in a range of respiratory symptoms and a reduced quality of life for affected individuals. The economic cost of COPD is increased significantly by recurrent hospital admissions for exacerbations[4]. COPD can be complicated to diagnose because of its prolonged onset, typically necessitating coordination between

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general practitioners and pulmonologists for correct identification[5]. Exacerbations, which have a considerable impact on patients' quality of life and healthcare costs, add to the disease's complexity. Severe exacerbations necessitate hospitalization [6].

Objective of the review

Our review focused on the prevalence of COPD, factors affecting the progression of the disease, and treatment options especially inhaler bronchodilator and peak inspiratory flow (PIFR) requirements. It was mainly designed to answer three important questions: Is there a relationship between suboptimal PIFR and lung function and what is the impact of suboptimal PIFR on the progression of the disease and the outcomes of treatment in patients with COPD? Is PIFR modifiable or not? And for COPD patients with suboptimal PIFR; does the preliminary dose of pMDI affect the efficacy of DPI and lung function?

A comprehensive search was conducted across several databases, including MEDLINE (PubMed), EMBASE, GOOGLE Scholar, ScienceDirect (Elsevier), and the Cochrane Library, covering literature from January 2017 to 2024. The inclusion criteria focused on controlled trials, cohort studies, and case-control studies that provided data on COPD patients using bronchodilator inhalers, especially DPIs, and evaluated lung function and exacerbation status.

Factors affecting the progression of COPD

COPD development is heavily influenced by both genetic and environmental factors. Genetic variations related to lung function and COPD risk underline the importance of genetic determinants in disease pathogenesis, demonstrating that COPD-causing derangements may occur during lung development [7]. Environmental exposures, such as cigarette smoking and indoor biomass smoke, are substantial risk factors for COPD, with biomass smoke exposure linking to a unique phenotype of the illness characterized by slower lung function decrease and more airway involvement [8, 9]. Smoking is the greatest risk factor for COPD, which is mostly caused by exposure to noxious particles and gases [10, 11]. Maternal smoking during pregnancy can also increase COPD risk through epigenetic changes, indicating a possible prenatal genesis of the disease[12]. In addition, metabolic syndrome has been linked to an increased risk of COPD, regardless of genetic susceptibility, underscoring the complex nature of COPD development [13]. The development and progression of COPD are also greatly influenced by occupational exposure to vapors, gases, dusts, and fumes, especially in industries such as mining, metalworking, and textiles[10, 14]. Furthermore, there is a significant danger associated with using biomass fuels for cooking and heating in a family, especially in rural and suburban regions. This risk is especially present for women who do not smoke[14]. Inflammation, increased mucus secretion, and bronchial epithelial lesions are all part of the pathophysiology of COPD, which results in irreversible airflow limitation[15].

COPD treatment options

COPD presents as a multifaceted ailment necessitating a range of therapeutic interventions designed to address symptomatology, minimize exacerbations, and enhance overall quality of life. Standard therapies consist of inhaled corticosteroids (ICS), long-acting muscarinic antagonists (LAMAs), and long-acting beta2-agonists (LABAs), all of which serve to mitigate symptoms and enhance pulmonary function[16, 17]. During episodes of acute exacerbations of COPD, it is typical to employ short-acting bronchodilators and systemic corticosteroids for symptom control and to lessen the requirement for invasive mechanical ventilation[18]. In instances of heightened severity, supplementary pharmacological interventions like inhaled anesthetic agents, ketamine, intravenous methylxanthines, and magnesium may be utilized within the confines of intensive care environments[18]. Non-pharmacological approaches are essential contributors, encompassing pulmonary rehabilitation, chronic noninvasive ventilation, and surgical or endoscopic lung volume reduction strategies. These interventions have the potential to notably improve the functional capacity and quality of life in individuals [19]. Novel therapies aimed at distinct phenotypes and endotypes of COPD, including interventions that focus on oxidative stress and

