BALNEO RESEARCH JOURNAL
English Edition
eISSN 2069-7619 pISSN 2069-7597 ROMANIAN ASSOCIATION OF BALNEOLOGY

Cardiovascular surgery complication and the benefits of pulmonary rehabilitation in preventing COPD exacerbation

STANCIU Ionut[1], LIBU Cristiana[1*], DOCU AXELERAD Any[1], APETREI CORDUNEANU Otilia[2], DANTES Elena[1]

Corresponding author: **LIBU Cristiana, E-mail: libu.cristiana@yahoo.ro**

Balneo Research Journal DOI: http://dx.doi.org/10.12680/balneo.2020.314 Vol.11, No.1, February 2020 p: 45–49

1. "Ovidius" University, Constanta, Romania
2. "Grigore T. Popa" University of Medicine and Pharmacy, Iasi, Romania

Abstract

Introduction. Chronic obstructive pulmonary disease (COPD) is one of the leading causes of morbidity and mortality worldwide, and the burden of the disease is constantly increasing. Although COPD is primarily characterized by the presence of airflow obstruction, in many patients, it is associated with systemic manifestations that can result in impaired functional capacity, reduced quality of life, and increased mortality. Pulmonary rehabilitation (PR) consists of a multidisciplinary and comprehensive non-pharmacological intervention that is designed to improve health status in COPD patients, along with pharmacologic treatment. PR has also been shown to improve the diaphragmatic mobility in patients with different conditions that affect the diaphragm. The aim of the paper is to describe the clinical and functional features of a COPD patient with unilateral paralysis of the phrenic nerve and the role of PR as a major component of the case management. **Material and method.** This paper presents the case of a 66-year-old patient, diagnosed with COPD Gold stage III, which suffered a surgical intervention for an aorta aneurysm and later complicated with phrenic nerve injury and left diaphragmatic paralysis. This condition worsened the respiratory functional status and the patient needed a tailored treatment. **Results and discussions.** The treatment included besides inhaled dual long acting bronchodilator and corticoid therapy, pulmonary rehabilitation with complex methods, consisting in training of the respiratory musculature and techniques of bronchial drainage using devices with positive inspiratory and expiratory pressure, with good clinical and functional outcomes. A PR program should be included into a personalized management plan, along with pharmacological therapy. **Conclusion.** Although there is no standard treatment for COPD associated with unilateral paralysis of the phrenic nerve, it is important to diagnose these conditions promptly, and to recommend the adequate pharmacological treatment for controlling the symptoms along with a personalized complex respiratory rehabilitation program, in order to increase functional status and quality of life.

Key words: *respiratory rehabilitation, COPD, phrenic nerve paralysis,*

Introduction

Chronic obstructive pulmonary disease (COPD) is an important cause of mortality worldwide, with a constantly increasing prevalence, mainly due to smoking and different exposures to noxious particles (1,2). The progressive decline in lung function that defines COPD is commonly associated with a significant reduction in exercise capacity and psychological issues, all of which contribute to greater patient's disability, poor quality of life and reduced survival (3,4). Pulmonary rehabilitation (PR) consists in a multidisciplinary and comprehensive non-pharmacological intervention that is designed to improve health status in COPD patients (3-5). PR has also been shown to improve the diaphragmatic mobility in patients with different conditions that affect the diaphragm (6-8). The aim of the paper is to describe the clinical and functional features of a COPD case associated with unilateral paralysis of the phrenic nerve and the role of PR as a major component of the case management.

Material and method

This paper reports the case of a 66-year-old patient, with a 42-pack year history of smoking, diagnosed with COPD Gold stage III, in 2011, and treated with a fixed combination of inhaled corticosteroid and beta-2 agonist bronchodilator (fluticasone/salmeterol 50/500 µg, 2 inhalations/day) and salbutamol as needed. The initial values of spirometry parameters were: reduced forced expiratory volume in 1 second (FEV1) 1.42 L (41.3%) and forced vital capacity (FVC) 2.43L (52.3%) corresponding to a decreased FEV1/FVC ratio of 58.4%. The patient was regularly monitored, including clinical and functional assessment.

