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CASE REPORT Open Access

Effect of physiotherapy intervention (chest physiotherapy) on chronic obstructive pulmonary disease (COPD) in a 72-year-old patient: a case report

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Abstract

Background Chronic obstructive pulmonary disease (COPD) is a progressive obstruction of the airflow that is often fatal if not appropriately managed. COPD is prevalent among older adults worldwide, and diagnosis is often missed in comprehensive geriatric assessment. According to the Global Initiative for Chronic Obstructive Lung Disease (GOLD) guidelines, the management approach includes pharmacological, non-pharmacological treatment, and surgery in severe cases. This case report determines the effect of physiotherapy intervention (a non-pharmacological approach) on geriatric patients with COPD.

Case presentation This is a case report of a 72-year-old male patient who presented as an outpatient with COPD grade D (GOLD guidelines) with a forced expiratory volume in 1 s (FEV1) value of 52%. The patient had 3 acute episodes of exacerbation but was stabilized. The first episode of shortness of breath was 2 years ago while taking a brisk walk at home. He was immediately rushed to the hospital where he was placed on hospital admission and managed for about 2 weeks and was discharged but to continue physiotherapy on an outpatient basis due to the proximity of his home from the hospital. On physical examination with chronic obstructive pulmonary assessment test (CAT), 6-min walk test (6MWT), and functional assessment with the Barthel Index, the patient was easily fatigued and had challenges in performing basic activities of daily living (BADL). The patient had 72 sessions of physiotherapy interventions for 6 months which consisted of education, purse-lip breathing, active cycle of breathing technique, incentive spirometry exercise, aerobic exercise, and home exercise aimed at improving activity tolerance, encouraging diaphragmatic breathing, enhancing sputum clearance, improving function, and overall quality of life.

Improvement was initially gradual and then significant in about the third month of the intervention. Activity tolerance improved with a 6MWT of 2 laps. The patient developed more confidence in performing ADL and leaving his home despite his lung condition as seen in CAT scores.

Conclusions Overall, results from this study showed that COPD is a treatable condition that is amenable to physiotherapy interventions in a multidisciplinary approach.

Keywords Chronic obstructive pulmonary disease, Older adult, Physiotherapy intervention, Incentive spirometry exercise, COPD

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Background

Chronic obstructive pulmonary disease (COPD) is a progressive obstruction of the airflow that is often fatal if not appropriately managed. Persons with COPD could be asymptomatic or present with a limitation of respiratory function [1]. Exposing the lungs to noxious substances or gases for a long duration of time is the major cause of COPD. These substances irritate the lungs leading to structural changes occurring from chronic inflammation of the lung tissue. Symptoms such as cough, shortness of breath, and sputum production are often seen in people affected by this disease. Additionally, COPD is preventable and can be treated when timely diagnosed [2]. Emphysema and chronic bronchitis are the two conditions present in people with COPD. In emphysema, the air sacs become damaged and lose their elasticity affecting the normal expansion and "spring" back effect that occurs in gaseous exchange. Chronic bronchitis affects normal gaseous exchange due to the accumulation of fluid [2].

Globally, the prevalence of COPD among older adults is about 10% and is usually associated with co-morbidities [2–4]. In another study comparing the adult population of 40 to less than 65 years to older adults 65 years and older, the prevalence of COPD was seen to be about 9.9% and about 14.2%, respectively [5]. Literature has no clear record of aging changes that lead to COPD but associated co-morbidities include ischemic heart disease, heart failure, anemia, hypertension diabetes, depression, osteoporosis, and lung cancer among others [3, 5]. On average, the number of co-morbidities per individual ranges from 1.2 to 4.3, and the number of co-morbidities is directly proportional to the degree of reduction in quality of life even more than the actual pathological effect on lung function [3]. The aging process leads to a decline in the efficiency of the respiratory system such as a decline in static-elastic recoil of the lung tissue, reduction in efficiency of respiratory muscle, and decreased chest wall compliance. The pathological changes also include systemic changes such as cachexia that occur due to the release of inflammatory mediators [5, 6].

