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Review

Home-Based Respiratory Care for COPD Patients

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Abstract: Despite significant advances in the pharmacological treatment over the last few decades, COPD remains a heavy burden on the health systems around the world that affects approximately 210 million people, with elevated morbimortality and socioeconomic impact. Barriers to healthcare access were even more evident during the coronavirus disease 19 (COVID-19) pandemic and increased patients' vulnerability to physical deconditioning, depression, and social isolation. Home-based respiratory care in patients with COPD provides valuable contribution to effective disease management, with potential advantages for monitoring, treatment adherence and cost reduction. Technological innovation allows clinical markers of interest, such as respiratory frequency, pulmonary function, and oxygen saturation, to be tracked remotely from the patients' homes, as well as providing a better understanding as to their real needs. Home-based telerehabilitation can also be a viable alternative to hospital-based programs. Here, we highlight the full extent of health benefits of HRC in COPD, particularly to patients with higher risk of exacerbations, multiple comorbidities, and limited access to health services.

Keywords: COPD, home monitoring, pulmonary rehabilitation

1. Introduction

Chronic Obstructive Pulmonary Disease (COPD) is a multisystem inflammatory disorder intimately related to cigarette smoking, occupational factors and/or biomass combustion, which alters respiratory mechanics and gas exchange [1]. Despite significant advances in the pharmacological treatment over the last few decades, COPD remains a heavy burden on the health systems around the world that affects approximately 210 million people, with elevated morbimortality and socioeconomic impact [2]. Therefore, home-based respiratory care (HRC) plays a major role in the effective disease management, with potential advantages for monitoring, treatment adherence and cost reduction.

Ideally, screening of patients for HRC should depend on a predefined risk management strategy. The identification of risk factors of COPD poor outcomes, vulnerable populations, and impaired mobility favors the inclusion in HRC programs. This strategy aims to implement preventative health actions in high-risk populations, with the objective of identifying, controlling, or eliminating related disfunctions [3]. Unfortunately, due to the multicausality of these events, one of the major barriers to effective management of exacerbation in COPD is the lack of a reliable predictive biomarkers. However, there are validated models and risk scales that are likely to contribute to decision-making process [4]. Therefore, HRC should be available to provide full extent of health benefits and well-being, particularly to patients with higher risk of exacerbations, multiple comorbidities, and limited access to health services.

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2. Pulmonary Rehabilitation

Despite its undoubted benefits for COPD treatment at different severity levels, pulmonary rehabilitation continues to be underused due to limited access to rehabilitation centers and specialized multidisciplinary teams [5]. Home-based pulmonary rehabilitation (HPR) can be a viable alternative to provide more equal access to this therapeutic strategy, as well as increasing rehabilitation adherence in patients with reduced mobility and in advanced phases of the disease [6]. However, data concerning its efficacy and safety are currently limited to studies involving heterogeneous samples with a small number of participants. In a Spanish study involving 60 patients with moderate COPD, a 12-week-long HPR program resulted in significant improvement in tolerance to exercise, dyspnea, and life quality [7].

Aerobic respiratory exercise at home can alleviate the effects of dynamic hyperinflation during exercise, by improving inspiratory capacity and respiratory muscle's function [8]. HPR also contributes to greater long-term cardiorespiratory endurance. However, the benefits obtained in terms of exercise capacity and life quality are multifactorial and cannot be attributed exclusively to an improvement in pulmonary function and respiratory muscle training.

Access barriers to pulmonary rehabilitation centers were even more evident during the coronavirus disease 19 (COVID-19) pandemic. The unprecedented worldwide spread of the virus has quickly turned COVID19 into a critical global public health problem and increased patients' vulnerability to physical deconditioning, depression, and social isolation [9]. This scenario has greatly impacted traditional modes of pulmonary rehabilitation. As most COPD patients are notably susceptible to severe complications of COVID-19, the pandemic has fastened the debate on the implementation and delivery of HPR [10].

