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

Does Respiratory Rehabilitation improve the outcome of pleural effusion in pulmonology department? Case report series and short literature review.

CROITORU Alina[1]*, MOTOC Nicoleta Ştefania[2]*, IANOSI Edith Simona[3], TODEA Doina[2], STANCIU Ionut[4], ALEXESCU Teodora-Gabriela[2], CIUMĂRNEAN Lorena[2], DOGARU Gabriela[2], ARGHIR Oana Cristina[5]**

Corresponding author: **DOGARU Gabriela B.**: dogarugabrielaumf@gmail.com

BY-NC-ND

Balneo Research Journal DOI: http://dx.doi.org/10.12680/balneo.2019.283 Vol.10, No.4, December 2019 p: 466–471

1. "Carol Davila" University of Medicine and Pharmacy", Bucharest, Romania
2. "Iuliu Hatieganu", University of Medicine and Pharmacy, Cluj Napoca, Romania
3. "George Emil Palade" University of Medicine, Pharmacy, Science and Technology" Tg.Mureş, Romania
4. Clinical Hospital of Pulmonology, Constanta, Romania
5. "Ovidius" University of Medicine and Pharmacy, Constanta, Romania

Abstract

Introduction. Pulmonary rehabilitation is recognized as a complementary, non-pharmacological therapy for patients with COPD and pulmonary fibrosis. For pleural effusion, however there are not current recommendations in the existing literature. The aim of this study was to evaluate the beneficial role of respiratory rehabilitation (RR) in patients with pleural effusion and to review the main physiotherapy (kinetic therapeutic) techniques, as part of RR programs. **Material and method.** The article exemplifies three cases of acute pleural effusion or pachypleuritis, describing the diagnostic and treatment procedures as well as the pulmonary rehabilitation technique used. **Results and discussions.** Treatment goals, intervention, types of exercises were explained for each type of pleural disease. The diaphragmatic breathing, relaxation and/or antalgic postures, early mobilization, and a daily walking are recommended. **Conclusions.** Pulmonary rehabilitation should be applied in every patient with acute pleural effusion or pachypleuritis considering the potential benefits of physical therapy in the management of the patient`s illness.

Key words: *pleural effusion, respiratory rehabilitation, pachypleuritis,*

Introduction

Pleural effusions (PE), defined as an accumulation of fluid in the pleural space due to the broad range of etiology, are a common pathology of any Pulmonology Department; most cases requiring further hospitalization. Although the clinical diagnostic of pleural syndrome is easily done, the etiology is quite difficult to determine (1). The most common respiratory causes of PE are lung cancer, pneumonia and tuberculosis (TB), in various proportion in different parts of the world. In Romania, for example, the main infectious etiology is tuberculosis as TB in Romania is higher compared to other developed countries. In many situations TB needs to be taken into consideration, especially in immunocompromised patient (2,3,4,5,6).

Some pleural involvement, such as TB pleural effusion, hemothorax, empyema, is healing with large pleural sequelae consisting in pachypleuritis, which can limit the expansion of the lung during expiration. For these reasons, patients presenting chronic impaired breathing, thoracic pain, changes in breathing mechanism, gain vicious posture. In time, patients may develop restrictive ventilatory defects, respiratory failure, which leads to impaired quality of life. In recent decades, pulmonary rehabilitation (PR) gained popularity as a non-pharmacological treatment of chronic obstructive pulmonary disease (COPD) as well as of interstitial fibrosis and as a useful procedure before surgical resection of lung cancer (7,8,9,10). COPD, interstitial pneumonias, lung cancer and many other respiratory diseases share common risk factors, such as smoking and environmental exposures (11, 12, 13,14,15). PR include also education and smoking cessation advise besides supervised exercise training programs (7,16,17). Diagnosing tobacco dependence involves both clinical and biological evaluation of the tobacco consumption disorder, together with a psycho-behavioral evaluation (18). We have to emphasize the fact that anxiety and depression are not contraindication for referral the patients to PR; on the contrary, positive results can be obtained on the mental status as a result of an rehabilitation program (7,8,17). There are studies that have shown that PR can also improve the dyspnea and quality of life in patients with acute pleural effusion and extensive pachypleuritis (19). Chest physiotherapy intervention in PE aims to alleviate symptoms and assure minimal damage to lung function. The cases of patients that followed a respiratory physiotherapy program, associated with conventional therapy, support the use of this non-pharmacological