Diagnosis of COPD is often missed in comprehensive geriatric assessment. The standard diagnosis of COPD is with the use of spirometry which measures restriction in the flow of air [6]. Management of COPD includes evaluating and taking note of disease severity, minimizing risk factors, preventing and managing symptoms, promoting health, and improving functional ability [5]. Medications used for COPD are delivered using meter-dose inhalers, dry powder inhalers, and ultrasonic nebulizers. Beta-agonists are also used either orally or via aerosol. Methylxanthines are also used, but side effects should be noted so as not to worsen associated co-morbidities [5].

Medical care costs from COPD are mostly from hospitalization and medication use which is indicated by the level of disease severity and number of acute episodes [2]. About 90% of deaths from COPD have been recorded in low- and middle-income countries (LMIC) [1]. There is a lack of comprehensive data on the burden of COPD and the use of the best available treatment guidelines especially among older adults in Nigeria. The majority of the population in Nigeria lacks awareness of COPD and the consequences of the condition on functional independence. Management of COPD in Nigeria is below standard [1]. In a study by Desalu et al. [7], the lack of familiarity with COPD guidelines according to GOLD was 39.8% among health care professionals in some selected hospitals in 6 geopolitical zones in Nigeria [7]. Physiotherapy management according to the Global Initiative for Chronic Obstructive Lung Disease (GOLD) guidelines includes education, self-management, and pulmonary rehabilitation. This case study adheres to guidelines for the physiotherapy management of COPD as outlined by the GOLD guidelines.

Case presentation

This is a case report of a 72-year-old male patient (1.65 m, weight = 108 kg, BMI = 42.2 kg/m^2) who presented as an outpatient with a referral diagnosis of COPD grade D (GOLD guidelines) with a forced expiratory volume in 1 s (FEV1) value of 52%. The patient had about 3 acute episodes of exacerbation in the previous year, but the condition was stabilized and the patient was referred to continue physiotherapy as an outpatient due to proximity of his residence from the hospital. The patient had the first episode of shortness of breath about 2 years ago while taking a brisk walk in his residential environment. He was immediately rushed to the hospital where he was placed on hospital admission for about 2 weeks. Investigations were carried out, and he was diagnosed with COPD. The patient had about 3 sessions of physiotherapy while on admission. His problem list includes difficulty breathing with exertion, easy fatigability, forgetfulness, increased urinary frequency, pain in his right hip, and inability to perform ADL. Shortness of breath was aggravated by activity and relieved with rest, with no report of known environmental allergies.

His past medical history includes hypertension; however, he was not diabetic, but had peptic ulcer disease, appendectomy (20 years ago), prostate surgery (5 years ago), and lobectomy middle lobe (1 year ago). His drug history includes antihypertensive (ACE inhibitor—lisinopril), beta 2 agonist (salbutamol), prednisone, nil vaccine, vitamin B3, rosuvastatin, ibuprofen, and donepezil.

The patient is a retired professor who is married with 4 issues, all alive, and lives in a duplex (patient's room is

downstairs). He used to play golf but lost interest due to the demise of his friend and golf partner. The patient likes to take brisk walks about 3 to 4 times a week around his residence, a former smoker of up to 3 sticks of cigarette a day but quit about 10 years ago, takes alcohol about once a week, and takes bitter cola. The patient denied that any of his family members had been diagnosed with COPD.