inflammation, are currently being researched and demonstrate the potential to impede the advancement of the disease [17]. Despite the implementation of these interventions, the advancement of COPD poses a persistent challenge, thus prompting the need to examine innovative treatment approaches. Current research efforts are focused on the evaluation of modern bronchoscopic interventions aimed at managing chronic bronchitis and recurrent exacerbations, both of which exert a substantial influence on the evolution of the disease and the associated economic burden[20]. Despite these advancements, it is imperative to note that the prognosis for COPD continues to pose significant challenges. Furthermore, continuous research efforts are essential to generate more efficient treatments capable of altering the progression of the disease and enhancing long-term results [18]. Drug therapy for COPD management primarily relies on management inhaler drugs to minimize symptom load and the frequency of exacerbations[21]. Inhaled medications have higher pulmonary bioavailability, lower dosage requirements, and less systemic side effects than oral or injectable treatments. However, inhaled medication delivery and dose-mixing systems significantly impact the deposition of inhaled medications in the lungs [22]. Pressurized metered dose inhalers (pMDIs) and dry powder inhalers (DPIs) are among the most often used inhaler devices to give aerosolized drugs, which are the backbone in the treatment of COPD [23]. pMDIs, one of the most prevalent types of delivery devices, provide regular and dependable doses by pressured distribution, but require patient coordination to reduce oro-pharyngeal deposition and associated systemic side effects, as well as correct preparation before use [21]. **Table** 1 summarizes the advantages and disadvantages of commonly used inhaler devices (pMDIs and DPIs)[24].

PIFR in COPD

Because DPIs are breath-actuated, using pMDIs requires less hand-breath coordination. DPIs are a popular medication-delivery device for various respiratory disorders, though they can be more expensive than regular pMDIs or nebulized treatments. DPIs require breath actuation for successful medicine administration, hence they can be tough to use, with only around half of patients displaying good inhaler technique [25] Yet, DPIs need a PIFR to conquer the device's unique internal resistance and disperse the medication powder properly. The capacity to sustain an optimal PIFR is a significant necessity to effective DPI use [21]. They heavily rely on the patient's inspiratory effort and inhalation technique. Each DPI has its own optimal PIFR, which ranges from 30 L/min for high-resistance inhalers to 65 L/min for low-resistance devices [4]. Each DPI has an internal resistance that requires a turbulent inspiratory force to take the drug from the inhaler device, disaggregate it from the carrier, and de-aggregate it into more fine particles **(Fig. 1)**. Establishing a PIFR relies on the patient's respiratory muscle strength and amount of effort, which may be reduced in patients with COPD due to acute exacerbation, lung hyperinflation, hypoxemia, and/or muscle wasting [26]. To utilize DPIs effectively, patients must produce a level of inspiratory effort proportional to the internal resistance of the inhaler, providing the necessary power for dose emission and de-aggregation of the inhalation powder to produce particles of a suitable size for deposition within the lower respiratory tract[27]. The optimal PIFR a patient should produce for dispensing the medicine from its carrier varies by DPI. A PIFR below the optimal PIFR threshold, and hence called suboptimal PIFR has recently been related to poorer health status in COPD patients[28]. Effective inhaler use is dependent on a complicated set of criteria, including adequate inhaler preparation, effective inhalation maneuver, and medication adherence. A good inhalation maneuver includes the ability to achieve sufficient PIFR, which is especially important in patients who are utilizing DPIs. Effective inhaler use is dependent on a complicated set of criteria, including adequate inhaler preparation, effective inhalation maneuver, and medication adherence. A good inhalation maneuver includes the ability to achieve sufficient PIFR, which is especially important in patients who are utilizing DPIs [29]. PIFR is the highest possible flow achieved during a forced inspiratory maneuver, whether with or without resistance. It is proportional to the maximal inspiratory pressure, which is frequently measured without resistance during normal

spirometry [21]. Each inhaler device requires a unique PIFR to achieve deep medication delivery into the lower respiratory tract while preventing early deposition of the effective dose. It was repeatedly recommended that the patient's capacity to generate an appropriate PIFR with an inhaler device should be taken into consideration when selecting an inhaler device on a prescription [30].

Table 1: Advantages and disadvantages of commonly used inhaler-devices (pMDIs and DPIs)[24].