intervention in PE management (20-23). As pleural effusion is a common cause of hospitalisation all over the world, and pachypleuritis as a sequalae of pleural tuberculosis, unfortunately is still prevalent in our country with important impaiment in respiratory function we sought to evaluate the importance of pulmonary rehabilitation on these patients. Therefore this article aims to describe the effects of respiratory rehabilitation (RR) on a series of patients with PE and to summarize the main effective physiotherapy (kinetic therapeutic) techniques, as part of RR programs, that improve the prognostic of disease.

Material and method

This paper presents 3 cases of patients with pleural disease consecutively admitted in the pneumology department that received pulmonary rehabilitation procedures as part of their therapy. All patients signed an informed consent that their data could be used for research purpose. The Hospital Ethics Committee approved the study. The assessment included: demographic, clinical, laboratory data, chest X-Ray, chest scans, pleural ultrasound, types of physiotherapy intervention and evolution under treatment.

Case 1: An infectious parapneumonic effusion (PPE) in a Caucasian, female, 21-year-old student, admitted to the hospital for high fever, bilateral chest pain, polypnea, dry cough, and severe asthenia. Symptoms had an acute onset, with progressive worsening despite Clarithromycin administered before hospitalization. The clinical exam revealed a general impaired status with tachycardia, pharyngeal congestion, dullness, inability to maintain orthostatism, and abolished breath sounds in the inferior part of the left hemithorax, heart rate (HR) of 102 beats per minute, low oxygen saturation (SpO2) of 93%. The laboratory investigation revealed anemia (10,5 g/dl hemoglobin), severe systemic inflammatory syndrome with an elevated erythrocyte sedimentation rate (ESR) of 75 mm/1 hour, fibrinogen (646 mg/dl), C-reactive protein (PCR) level (225 mg/L), white blood cell (WBC) count (18,000/mmc), negative Mycoplasma pneumonia and Chlamydia pneumoniae immunoglobulin M, negative Gram staining smears, negative sputum and blood cultures for Streptococcus pneumoniae, Staphylococcus aureus, Enterobacteriaceae, Pseudomonas aeruginosa and negative tests for A and B influenza virus. Initial thoracentesis revealed an exudative pleural effusion, with 90% of neutrophils and a very elevated value of adenosine deaminase (ADA) of 80 IU. All molecular and bacteriological tests for Mycobacterium tuberculosis detecting in sputum and pleural liquid were negative. Because of the severe onset of illness, the empiric antibiotic treatment was started with Meropenem 3 g/day, Moxifloxacin 400 mg/ day, Vancomycin 2 g/day, and non-steroidal anti-inflammatory drugs. Initially there was positive clinical evolution with improvement of general condition, decreased intensity of chest pain and releasing of dyspnea, but with persistent high fever after ten days of mentioned treatment. The thoracic ultrasound exam showed a large left pleural collection, mainly in the anterior part of the left thorax, with multiple fibrin filaments (Fig. 1).

Fig. 1. The pleural effusion with fibrin filaments at Thoracic ultrasound.

Chest computed tomography (CT) scan showed lateral and anterior loculated pleural fluid (Fig. 2). The intercostal tube drainage of the left pleural cavity revealed the purulent tendency of pleural fluid, suggestive for empyema stage of PPE.

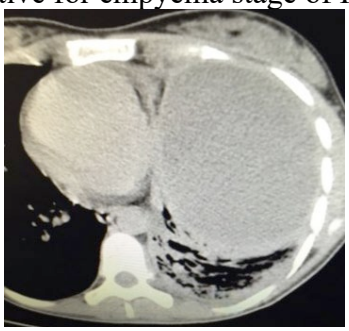

Fig. 2. The loculated pleural effusion revealed on CT scan

A prolonged large spectrum antibiotic treatment was administered for another 10 days, associated with intra-pleural washing with antiseptic solutions by chest tube. After 10 days, chest drain tube was removed and patient started a 14 - days RR program with control breathing exercise, active expiration, pursed lips breathing, abdominal breathing with mobilization of diaphragm, and passive and active limb exercises. The patient was discharged in good

condition, asymptomatic, with no pleural fluid revealed by transthoracic ultrasound. The follow-up 6-month reevaluation revealed normal lung function and normal chest X-Ray (Fig. 3).