In December 2012, the patient was admitted in Pulmonology department for severe infectious exacerbation of COPD with left upper lobar pneumonia and minimum left pleural effusion, cured under broad-spectrum intravenous antibiotic therapy (ceftazidime 3g/day, gentamicin 160mg / day, and

ciprofloxacin 1000mg /day) administered for 10 days. Chest computed tomography (CT scan) exam, performed after the pneumonia resolution, revealed the presence of a sacciform dilation of the aortic cross, distal of the emergence of the left subclavian artery, with a diameter of 35/25mm.

The patient was referred to Cardio-vascular surgery department and suffered a curative intervention for aorta aneurysm. Phrenic nerve injury occurred during the cardiothoracic surgery intervention, led to left diaphragmatic paralysis, revealed by chest X-ray (fig 1). This complication affected the health status condition both functionally (FEV1 decreased to 1.25L, corresponding to 35% of predicted value) and regarding the quality of life.

Results

The post-operatory evaluation revealed an overweight patient (BMI = 28.7kg/m^2), presenting dyspnea on exertion (grade 3-4 mMRC), decreased breath sounds on the left lower hemithorax, dullness to percussion in the same area, and inward movement of the epigastrium during inspiration. Pulmonary function tests suggested severe irreversible obstructive disease: post-bronchodilator values of FEV1, FVC and FEV1/FVC ratio were lower (34%, 50% and 54.5% respectively). CT exam of the chest revealed the presence of accessory hemiazygos vein, calcified micronodular lesions in both upper lobes, left supradiaphragmatic lamellar atelectasis, bronchiectasis in lingula and left lower lobe (fig. 2) and a highly elevated left hemidiaphragm (fig. 3). The walked distance on the 6 minutes walking test (6 MWD) was 390 m, representing 70% of predicted value, and a significant desaturation up to 85% during the test. The treatment included besides inhaled dual bronchodilator and corticoid therapy, pulmonary rehabilitation with complex methods, consisting in the training of the respiratory musculature, pursed lip breathing, arm and chest exercises, resistance training exercises including walking on a treadmill, and, also, techniques of bronchial drainage using devices with positive inspiratory and expiratory pressure (fig 4). PR included also the educational and nutritional support. The patient followed the rehabilitation program twice daily for one month in the rehabilitation department.

The PR program, along with the pharmacological therapy had good clinical and functional outcomes. Dyspnea was reduced to grade 2-3 mMRC, the values of FEV1, FVC, and FEV1/FVC ratio increased to 44.7%, 58.3%, and 55% respectively. The 6 MWD increased up to 82% of predicted value, and the lower value of SpO_2 during the test was 90%.

Two years after cardiothoracic surgery, patient reported persistent low back pain in the chest, and he was referred to Balneal and Rehabilitation Sanatorium of Techirghiol, Romania, where specific balneal therapy was started, consisting in peloidotherapy – cold mud baths and adjuvant procedures such as: electrotherapy, massage and kinetotherapy. After seven years of monitoring, the patient remains stable, with no respiratory exacerbation. He is under pulmonology and cardiologic pharmacological treatment.

Discussions

COPD represents a major public health problem, the main cause of global morbidity and mortality (1,8). Along with pulmonary tuberculosis, HIV infection and lung cancer, obstructive lung diseases represent a major component of health care system burden (10-15). COPD exacerbations and associated comorbid conditions, such as cardiovascular diseases, obstructive sleep apnoea, metabolic syndrome or other rare diseases, are responsible for much of the morbidity and mortality (15-20), along with suboptimal adherence to pharmacological treatment (21,22). Although COPD is a progressive respiratory disease, it also has diverse manifestations beyond the lungs, known as systemic effects (23). The most important systemic dysfunction in COPD patients is the peripheral muscle impairment resulting from both systemic inflammation and physical inactivity (24). Skeletal muscle dysfunction is a frequent and important feature of COPD (5), especially in advanced stages and it is associated with reduced quality of life, exercise capacity and survival.