Inhaler device	Advantage	Disadvantage
pMDIs	• Compact and portable • Multi-dose device • Delivered dose and particle size are Independent of inhalation maneuver • Less expensive than other inhaler-devices • Quick and easy to use • Available for most drugs • Suitable for emergencies	• Coordination of inspiration with actuation • Propellant use • High oro-pharyngeal deposition (without a spacer) • Not suitable for young children (without a spacer) • Shaking well is needed before each inhalation • No dose counter to assess the remaining doses • Needs priming if not used within a specified time
DPIs	• Less coordination needed • Small and portable • Breath-actuated • Short treatment time • Available for most drugs	• Moderate to high inspiratory flow is needed • Proper dose preparation/loading is needed to achieve optimal therapy • Not suitable for young children • May not be suitable for emergencies • Partially sensitive to humidity

- Abbreviations: DPIs, dry powder inhalers; pMDIs, pressurized metered-dose inhalers.

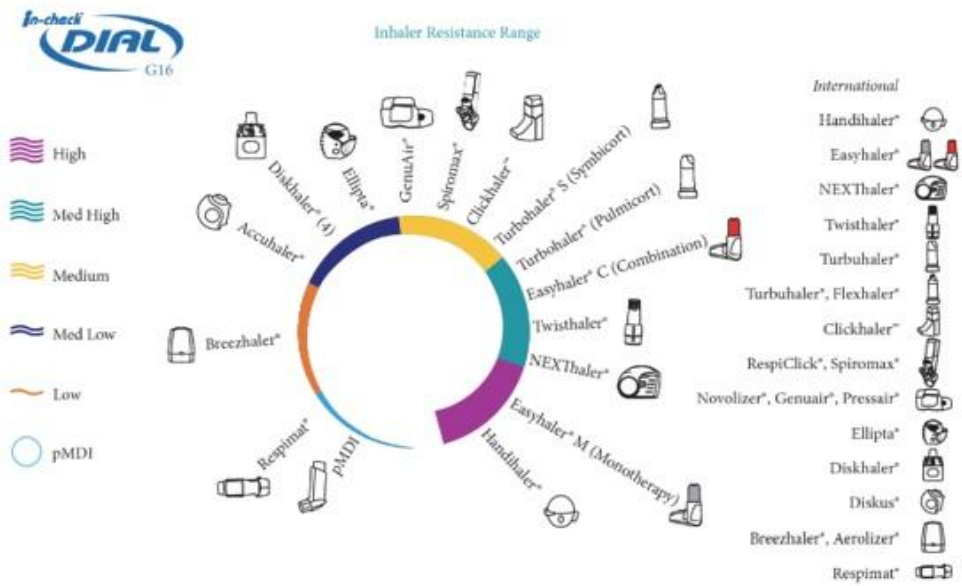

Fig. 1: Different inhalers' resistance ranges [1].