Fig. 3. The normal chest X-Ray after 6 month

Case 2 was an 26-year-old Caucasian male, active smoker (8 pack-years), with chest pain, dyspnea, profuse night sweating, productive cough, and mild weight loss. He declared no previous disease or other disorders in his medical history, and occasional consuming of ethanol. Clinical exam revealed an influenced general condition, SpO2=93%, normal blood pressure (BP)=121/67 mmHg, mildly decreased chest movement, stone dullness to percussion, and abolished breath sound on the lower 2/3 parts of the left chest indicating a pleural effusion. Biological investigations showed systemic inflammatory syndrome (ESR=54mm/1h), hepatic cytolysis (ALT=87mg/dl; AST=63 mg/dl) and negative HIV status. ECG revealed sinus tachycardia.

Fig. 4. The large left pleural effusion on chest X-Ray

The chest X-Ray (Fig. 4) showed unilateral medium homogeneous density opacity, localized in the left lower 2/3 zone of the chest, and pleural effusion was confirmed by chest ultrasound. Sputum bacteriological screening for Mycobacterium tuberculosis (MTB) was negative in both microscopy and cultures. Thoracentesis was performed and 1,500 ml of sero-citrine pleural fluid was extracted. The TB etiology was sustained on the results of biochemical, cytological, and bacteriological pleural effusion examination. Rapid liquid of culture BACTEC MGIT revealed a positive presence of mycobacterium tuberculosis in the pleural fluid. The new case of extrapulmonary tuberculosis (EPTB) was declared and first regimen of directly observed anti-TB treatment (DOT) started. Respiratory physiotherapy program was associated, consisting of breathing technique, in the first days with an incentive spirometer 10 minutes every 2 hours, folowed by limb exercises, and treadmill walking. After one month of clinical, functional and radiological therapy, the patient showed a decreased level of PE but with obvious extensive fibrotic lesions of pleura (Fig. 5). So, respiratory rehabilitation was continued as outpatient for one month (breathing exercises, lower and upper limb training) with positive results on dyspnea.

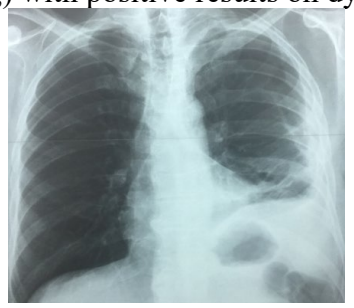

Fig. 5. Chest X Ray: the lateral and basal pachypleuritis

Case 3 was defined by post-TB syndrome complications with bilateral traction bronchiectasis, calcified left pachypleuritis after collapse-therapy, and severe chest kyphoscoliosis in an 84- year-old male, nonsmoker, with pulmonary secondary cavitary tuberculosis at the age of 20, treated only by collapse-therapy. At present, the patient was hospitalized for a persistent purulent cough, aggravated dyspnea (3rd degree on mMRC scale), diffuse chest pain, weight loss, and loss of appetite. The clinical examination at hospital admission revealed a poor general condition, cachexia (body mass index under 20 kg/m^2), sensitivity to palpation of paravertebral zones, the spasticity of the paravertebral muscles, diminished breath sounds on left hemithorax, SpO2=94%, BP=102/64 mmHg, HR=82 bpm, and chest deformation with a retracted and flattened left hemithorax, and a sub-scapular, post-surgical linear scar (Fig. 6).

Fig. 6. Posterior chest deformity

The chest X-Ray showed chest deformation secondary to ancient collapse-therapy, a calcified left pachypleuritis, and accentuated pulmonary draw with a tram line aspect suggesting bronchiectasis (Fig. 7).