Pulmonary rehabilitation is a well-proven complex and multidisciplinary treatment approach that includes patient evaluation and education, smoking cessation intervention, physical training and skeletal muscle strengthening, nutritional intervention, occupational therapy and psychosocial support (25). A PR program should be included into a personalized management plan, along with pharmacological therapy (26,27) and long term oxygen therapy when needed (28,29). Patients who should benefit the most from a PR program are COPD patients from groups B−D, according to the Global initiative for Obstructive Lung Disease (GOLD) guidelines (30).

However, the American College of Physicians evidence-based practice guideline supports the indication of PR for symptomatic COPD patients with FEV1 <50% of predicted (strong recommendation) (31), conditions which were present in our reported case, because the patient was initially diagnosed with COPD Gold stage III, with a FEV1 of 41.3% of predicted value, and dyspnea of 3-4 mMRC scale.

In the next year after the COPD diagnosis, the patient suffered a surgical procedure for an aorta aneurysm, after which he presented in the pulmonary department with left diaphragmatic paralysis. Usually, this unilateral diaphragmatic paralysis is incidentally found on routine chest X-ray (32,33). Most patients diagnosed with asymptomatic hemidiaphragmatic paralysis do not require treatment (32). In this case, the patient did not consent for a surgical procedure for the correction of unilateral diaphragm paralysis by plication of the affected site. This option is considered if the patient has important symptoms, or if the patient has bilateral diaphragmatic paralysis (32,33).

In our case, the respiratory status of the patient was already impaired due to obstructive disease. After cardiovascular surgery intervention, he presented a worsened dyspnea and functional status, with post-bronchodilator values of FEV1, FVC and FEV1/FVC ratio of 34%, 50% and 54.5% respectively. The pharmacological treatment consisted in adding a long acting anticholinergic to his inhaled combination of corticosteroid and long acting beta2-agonist. The patient also benefited from a complex PR program, twice daily for one month in the rehabilitation department, having a favourable evolution, with significant clinical and functional improvement of respiratory symptoms and spirometric parameters. Balneal therapy for degenerative low back pain done consisting in peloidotherapy – cold mud baths and adjuvant procedures such as: kinetotherapy, electrotherapy, massage therapy, had a very good clinical response. Data from literature also support the beneficial clinical effectiveness of balneal treatment (34-36). After seven years of monitoring, COPD remains stable, with no further respiratory exacerbation.

Conclusion

Although there is no standard treatment for COPD associated with unilateral paralysis of the phrenic nerve, it is important to diagnose promptly these conditions and to recommend the adequate pharmacological treatment for controlling the symptoms along with a personalized complex respiratory rehabilitation program, in order to increase functional status and quality of life.

Fig 1. Chest CT scan revealed a sacciform dilation of the aortic cross, distal of the emergence of the left subclavian artery, with a diameter of 35/25mm.

Fig 1. Chest radiograpy - elevated left hemidiaphragm, diffuse right pulmonary hyperlucency and enlargement of intercostal spaces

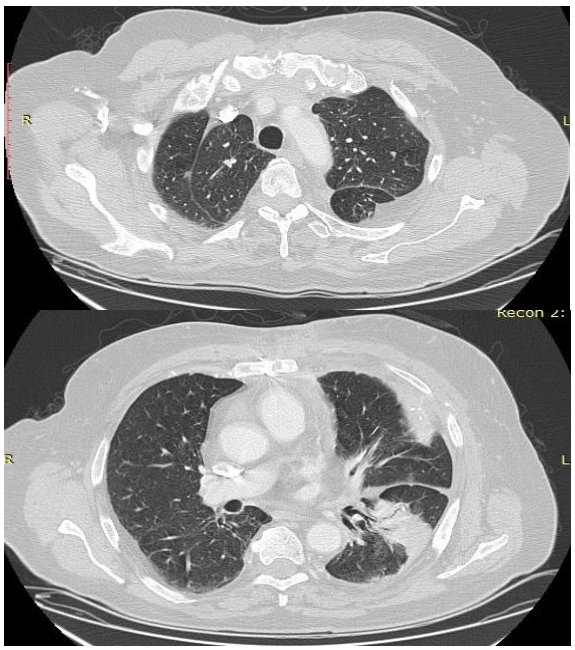

Fig 2. Chest CT scan revealed accessory hemiazygos vein, calcified micronodular lesions (upper); left supra-diaphragmatic lamellar atelectasis, and bronchiectasis in the lingula and in the left lower lobe (lower)