A successful HPR should be matched for principles of exercise training and education provision to improve patient outcomes. Nonetheless, telehealth rehabilitation requires some adjustments regarding access and use of technology, available space, adequate training and resources for health professional, and patient individualization of care [11]. HPR may be an effective lower cost alternative of delivering pulmonary rehabilitation for COPD patients.

3. Long-term Non-invasive Ventilation

Long-term home non-invasive ventilation (LTH-NIV) is an established intervention to improve prognosis of COPD patients with hypercapnic chronic respiratory failure [12]. Domiciliary non-invasive ventilation is widely used to correct CO2 levels in stable hypercapnic, reduce hospital admissions and improve quality of life [13].

Severe COPD patients may remain with a $PaCO_2 \geqslant 55mmHg$ after hospital discharge following a life-threatening exacerbation. Although LTH-NIV was not associated increased survival, it may provide improvement in dyspnea scores, reduce subsequent exacerbations and rehospitalization, after an acute acidotic respiratory failure [14]. A conditional recommendation for targeted reduction of $PaCO_2$ in hypercapnic patients was proposed by European Respiratory Society (ERS) task force under low certainly of evidence driven by minimal potential harms of this intervention [13, 15].

4. Long-term Oxygen Therapy

According to the Global Initiative for Chronic Obstructive Lung Disease (GOLD) report, supplemental oxygen is indicated to stable patients with arterial hypoxemia defined as PaO_2 at or below 55mmHg or SaO_2 at or below 88%. Long-term oxygen therapy (LTOT)

should also be prescribed to patients with pulmonary hypertension, peripheral edema suggesting congestive heart failure or polycythemia (hematocrit >55%) and PaO_2 between 55 – 60mmHg or SaO_2 of 88% [2]. Oxygen levels should be monitored after 2 or 3 months to define whether LTOT will be still indicated.

Oxygen levels can vary greatly during the nocturnal period and daily activities. Continuous SpO2 measurements with wearable finger pulse oximeters may be helpful to identify SpO2 fluctuations in COPD subjects with unexplained dyspnea or severe exercise intolerance [16].

5. Exacerbations

Avoiding exacerbations has major prognostic implications on health status and is one of the main goals in COPD treatment [2]. A recent multicentric study involving 1,150 patients demonstrated the benefits of HRC as an independent predictor for the reduction of severe exacerbations, hospitalizations, and emergency room visits, to a magnitude of 48%, 36% and 88% respectively [17]. In this study, HRC by telemonitoring was considered as effective as hospital rehabilitation. The COPD Patient Management European Trial (COMET), conducted in 4 European countries, evaluated the impact of a broad HRC programme involving counselling sessions, a symptoms diary, pulmonary function monitoring and oxygenation in stable COPD patients [18]. A reduction in mortality has been show in patients with severe COPD, probably due to early detection and management of acute exacerbations; however, the study did not reach its primary endpoint of reducing hospitalizations over a 12-month period.

Acute exacerbation leading to hospitalization is associated with poor prognosis, elevated morbimortality and risk of rehospitalization [2]. These patients usually experience loss of independence in daily living after hospital discharge. McDowell and colleagues studied the impact of a HRC strategy conducted by a nurse for five weeks after hospital discharge following an acute exacerbation. The intervention group showed a significant reduction in anxiety and a better understanding of the disease. Nonetheless, there was not a major reduction in rehospitalizations [19].

6. Sociocultural Factors and Patient Education

The health-disease process involves biopsychosocial interactions with great influence from the environment in which the individual is inserted [20]. A HRC programme should be developed under the perspective of health beyond its biological character, considering social aspects and patient preferences. It is essential, therefore, to analyze the complex relationships among sociocultural factors, lifestyle, dietary pattern, and daily routine for a better understanding of the health inequities in COPD patients.

Patients must have an adequate knowledge about the disease, the risk and benefits of treatment options and behavioral changes to ensure active engagement in health care [21]. Health coaching is a feasible way to promote patient education and counseling in a home-based respiratory care setting. A recent randomized controlled trial with 154 moderate to severe COPD patients showed a significant improvement in self-management abilities and a high degree of acceptability of the programme [22].