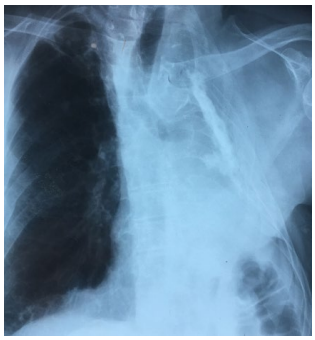

Fig. 7. Chest X-ray: thoracic distorsion due to large calcificated pachypleuritis

All bacteriological examinations in sputum were negative for MTB or other bacteria. The spirometry showed severe restrictive ventilatory dysfunction with 65% decreased forced vital capacity (FVC). During a six-minute walking test (6MWT), the patient walked 300 m (60%) from 498 m predicted distance, with a significant desaturation (decrease of SpO2 from 94% to 90%). During hospitalization, the patient received antibiotics, mucolytics, analgesic, bronchodilators, and a gastric protector associated with RR. The patient followed the technique of relaxation and posture, breathing exercises, diaphragmatic breathing, exercise training. After six weeks of treatment, the patient was discharged in good clinical condition, with a ten percent improvement FVC and a gain of 72 meters walked at the 6MWT. The difference between chest circumference at the end of maximum inspiration and maximum expiration, before and after rehabilitation program, measured the chest mobility and also demonstrated the positive effects results of the intervention.

Discussions

During pleurisy, there are some changes in thoracic mechanics, when the accumulated pleural fluid poses the diaphragm in a position that does not allow it to expand completely. Consequently, the respiratory frequency will increase to compensate the ventilation leading to dyspnea. The main objective of physiotherapy in pleurisy is to break this cycle. In active phase of pleurisy, the exercises must aid pleural fluid resorption, prevent the occurrence of pachypleuritis and relieve the pain.

In the sequelae phase with restrictive syndrome, other symptoms may occur, as dyspnea, decrease exercise tolerance, chronic cough. In this chronic phase of disease, the goal of RR is to reduce the symptoms mentioned above.

The physiotherapy in pleurisy can be divided into different interventions depending on the PE phase (liquid phase, PE drainage, and pachypleuritis).

In the **liquid phase of PE,** physiotherapy has a preventive role to avoid pain and pleural sequelae by re-expanding the lung and increase the diaphragm mobility. The patient must be advised to stay in lateral position, with the pleurisy up, alternating position every 10 minutes with the decubitus dorsal and ventral. Dynamic expiration increases pleural pressure, which makes residual fluid drain through pleural tissue.

Another example of exercise is with patient placed in decubitus on the opposite side of pleurisy, to facilitate ventilation. Physical therapist must stand on the side of pleurisy with a hand under the abdomen of the patient to stimulate the diaphragm and a hand under the chest to stimulate the accessory respiratory muscles, forcing the inspiration. The physical therapist will induce a ventilation cycle based on apnea during inspiratory times. Apneas increase intrathoracic pressure to maximize the mobilization of the pleura. Other recommended types of exercises are diaphragmatic breathing, relaxation breathing exercises, and trunk rotations (5-10 minutes, three times per day), cough control exercises.

In the active phase of pleural disease, incentive spirometry (fig. 8), daily used, it is an useful tool with positive results on liquid resorbtion and thoracic expansion (19,20).

Fig. 8. Incentive spirometry devices

Patients with PE must, also, be advised to have an active lifestyle. Early mobilization and daily walking are recommended, as soon as possible from the first day of diagnosis and continue for at least 3 weeks.

When there is associated pain, physical therapist should do massage of the paravertebral muscle and shoulder muscle (21). Also, the patients could be educated for superior or inferior costal type of breathing (19, 20).

After the acute liquid phase, the exercises are focused on diaphragm training. The exercises consist

of abdominal-diaphragmatic breathing, full cycles of inspiration/expiration, massage to stop painful parietal contractions, posture correction, and bronchial drainage. After one month, the exercise for coastal expansion must be started, to re-expand the lung by lateral inclinations, rotations, upper arm lifting from lateral decubitus on a pillow, asymmetrical suspension with espalier, swimming (crawl style), slow nasal inspiration against resistance, diaphragmatic expansion (forced inspiration with patient half-seated and then supine), or, in ipsilateral decubitus, where the patient is performing maximal expiration followed by Valsalva maneuver (21).