The physiotherapy intervention aimed at improving activity tolerance, encouraging diaphragmatic breathing, reducing pain, enhancing sputum clearance, improving function, and overall quality of life. Intervention commenced with patient education to enable patients and caregivers to participate actively and be empowered with knowledge and skills to cope well with the condition. The patient was thought to assume a forward stoop position when feeling shortness of breath and to perform purse-lip breathing. For the purse-lip breathing training, the patient was instructed to stoop forward while sitting on a chair or while standing followed by taking a deep breath with mouth closed and then breathing out through pursed lips as though attempting to put off a candle this was repeated for six times or until he starts feeling better. The intervention also included an active cycle of breathing technique (ACBT) to enhance mucus clearance. This technique combines breathing control and chest expansion followed by huffing or huff coughing. For the ACBT, the patient was instructed to assume a comfortable sitting or standing position followed by breathing through his nose and out through his mouth with little effort making sure to move the lower chest while relaxing the upper chest and shoulders. This was done six times to relax the airways. Next, the patient was instructed to breathe in deeply and hold for 3 s to enable air to get into smaller airways, then he was asked to breathe out without forcing the air out. This phase was followed by the breathing control phase before the huffing phase to clear mucus out of the lungs.

Additionally, the patient was taught how to use the incentive spirometer aimed at training inspiratory muscles. The incentive spirometer is a handheld device used to encourage sustained maximal inspirations to enhance the re-inflation of lung tissue. The patient was instructed to hold the spirometer in an upright position, exhale normally, and then place his lips tightly around the mouthpiece and then slowly inhale such that the balls are raised up. The mouthpiece was removed following maximal inhalation, and this was repeated 5 times for 10 repetitions with rest breaks. A portable bicycle ergometer was used for endurance training and strengthening of the upper limbs and lower limbs. The patient initially cycled for 2 min then rested, then completed 3 repetitions of 2 min circling making 6 min in total. This was followed by sit-to-stand training to re-integrate functional activities for 5 repetitions and then standing re-education for 3 min. The pain in the right hip was managed using transcutaneous electrical nerve stimulation (TENS) and isometric exercise in all planes of movement of the hip (5 s hold 5 repetitions) with soft tissue manipulation using analgesic gel (fastum). The patient was given a home program to be carried out on off-treatment session days (twice daily if tolerable). This included an incentive spirometer, sit-to-stand, and standing re-education. He was also instructed to use a hot water bottle at home because he complained of feeling increased pain in his right hip a week after carrying out the home program. Treatment session was scheduled three times weekly for 6 weeks (about 1 and a half months) after which the patient was reviewed and improvement in the condition was noted. The patient cardiorespiratory assessment includes systolic/diastolic blood pressure (SBP/DBP) of 108/65 mmHg, pulse rate (PR) of 80 bpm, respiratory rate (RR) of 24 cycles per minute, and SPO_2 of 90%. SBP/DBP and PR were measured using a digital blood pressure monitor. Observation and chest wall inspection, auscultation, and palpation reveal apical breathing with difficulty completing sentences and wheezing throughout the lower lobes; however, palpation of the muscle of the hip elicited pains, and there was no nail clubbing, tenderness, and asymmetry with tactile fremitus. Diagnosis of COPD was made using the COPD Assessment Test (CAT) with the patient scoring 26 on the COPD scale. This scale measures the impact of COPD and rates patient cough, mucus on the chest, chest tightness, stair climbing, home activity limitation, leaving home, sleep, and energy level on a scale of 0 to 5 with a total score of 40. The higher the score, the higher the impact of the condition. The 6-min walk test (6MWT) was used to assess the patient walking and show that the patient was unable to complete one lap due to fatigue. Borg Rating of Perceived Exertion (RPE) was used to measure the patient's perceived exertion while walking. The pre-6MWT RPE was 3/10, and the post-6MWT RPE was 9/10. Additionally, specialized tests conducted on the patient include FABER (RLL, positive, LLL negative), straight leg raises (SLR, RLL negative, LL negative), and piriformis test (RLL negative, LLL negative). The special test was executed in a stepwise manner; thus, the patient was transferred to bed, and FABER test was performed by instructing the patient to flex the knee of the test lower limb (LL) such that the heel rests on the non-test (LL) and then a force was gradually applied by the therapist in the direction of abduction and external rotation. If the patient reported pain at the hip of test LL, this confirms a diagnosis of hip osteoarthritis. The same was repeated for both LL.