7. Home Health-monitoring Technologies

An approach toward a better experience during COPD treatment is critical to guarantee better results in HRC. It is in this context that biotechnology solutions and remote monitoring take on an increasing importance to offer the patient personalized and multidimensional care (Figure 01). Home health monitoring of pulmonary function, oxygenation, physical activity levels and exacerbations, via applications and videoconferencing by trained teams, has proven to be a valuable tool in the management of COPD patients [23]. Furthermore, since 2019, many pulmonary rehabilitation programs have been suspended

during the periods of elevated risk of infection of the SARS-COV-2 virus. According to the Global Initiative for Chronic Obstructive Lung Disease (GOLD), technological solutions, such as internet and cellphone applications, can be useful to encourage and stimulate patients under HPR during the pandemic [2].

Remote monitoring allows to reach population groups that, due to access barriers, are generally excluded, as well as providing greater convenience, security, and service efficiency. However, economic evaluation of smart homes and home health-monitoring technologies are still relatively rare, and the cost-effectiveness of remote monitoring strategies has yet to be validated by prospective studies [24,25].

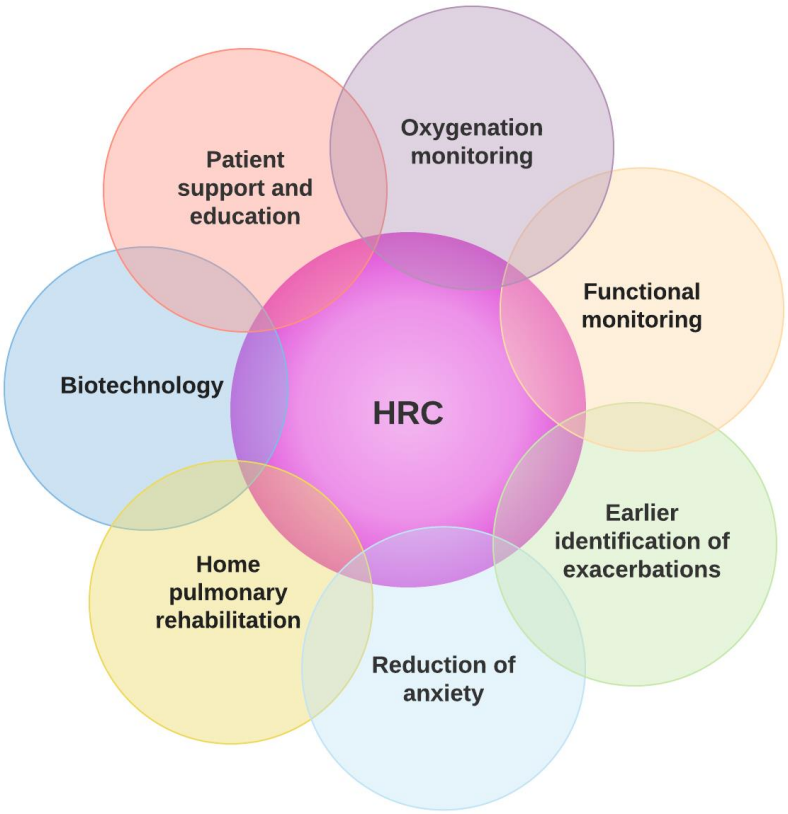

Figure 01- Home-based respiratory care as multidimensional health strategy for COPD; HRC: home-based respiratory care

8. Conclusion

Home respiratory care (HCR) represents a valuable tool for promoting personalized health care in patients with COPD. Technological innovation allows clinical markers of interest, such as respiratory frequency, pulmonary function, and oxygen saturation, to be tracked remotely from the patients' homes, as well as providing a better understanding as to their real needs. Home-based telerehabilitation can also be a viable alternative to hospital-based programs, with the advantage of amplifying access to this therapeutic modality, especially in the light of concerns regarding the biosecurity of patients during the pandemic.

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