For facilitating **pleural drainage**, RR includes active expiration with passive inspiration to favor the circulation of pleural fluid. Inspiration should be initially passive then active to favor pulmonary re-expansion, and bronchial drainage. After the thoracic drain is removed, the exercise for coastal expansion must be started.

In **pachypleuritis stage,** the pleural adhesions are installed, coastal spaces are narrow, and the diaphragm is elevated in the thoracic cage. The consequences are impaired breathing with dyspnea and diminished exercise tolerance. In these cases, chest exercises may be used, in order to do diaphragmatic mobilization and coastal expansion, but an important support may be represented by exercise training.

Firstly, the individual level of effort tolerance must be evaluated. The tests used are simple, as 6 minutes walking test 6 MWT or complex, as Cardio-pulmonary exercise testing CPET (8). The goal is to determine the intensity of lower limb exercise training (7,17). Aerobic lower limb exercise training may be performed on a velo or treadmill, with the same program design as in COPD. The intensity of training is set up in order to reach 60-80% of the maximal power obtained at CPET or walking tests. The exercise training session work schedule may vary between 30 minutes and one hour, one session per day, 5-7 days per week. Every session must combine lower and uper limb training (cycle, velo, weights).

Walking, climbing stairs or running also have a beneficial role (22-25).

Literature studies support the role of physical therapy in improving the quality of life and promoting healing in pleural effusion. The study of G. Valenza-Demet showed a significant improvement of the forced vital capacity and forced expiratory volume in the first second (FEV1) in patients who follow the physiotherapy program. Also, patients with RR had a better clinical and radiological progression, with a shorter length of hospitalization compared with those who followed only the pharmacological treatment (26.7 ± 8.8 vs. 38.6 ± 10.7 days) (19).

Conclusions

The case reports series revealed the main benefits of physical therapy in patients with different types of pleural involvement. An individualized respiratory rehabilitation program may be usefull in the treatment of patients with pleural effusions because it contributes to a considerable reabsorption of pleural fluids with prevention of large pleural sequelae, optimization of lung expansion, diminished symptoms. The PR program may be also sucessful used in pachypleuritis with functional impact, leading to improved effort tolerance and quality of life.

Acknowledgements.

*Alina Croitoru and Nicoleta Ștefania Motoc had equal contribution to the present work.

**Corresponding author: Gabriela Dogaru, e-mail: dogarugabrielaumf@gmail.com

The authors would like to thanks Stephanie Anna Nicolae for her help in editing the paper.

Declaration of conflicting interest: the authors declare that there are no conflicts of interest.

Ethics: An informed consent was obtained from all the patients presented in the article.

References

1. Cojocaru V, Dantes E, Novac MG, Ionescu AM, Ianosi ES, Rusu E, Nemes RM. The value of adenosine deaminase enzime level in the positive diagnosis of tuberculous pleural effusion. Revista de Chimie. 2018;69(12):3688-3691.
2. Man MA, Arghir OC, Man S et al. Fatal paradoxical cryptic military tuberculosis and immune reconstitution disease in a young non-HIV immunocompromised male patient: case report with autopsy findings. Rom J Morphol Embryol. 2014;55(2):453-457 .
3. Dantes E, Tofolean D, Fildan A.P, Craciun L, Dumea E, Tofolean I.T, Mazilu L. Lethal disseminated tuberculosis in patients under biological treatment – two clinical cases and a short review. J Int Med Res. 2018;46(7):2961-2969.
4. Fildan AP, Toma CL, Tofolean D, Balteanu M, Dantes E. Overlapping tuberculosis in a patient