PIFR can be measured using many methods, such as the In-Check™ DIAL device or flow volume measurements. In previous trials, various investigators employed the In-Check DIAL device to evaluate PIFR [26]. The In-Check Dial® G16 (Clement Clarke International Limited, UK) **(Fig. 2)** is a handheld device with an adjustable dial that simulates the resistance of various inhaler devices. It measures flows from 15 to 120 L/min with an accuracy of ± 10% or 10 L/min, whichever is larger [1]. Based on each inhaler's PIFR match or mismatch with inhaler resistance, COPD patients can be classified as either optimal or suboptimal. However, because COPD patients are typically elderly, several factors may make it difficult for them to use an inhaler correctly. These factors include muscle wasting, hypoxemia, and weak respiratory muscles caused by lung hyperinflation, which are common in advanced COPD patients and are the main cause of suboptimal PIFR [4]. Optimal PIFR was regarded as the primary prerequisite for successful inhalation treatment. It greatly differs based on the inhaler-device resistance [30]. A PIFR of 60 L/min is generally considered ideal for most devices. However, PIFR levels >60 L/min may be related to extremely turbulent flow and thus poor lung deposition [21]. The effectiveness of each device relies on the patient's ability to generate enough PIFR to break up drug particles into less than 5 μg [30]. Each DPI has a distinctive resistance and molecules, as well as a unique optimal PIFR. As a result, the appropriateness of the PIFR range of 30-60 L/min remains controversial. Suboptimal PIFR, which is below the device's minimal threshold, may result in insufficient drug disaggregation and distal airway drug deposition [21]. PIFR has been demonstrated to have a proportional impact on drug administration for DPIs, with higher PIFR values resulting in increased drug deposition, which may lead to improved health outcomes. Harb and colleagues discovered that suboptimal PIFR readings were associated with a higher rate of GOLD D categorization and a higher symptom load[4]. Suboptimal PIFR levels are expected to develop in approximately 40-50% of COPD patients, while true prevalence rates vary widely. For patients with suboptimal PIFR, using a more typical pMDI with a spacer or a nebulized solution may result in higher drug deposition in the lungs and improved health outcomes. In clinical practice, measurement of PIFR values is not always possible; hence, inhaler selection must be determined through consideration of easily available patient and agent-related characteristics[25]. An example of this can be seen in a retrospective cohort investigation wherein it was observed that 56.9% of COPD patients who were hospitalized exhibited diminished PIF when faced with medium-low resistance (R-2). This occurrence was linked to a rise in the utilization of healthcare resources (HRU), leading to an increase in both hospital admission rates and the number of days spent in the intensive care unit (ICU) [31]. Likewise, a prospective observational investigation revealed that 38.8% of individuals receiving outpatient care for moderate to extremely severe COPD exhibited inadequate PIF, a factor associated with a decreased duration until the occurrence of the initial exacerbation and an increased level of symptomatic distress [32]. The efficacy of DPIs, characterized by their breath-actuation mechanism, is contingent upon the patient's capacity to produce adequate inspiratory flow. Insufficient PIF may lead to unsatisfactory administration of medication, as evidenced in research investigating the ELLIPTA DPI, where almost all participants attained a PIF of ≥30 L/min, guaranteeing efficient delivery of the prescribed dose and uniform therapeutic results irrespective of PIF fluctuations [27]. Nevertheless, the absence of standardized protocols for quantifying PIF presents challenges in evaluating and contrasting PIF levels in various research and medical environments. An examination underscored the necessity of uniform PIF evaluation methods to guarantee precise and dependable results, which are essential for enhancing the utilization of DPIs in managing COPD [33]. Moreover, PIF serves not only as an indicator of inhaler effectiveness but also exhibits a relationship with more extensive health results.

Fig. 2: In-Check™ Dial G16 attached to a one-way disposable mouthpiece [1]

To illustrate, an elevated peak expiratory flow, a closely related metric, demonstrated a connection with decreased probabilities of heart failure, cardiovascular mortality, and overall mortality in a significant study group, indicating that enhanced pulmonary function in general can result in better health consequences [34]. Additionally, the occurrence of expiratory flow limitation (EFL), which is linked to PIF, was observed to be prevalent and consistent among severely symptomatic COPD patients. This underscores the significance of controlling inspiratory flow to enhance quality of life and alleviate the burden of the disease [35]. Finally, the occurrence of dynamic hyperinflation, noted for its effects on both exercise performance and dyspnea, is closely connected to inspiratory flow parameters, thus underscoring the intricate nature of the impact of PIF on the management of COPD[36]. As a result, the PIFR correlated to DPI is a crucial factor to consider when selecting an inhaler for COPD patients. For example, patients with muscle weakness, short stature, or severe to extremely severe airflow limitation may have a restricted ability to create larger inspiratory flows. A minimum PIFR of at least 30 L/min and 20 L/min is suggested for Diskus® and HandiHaler®, respectively, for the patient to activate the DPI and inhale the fine drug particles into the lungs; while a PIFR of at least 60 L/min, 30 L/min, or 40 L/min is considered optimal for Diskus and HandiHaler, respectively [26].