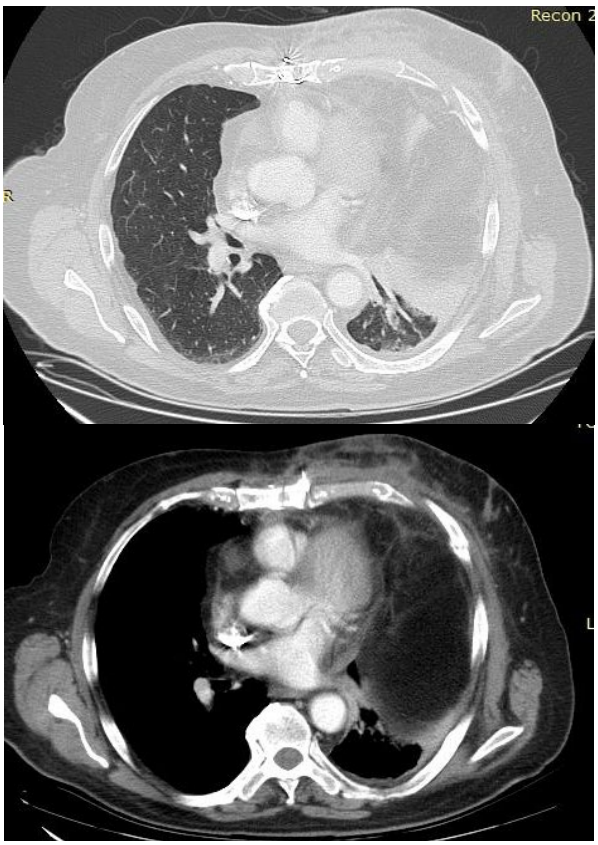

Fig 3. Chest CT scan by lung window (upper) and mediastinal window (lower) revealed highly elevated left hemidiaphragm

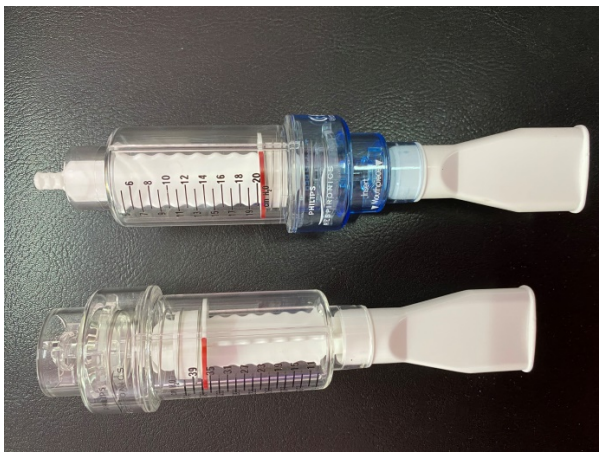

Fig 4. Training devices with positive inspiratory and expiratory pressure

Author contributions.
The authors contributed equally to the work.

Declaration of conflict of interests.
There is no conflict of interest for any of the authors regarding this paper.

Informed consent.
An informed consent was obtained from the patient included in this study.