with pulmonary alveolar proteinosis. Acta Medica Mediterranea. 2016;32:1021-1025 .
5. Man MA, Nitu MF, Strambu L et al. Tuberculous constrictive pericarditis complicated with tuberculous mediastinitis-case report. Rom J Morphol Embryol. 2016;57(1):237-242.
6. 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.
7. Rochester CL, Vogiatzis I, Holland H et al. An Official American Thoracic Society/European Respiratory Society Policy Statement: Enhancing Implementation, Use, and Delivery of Pulmonary Rehabilitation. Am J Respir Crit Care Med Vol 192, Iss 11, pp 1373–1386, Dec 1, 2015.
8. Voicu M T, Lovin S, Friesen M. Tratat de reabilitare pulmonară. Ed. Mirton, Timisoara; 2009. ISBN: 978-973-52-0574-4.
9. Spruit MA et all. An official American Thoracic Society/European Respiratory Society statement: key concepts and advances in pulmonary rehabilitation. Am J Respir Crit Care Med. 2013 Oct 15;188(8):e13-64.
10. Dantes E, Man MA, Tudorache E. The role of pulmonary rehabilitation in patients with idiophatic pulmonary fibrosis. DOI: http://dx.doi.org/10.5772/intechopen.84283 Available from https://www.intechopen.com/online-first/the-role-of-pulmonary-rehabilitation-in-patients-with-idiopathic-pulmonary-fibrosis.
11. Toma CL, Dantes E, Oancea C, Fildan AP. Respiratory bronchiolitis - associated interstitial lung disease - an unexpected form of idiopathic interstitial pneumonia in a young male. Rom J Morphol Embryol. 2017, 58(1):261–265 .
12. Dantes E, Lilios G, Fildan AP. Environmental smoke exposure – an independent risk factor for lung cancer? J Environ Prot Ecol. 2015;16(4):1620-1626.
13. Arghir OC, Halichidis S, Cambrea SC, Ruta MV, Ciobotaru C, Man MA. Environmental risk factors for lung cancer in never-smokers. J Environ Prot Ecol. 2014 Jan 1;15(1):348-52.
14. Dantes E, Fildan AP, Toma CL, Voicu GH, Oancea C. Respiratory impact in workers exposed to air pollutants from petroleum refinery. J Environ Prot Ecol. 2016;17(2):523-531.
15. CE Budin, AD Maierean, ES Ianosi, A Socaci, AD Buzoianu, et al. Nocturnal Hypoxemia, a Key Parameter in Overlap Syndrome. Rev. Chim.(Bucharest). 2019; 70 (2):449-54.
16. Alexescu TG, Măierean A, Ciumărnean L, Budin C, Dogaru G, Todea DA. Rehabilitation therapies in stable chronic obstructive pulmonary disease. Balneo Research Journal. 2019; 10(1): 37-44.
17. Bolton CE, Bevan-Smith EF, Blakey JD, et al. British Thoracic Society guideline on pulmonary rehabilitation in adults. Thorax. 2013;68:Suppl.2, i1–i30.
18. Trofor A, Petris O, Trofor L et al. Biochemistry in Assessing Tobacco Exposure-Smokers versus Non-smokers. Revista de Chimie. 2017;68(5):1002-1006.
19. Valenza-Demet G, Valenza MC, Cabrera-Martos I et al. The effects of a physiotherapy programs on patients with a pleural effusion: a randomized controlled trial. Clinical Rehabilitation. 2014;28(11):1087-1095 .
20. Valenza MC, Valenza-Demet G, Torres-Sanchez I et al. Effectiveness of a respiratory physiotherapy program on pleural effusion: A randomized controlled trial. European Respiratory Journal 2013 42: 3338; Suppl 57.
21. Vandevenne A. Pathologie pleurale in Reeducation respiratoire-Bases cliniques, physiopathologie et resultats, Ed. Mason 1999, pg 207-218.
22. John P. Corcoran, Ioannis Psallidas, John M. Wrightson, Robert J. Hallifax, Najib M. Rahman. Pleural procedural complications: prevention and management. J Thorac Dis. 2015 Jun; 7(6): 1058–1067. doi: 10.3978/j.issn.2072-1439.2015.04.42 PMCID: PMC4466427.
23. Anturia Merţan. Contribution of physical therapy in the complex treatment of pachypleuritis functional reeducation. Revista Romana de Kinetoterapie. 2012; 18(29):27-37 .
24. Gabriela Jimborean, Edith Simona Ianosi ”Pneumologie. Diagnosticul și tratamentul afecțiunilor pleurale. Ed. University Press, Târgu-Mureş, **2016**-159 pg, ISBN 978–973–169–459–7, codCNCS210/.
25. McCarthy B, Casey D, Devane D, Murphy K, Murphy E, Lacasse Y. Pulmonary rehabilitation for chronic obstructive pulmonary disease. Cochrane Database Syst Rev. 2015 Feb 23;(2):CD003793.