The resistance rating of inhalers significantly influences the clinical outcomes for patients with COPD. Studies indicate that inhaler resistance affects particle deposition in the airways, with higher resistance leading to altered flow dynamics and reduced therapeutic efficacy of inhaled medications [37]. For instance, low-resistance inhalers, such as the Soft Mist Inhaler (SMI), have demonstrated superior pulmonary deposition compared to pMDIs, particularly in stable COPD patients, suggesting that inhaler choice can enhance drug delivery and clinical effectiveness [38]. Furthermore, optimal PIFR are crucial for effective drug delivery; patients using low-resistance inhalers exhibited a higher proportion of optimal PIFRs, which correlates with better medication adherence and outcomes[39, 40]. Therefore, selecting inhalers with appropriate resistance ratings is essential for optimizing treatment in COPD patients, particularly those with multimorbid conditions [41]. **Table** 2 summarizes the exact minimal and optimal PIFRs required for common DPIs as concluded by the main publications regarding PIFRs for different inhaler devices when measured with the specific inhaler-device resistance range [42]. Studies have shown that hospitalized palliative-care patients with advanced COPD can meet the minimal PIFR requirement, with a mean PIFR of 72.5 L/min, although only 51.4% could achieve the optimal PIFR of 60 L/min [25]. Kocks et al. found that 29% of COPD patients had suboptimal PIFR, which was associated with poorer health status, although adherence to the inhalation technique did not significantly affect exacerbation rates[43].

In essence, PIFR plays a crucial role in the management of COPD, influencing the administration of medications, frequency of

exacerbations, and general health results, highlighting the need for uniform assessment methods and specific strategies to enhance patient management. Various factors have an impact on PIFR, such as individual patient attributes, the severity of the disease, and particular medical treatments. Advanced age emerges as a crucial factor, as elderly individuals frequently demonstrate reduced PIFR levels attributable to declining muscle mass and pulmonary function [39, 44]. Gender, in addition, exerts an influence, as females typically exhibit decreased PIFR in contrast to males, a phenomenon that could be linked to variations in pulmonary capacity and muscular power [21, 44, 45]. Height is an additional significant variable since individuals of lesser stature typically exhibit diminished PIFR, possibly attributable to diminished lung capacities and airway measurements [21, 27, 44]. Moreover, there exists a positive correlation between handgrip strength and inspiratory muscle strength with higher PIFR, suggesting that the overall muscle strength plays a significant role in influencing the capacity to produce sufficient inspiratory flow[44]. Zhang et al. explored the genetic underpinnings of BMI and its association with COPD mortality, suggesting that patients with discordantly low BMI have higher mortality risks, potentially due to compromised respiratory muscle function affecting PIF[46]. The presence of comorbidities such as cardiovascular diseases and diabetes may have a detrimental impact on PIFR, potentially attributed to their effects on general health and pulmonary function. In COPD, lung hyperinflation, a prevalent characteristic, is linked to reduced PIFR due to its constraining effect on the capability to generate adequate inspiratory force[44]. The severity of a disease, assessed through indicators such as peak expiratory flow (PEF) and dynamic hyperinflation, exhibits an inverse relationship with PIFR, indicating that a more advanced stage of COPD is associated with a decreased PIFR[39, 44, 45]. Interventions such as education, counseling, and inspiratory muscle training have demonstrated efficacy in enhancing PIFR, underscoring the significance of patient education and physical conditioning in the management of COPD[44]. Conversely, compromised physical functionality and inaccuracies in inhalation methodology have been linked to suboptimal PIFR, thus underscoring the necessity for appropriate inhaler technique instruction [44]. Regular assessment of PIFR in relation to the particular resistance of DPIs is advised in order to guarantee the most efficient functioning of the inhaler since inadequate PIFR (whether too little or too much) can have a notable impact on the administration of medication and patient outcomes [39]. In the clinical practice setting, the measurement of PIFR is commonly restricted by temporal and equipment limitations, emphasizing the importance of considering these influential factors when prescribing inhalers[44]. Recent research has shown a considerable incidence of PIFR discordance in a significant number of patients diagnosed with COPD, particularly noticeable in females and individuals of shorter stature[21, 45]. Hence, an individualized strategy for prescribing inhalers, taking into account these specific patient and disease attributes, is essential for enhancing the management of COPD and enhancing patient results [21, 39, 44, 45].