This was immediately followed by SLR in which the patient was instructed to flex the test LL in supine lying

with the knee extended and the non-test LL kept flat on the bed. The test was positive if the patient reported pain at a point along the range of the motion, the test was done for both LLs.

Finally, the piriformis stress test was performed by passively flexing the hip and knee of the test leg such that the heel is on the non-test leg and then a force was applied in the direction of flexion and adduction to stress the piriformis muscle. The test was positive if the patient reported pain at the glutes around the ischial tuberosity. This was done for both LLs. We also assessed the pain level, mental status, depression, and functional ability of the patient. The pain level was measured using a numerical pain rating scale (NPRS) with the patient score recorded as 6/10. The mental status was measured using abbreviated mental test, and the patient scored 5 indicating moderate cognitive impairment (total score = 10, 0–3 = severe impairment, 4–6 = moderate impairment, > 6 = normal), while the geriatric depression scale (GDS-15) was used to assess for the presence of depression and the patient score was 10. Functional ability was assessed using the Barthel index, and the patient's score was 10 (score ranges from 0 to 20) while the intensity of pain was assessed using the NPRS, and the patient's pain level was 6/10.

Results

The patient's age, height, weight, and BMI were 72 years, 1.65 m, 108 kg, and 42.2 kg/m^2, respectively. The patient's baselines of SBP/DBP, PR, RR, and SPO_2 were 108/65 mmHg, 80 bpm, 24 cycles per minute, and 90%, respectively. He was managed for about 72 sessions in 6 months, and the improvement was initially gradual but a marked improvement in activity tolerance was noticed in the 10th week. Inspiratory capacity with incentive spirometer improved from 500 to 1500 cc. The patient could climb up and down two flights of stairs reporting a RPE of 5/10. His performance on the 6MWT was up to 2 laps. There was also a significant improvement in the CAT score which was as low as 8 from the baseline score of 26. Patients reported increased energy levels and more confidence in trying to perform ADL (BI score improved from 10/20 at baseline to 16/20 post-intervention), such as dressing up, feeding, and leaving the house. The pain intensity reduced from 6 to 2/10. There were no marked changes in the cardiorespiratory parameter (PR before and after intervention = 80 bpm, respiratory rate before and after intervention = 24 cycles per minute); however, there was an improvement in SBP/DBP and SPO_2, which were 120/70 mmHg and 93% after the treatment, respectively. There was a decrease in the CAT score from 26 to 20 and an increase in patient exercise endurance, and the treadmill training speed which was initially at 1.5 km/h for 2 min was progressed to 5 min after 3 weeks of treatment sessions as shown in Table 1. The impact and treatment duration of COPD varies among individuals with no specific standardized timing of discharge. In case of hospitalization, patients' health parameters are to be reassessed. In stable patients, a follow-up is done to monitor the trend in symptoms using spirometry assessment, arterial blood gas analysis, and disease-specific outcome measures. The patient was advised to adhere to a medication regimen and to procure a portable bicycle ergometer for exercising at home.

Discussion

Physiotherapy plays an essential role in the multidisciplinary approach as a non-pharmacological management of COPD. According to the GOLD guidelines, the management approach includes pharmacological and non-pharmacological treatment and surgery in patients with advanced emphysema. Evidence has shown that the level of physical activity is reduced in COPD patients. This leads to decreased quality of life and increased number of hospital admissions and mortality [1, 2, 5]. Exercise training in combination with bronchodilators has been shown to improve activity tolerance. A systematic review of randomized control trials on a combination of physiotherapy interventions for managing COPD among older adults in Brazil supports the use of resistance training to improve dyspnea, muscle strength, and activity tolerance. Patient education was also used in most of the studies to enable patients to understand and cope with the functional changes, and physical and psychological impact of the condition. Furthermore, the huffing technique was used together with a breathing exercise to clear lung secretions [8]. This evidence is in line with that produced from the outcome of the present case study.