References

1. Quaderi SA, Hurst JR. The unmet global burden of COPD. Glob Health Epidemiol Genom. 2018;3:e4.
2. Alexescu TG, Tarmure S, Negrean V, Cosnarovici M, Ruta VM, Popovici I, Para I, Perne MG, Orasan OH, Todea DA. Nanoparticles in the treatment of chronic lung diseases. J Mind Med Sci. 2019; 6(2): 224-231.
3. Vestbo J, Hurd SS, Agustí AG, et al. Global strategy for the diagnosis, management, and prevention of chronic obstructive pulmonary disease: GOLD executive summary. Am J Respir Crit Care Med. 2013; 187(4):347–365.
4. Corhay JL, Nguyen Dang D, Van Cauwenberge H, Louis R. Pulmonary rehabilitation and COPD: providing patients a good environment for optimizing therapy. Int J Chron Obstruct Pulmon Dis. 2014; 9:27–39.
5. Hopkinson N. Pulmonary Rehabilitation for COPD. Tanaffos. 2017; 16(Suppl 1):S7–S8.
6. Corbellini C, Boussuges A, Villafañe JH, Zocchi L. Diaphragmatic mobility improves after pulmonary rehabilitation. A study using M-mode ultrasonography. Eur Respir J. 2016; 48:OA3047.
7. Longoni A, Paddeu A, Mangiacasale D, Pozzi P, Cattaneo L, et al. Sonographic evaluation of the diaphragm muscle before and after pulmonary rehabilitation. Eur Respir J. 2017;50:PA4901
8. Alexescu TG, Maierean A, Ciumarnean L, Budin C, Dogaru G, Todea DA. Rehabilitation therapies in stable chronic obstructive pulmonary disease. Balneo Research Journal. 2019;10(1):37–44.
9. Lopez-Campos JL, et al. Global burden of COPD. Respirology 2016; 21: 14–23.
10. Grobusch MP, Kapata N. Global burden of tuberculosis: where we are and what to do. Lancet Infect Dis. 2018; 18(12):1291-1293.
11. Fildan AP, Toma CL, Tofolean D, Arghir OC, Dantes E. TB Risk in Patients with Biological Therapy for Psoriasis. Chest. 2016; 150(4_S):201A.
12. Cambrea SC, Popescu GG, Resul G, Petcu LC. The spectrum of infectious diseases hospital mortality by HIV status. Acta Medica Mediterranea. 2019; 35(6): 3517-3522.
13. Barta JA, Powell CA, Wisnivesky JP. Global Epidemiology of Lung Cancer. Ann Glob Health. 2019; 85(1):8.
14. Ulmeanu R, Antohe I, Anisie E et al. Nivolumab for advanced non-small cell lung cancer: an evaluation of a phase III study. Expert review of anticancer therapy. 2016; 16(2): 165-167.