Table 2: Minimal and optimal PIFRs (l/min) required for common DPIs**.**

Device	Resistance rating	Minimal PIFR (L/min)	Optimal PIFR (L/min)
Aerolizer®	R1	40	65
Breezhaler®	R1	50	50
Ellipta®	R2	30	60
Diskus®	R2	30	60
Turbohaler®	R3	30	60
GenuAir®	R3	40	45
Novolizer®	R3	35	50
Nexthaler®	R4	35	35
Easyhaler®	R5	30	30
Handihaler®	R5	20	30

- Abbreviations: R1, low resistance; R2, low–medium resistance; R3, medium resistance; R4, medium high resistance; R5, high resistance.

Relationship between suboptimal PIFR and lung function:

The correlation between suboptimal PIFR and Forced Expiratory Volume in one second (FEV_1) has a notable impact on the progression of the disease and the outcomes of treatment in patients with COPD. In COPD patients, the presence of suboptimal PIFR, characterized by a PIFR below the necessary threshold for optimal drug administration through DPIs, is common and is linked to unfavorable clinical results. Research indicates that suboptimal PIFR results in a considerable reduction in drug delivery and a slightly diminished pulmonary function response following bronchodilation in comparison to optimal PIFR, thereby potentially impeding the effective management of the disease [30]. Furthermore, suboptimal PIFR has been associated with an elevated symptom load, reduced duration to initial exacerbation, and heightened mortality rates, although the latter may not consistently demonstrate statistical significance [32].

The relationship between FEV_1 and PIFR exhibits a low level of correlation, suggesting that FEV_1 in isolation may not serve as a dependable indicator of a patient's capacity to produce an adequate PIFR for the utilization of DPIs [47]. This modest correlation indicates that individuals with advanced COPD (FEV_1 < 50% predicted) might be able to achieve adequate PIFR, even if not consistently[47]. Moreover, suboptimal PIFR and errors in inhalation techniques have been linked to increased healthcare resource utilization (HCRU) and expenses, underscoring the financial impact of insufficient inhalation therapy [28]. Additionally, the annual reduction in FEV_1 is markedly impacted by variables like smoking habits, pneumonia, and asthma, which have the potential to worsen the advancement of COPD and create challenges in treatment effectiveness[48]. Utilizing PIFR measurements to optimize inhalation therapy and delivering educational interventions on correct inhaler usage have shown potential in mitigating initial treatment ineffectiveness and enhancing patient outcomes, as indicated by research that centers on PIFR-based strategies[49]. Hence, the importance of addressing suboptimal PIFR by employing personalized inhaler selection and patient education cannot be overstated in enhancing the management of disease progression and treatment efficacy among individuals with COPD. This underscores the significance of conducting thorough evaluations and devising customized treatment strategies.

Impact of preliminary dose of pMDI in COPD patients with suboptimal PIFR:

The impact of using a preliminary dose of pMDI on the efficacy of DPIs in COPD patients with suboptimal PIFR is multifaceted and significant. COPD patients often struggle with suboptimal PIFR, which is crucial for the effective use of DPIs, as these devices require sufficient inspiratory effort to ensure optimal drug delivery to the lungs [39, 50]. Studies have shown that a significant proportion of individuals with COPD, especially those aged 75 and over, exhibit suboptimal PIFRs, leading to suboptimal administration of inhaled medications and inadequate disease management[39]. The use of a preliminary bronchodilator dose via pMDI can enhance the efficacy of subsequent DPI use by improving lung function and inspiratory capacity. For instance, a study demonstrated that administering a preliminary dose of salbutamol via pMDI before nebulization significantly increased the effective lung dose of the nebulized drug, suggesting a similar potential benefit for DPI use [51]. This approach can be particularly beneficial for patients with severe-to-very severe COPD and low PIF, as it may help them achieve the necessary inspiratory flow rates for effective DPI use[52]. Additionally, the environmental impact of inhaler choice is an important consideration; DPIs have a significantly lower carbon footprint compared to pMDIs, making them a more sustainable option when patients can generate sufficient PIF [53]. However, the challenge remains that many COPD patients, especially those hospitalized or with severe disease, often have suboptimal PIF for DPIs, necessitating alternative strategies such as the use of spacers with pMDIs or preliminary bronchodilator doses to enhance drug delivery [50, 54]. Furthermore, the correct inhaler technique is critical for optimal drug delivery, and errors in technique can significantly reduce medication deposition in the lungs, exacerbating the issue of suboptimal PIF[55, 56]. Therefore, regular monitoring of PIF and proper inhaler technique