In this patient case report, aerobic exercise was used to improve the patient's cardiovascular endurance and to enhance functional independence. A retrospective study also reviewed the effect of treadmill training combined

Table 1 Summary of results

Assessments	Pre-intervention	Post-intervention
CAT score	26	8
6MWT	< 1 lap	2 laps
Borg rating of exertion	3	5
NPRS	6	2
Barthel index	10	16
Incentive spirometer	500 cc	1500 cc

CAT COPD assessment test, *6MWT* 6-min walk test, *NPRS* numeric pain rating scale, *cc* cubic centimeter**s**

with patient education on older adults (mean age 62.75 ± 5.62) with COPD and reported improvement in 6MWD (6-min walk distance) and CAT score which was 541.19 ± 79.2 m and 16.69 ± 3.94, respectively, for pre-intervention and post-intervention was 603.44 ± 77.65 m and 8.31 ± 1.70 [9]. When performing aerobic exercise, there is increased energy and oxygen need in the human body leading to an increase in ventricular volume, enhanced myocardial contractility, and decreased oxidative stress and fiber formation. There is also a reduction in the inflammation of lung tissue associated with this condition and an increase in the efficiency of the diaphragm leading to a reduction in the symptoms of easy fatigability and breathlessness [9, 10].

Furthermore, the use of the incentive spirometer for training the muscle of inspiration has been previously used with evidence of significant improvement. El-Kloa et al. [11] studied the use of incentive spirometer as supplementary therapy among older adult COPD patients with a mean age of 60.7 ± 5.99 years in Egypt. There was a significant improvement in pulmonary function measured with $PaC0_2$ and FEV1/FVC (forced expiratory volume in one second and forced vital capacity). There was also improvement in patient wellbeing and breathlessness 2 months post-treatment. Additionally, we prescribed the use of an incentive spirometer during an outpatient session and as a home program with verbal feedback from the patient and caregiver, with significant improvement in fatigue level and activity tolerance evident after about 3 months. This was due to case reports of patients being in the middle-old category, with age being a risk factor in developing COPD.

Limitations and strengths of this study

This case report presents some evidence of significant improvement in presenting symptoms of COPD in an older adult using a combination of physiotherapy interventions in a multidisciplinary treatment approach according to GOLD guidelines but was limited by the unavailability of spirometry to measure FEV1 at baseline and post-intervention and was a case report based of a single patient managed in hospital setting using a multidisciplinary treatment approach; therefore, generalization of the outcome of this study to the community-based patient or to a patient managed at home should be made cautiously.

Conclusion

Chronic obstructive pulmonary disease is incurable but treatable, with evidence of adequate management of patient symptoms, thereby reducing the number of acute exacerbations and hospital admissions. Timely diagnosis and appropriate management of the condition and other co-morbidities are essential in reducing the chances of mortality. This study showed that physiotherapy interventions improve cardiovascular endurance and activity tolerance and enable patients to lead a more productive life and be as functionally independent as possible.

Abbreviations

ADL	Activity of daily living
COPD	Chronic obstructive pulmonary disease
FEV1	Force expiratory volume at 1 min
LMIC	Low- and middle-income countries
GOLD	Global Initiative for Chronic Obstructive Lung Disease
FVC	Forced vital capacity
6MWD	6-Min walk distance
$PaCO_2$	Partial pressure of arterial carbon dioxide
RPE	Rating of perceived exertion
FABER	Flexion abduction external rotation
SLR	Straight leg raise
RLL/LLL	Right lower limb/left lower limb
CAT	Chronic obstructive pulmonary assessment test
BI	Barthel index
SBP/DBP	Systolic blood pressure/diastolic blood pressure

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Availability of data and materials
The data of this study are available upon request.

Declarations

Ethics approval and consent to participate
A detailed explanation of the purpose and procedure of the intervention was given to the patient. Written and verbal informed consent was obtained before starting the intervention.

Consent for publication
Not applicable.

Competing interests
The authors declare that they have no competing interests.

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