15. Hogea Stanca P, Tudorache E, Fildan AP, Fira-Mladinescu O, Marc M, Oancea C. Risk Factors of Chronic Obstructive Pulmonary Disease Exacerbations. Clin Respir J. 2019; doi:10.1111/crj.13129.
16. Trenchea M, Arghir IA, Popescu G, Rascu S, Bechir ES, Tofolean D, Fildan AP, Ion I, Dantes E. The Triad Nocturia, Smoking and Obstructive Sleep Apnea. Revista de Chimie. 2019; 70(5):1839-1842.
17. Anton A, Tofolean DE. Obstructive sleep apnea and metabolic syndrome: is there a correlation? Sleep Medicine. 2017; 40(1):E16-E16.
18. Deacu M, Tofolean DE, Bosoteanu M, Pulmonary alveolar lipoproteinosis associated with emphysematous areas. Rom J Morphol Embryol. 2012; 53(1):173-177.
19. Todea D, Herescu A, Rosca L. Obstructive Sleep Apnea Syndrome - a matter of public health. Transylvanian Review Of Administrative Sciences. 2012;37E:186- 201.
20. Budin CE, Marginean C, Bordea IR, Enache LS, Enache EL, Grigorescu BL, Biro L, Rusu E, Nemes RE, Todea DA. The Influence of Smoking on Nicotine Exposure Biomarkers and Inflammatory Profile Among Foster Care Teenagers, Romania. Rev.CHIM. (Bucharest).2018; 69(12):3659-63
21. Mäkelä MJ, Backer V, Hedegaard M, Larsson K. Adherence to inhaled therapies, health outcomes and costs in patients with asthma and COPD. Respir Med. 2013 Oct; 107(10):1481-90.
22. Munteanu LA, Fildan AP, Tudorache E, Fira-Mladinescu O, Frandes M, Timar B, Oancea C, Tofolean DE. Inhaler technique errors in Romanian patients with asthma - a multicenter study. Patient Preference and Adherence. 2019; 13:1401-1414.
23. Agusti A, Soriano JB. COPD as a systemic disease. COPD. 2008; 5(2):133–138.
24. Wüst RC, Degens H. Factors contributing to muscle wasting and dysfunction in COPD patients. Int J Chron Obstruct Pulmon Dis. 2007;2(3):289–300.
25. Spruit MA, Singh SJ, Garvey C et al. An official American thoracic society/European Respiratory Society statement: key concepts and advances in pulmonary rehabilitation. Am J Respir Crit Care Med. 2013; 188(8):e13–e64.
26. Rajnoveanu RM, Antoniu S, Ulmeanu R. Combined long-acting bronchodilator single therapy for COPD. Expert Opinion on Pharmacotherapy. 2014;15(1):139-142.
27. Alexa I, Alexa-Stratulat T, Antoniu S, Antohe I, Arghir O, Grigorescu C. Roflumilast in patients with advanced chronic obstructive pulmonary disease: towards a better-targeted use. Expert Opin Pharmacother.2019; 20(1): 91-93.
28. Jimborean G, Arghir OC, Cambrea SC, Dantes E, Socaci A, Otelea MR, Bechir ES, Ianosi ES. The Clinical Implications of Carbon Dioxide Increased Level in Arterial Blood Related to Severe Exacerbations of Chronic Obstructive Pulmonary Disease. Rev Chimie (Bucharest), 2018; 69(8): 2050-2053.
29. Tofolean D, Popescu G, Arghir IA, Frandes M, Fildan AP. A Different Aproach of Chronic Obstructive Pulmonary Disease Severity and Plastic Medical Devices Used for Oxygenotherapy. Materiale Plastice. 2019; 56(2):295-300.
30. Global Initiative for Chronic Obstructive Lung Disease. Global strategy for the diagnosis, management, and prevention of chronic obstructive pulmonary disease 2019 Report. Available from: https://goldcopd.org/wp-content/uploads/2018/11/GOLD-2019-v1.7-FINAL-14Nov2018-WMS.pdf
31. Qaseem A, Wilt TJ, Weinberger SE, et al. Diagnosis and management of stable chronic obstructive pulmonary disease: a clinical practice guideline update from the American College of Physicians, American College of Chest Physicians, American Thoracic Society, and European Respiratory Society. Ann Intern Med. 2011; 155(3):179–191.
32. Mandoorah S, Mead T. Phrenic Nerve Injury. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing. 2019. Available from: https://www.ncbi.nlm.nih.gov/books/NBK482227/
33. Hart N, Nickol AH, Cramer D, Ward SP, Lofaso F, et al. Effect of severe isolated unilateral and bilateral diaphragm weakness on exercise performance. Am. J. Respir. Crit. Care Med. 2002;165(9):1265-70
34. Lupu AA, Ionescu EV, Iliescu MG, Almasan RE, Oprea C, Ion I, Iliescu DM. Effect of Techirghiol specific climate factors on the patients quality of life with degenerative lumbar pain. J Environ Prot Ecol. 2018, 19 (4), 1857.
35. Iliescu MG, Profir D, Surdu O, Marin V, Demirgean S, Almasan RE, Stanciu LE, Oprea C, Iliescu DM, Ionescu EV. Statistical View through Balneal Activity In Techirghiol Medical Area. J Environ Prot Ecol. 2018; 19(1):382.
36. Almasan RE, Ionescu EV, Iliescu MG, Oprea C, Iliescu DM, Nenciu MI, Golumbeanu M. Techirghiol lake in the context of the integrated development of health tourism. J Environ Prot Ecol. 2019; 20(1):206–213.