training are essential to optimize the therapeutic outcomes for COPD patients using DPIs [57]. In conclusion, using a preliminary dose of pMDI can potentially improve the efficacy of DPIs in COPD patients with suboptimal PIFR by enhancing inspiratory capacity and ensuring better drug delivery, thereby improving disease management and patient outcomes.

Conclusion

According to the literature evidence base, there is an advantage of addressing suboptimal PIFR through the utilization of personalized inhaler selection and patient education is crucial in improving the management of disease progression and treatment effectiveness in individuals with COPD. This highlights the importance of conducting comprehensive assessments and developing tailored treatment approaches. Administering a preliminary dose of pMDI can enhance the effectiveness of DPIs in COPD patients with suboptimal PIFR. This can be achieved through the augmentation of inspiratory capacity and the facilitation of improved drug administration, consequently leading to enhanced disease control and patient results, but this finding is still a controversial issue, and if there is a probability of generalizing this strategy to optimize the effectiveness of any inhaler therapy use in COPD patients with suboptimal PIFR. So, further research in this area could be promising for better outcomes.

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تعزيز إدارة مرض الانسداد الرئوي المزمن من خلال تحسين معدل التدفق الإلهامي الذروي واستراتيجيات الاستنشاق

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مقدمة حول مرض الانسداد الرئوي المزمن وإدارته :مرض الانسداد الرئوي المزمن (COPD) هو حالة تنفسية شائعة وتدريجية تؤثر بشكل كبير على جودة حياة المصابين به، مما يجعل الإدارة الفعالة ضرورية للتحكم في الأعراض وتحسين وظائف الرئة.

أهمية معدل التدفق الإلهامي الذروي (PIFR): يؤكد البحث على أهمية معدل التدفق الإلهامي الذروي في إدارة مرض الانسداد الرئوي المزمن، وخاصة في استخدام مستنشقات البودرة الجافة .(DPIs) معدل التدفق الإلهامي الذروي هو مقياس لمدى سرعة استنشاق الشخص، وهو أمر حاسم لتوصيل الدواء بفعالية من خلال مستنشقات البودرة الجافة.

تحديات معدل التدفق الإلهامي الذروي في مرضى الانسداد الرئوي المزمن :العديد من مرضى الانسداد الرئوي المزمن لديهم معدل تدفق إلهامي ذروي دون المستوى الأمثل، مما يمكن أن يؤدي إلى توصيل غير فعال للدواء وإدارة ضعيفة للمرض.

العوامل التي تؤثر على معدل التدفق الإلهامي الذروي :تحدد المراجعة عدة عوامل يمكن أن تؤثر على معدل التدفق الإلهامي الذروي، بما في ذلك شدة مرض الانسداد الرئوي المزمن، والعمر، ووجود حالات صحية أخرى.

استراتيجيات لتحسين معدل التدفق الإلهامي الذروي واستخدام الاستنشاق :يقترح البحث أن معالجة معدل التدفق الإلهامي الذروي دون المستوى الأمثل من خلال استراتيجيات العلاج المخصصة، مثل جرعات تمهيدية من مستنشقات الجرعات المقننة المضغوطة (pMDIs) قبل استخدام مستنشقات البودرة الجافة، يمكن أن تحسن من توصيل الدواء ونتائج المرضى.

خاتمة واتجاهات مستقبلية: يخلص البحث إلى أنه من الضروري إجراء المزيد من الأبحاث لاستكشاف فوائد