Case Report

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Manual chest physiotherapy during whole-lung lavage in pulmonary alveolar proteinosis

Umut Bahcaci, Songul Atasavun Uysal[1]

ORCID:
Umut Bahcaci: http://orcid.org/0000-0002-2567-4795
Songul Atasavun Uysal: http://orcid.org/0000-0001-7374-411X

Abstract:

Pulmonary alveolar proteinosis (PAP) is a diffuse lung disease that appears after the accumulation of lipoproteinaceous material in the alveoli. We aimed to compare the effects of using chest physiotherapy during a whole-lung lavage (WLL) to those without its use in a PAP case. A 33-year-old male patient with complaints of difficulty breathing, coughing, and dyspnea was admitted to the hospital. After the patient underwent a chest screening and diagnostic tests, WLLs were planned for his left and right lungs on separate days. Manual chest physiotherapy, including tapotement and vibration, was performed during the right WLL at the physician's request. Much more lipoproteinaceous material was visually detected in the saline collection bottles after the WLL using manual tapotement and vibration when compared to the WLL without tapotement and vibration. The improvement in the patient's clinical status was supported by chest X-ray and auscultation results.

Keywords:

Bronchoalveolar lavage, pulmonary alveolar proteinosis, pulmonary rehabilitation

Introduction

Pulmonary alveolar proteinosis (PAP) is a diffuse lung disease that appears after the accumulation of lipoproteinaceous material in the alveoli.[1] The estimated incidence and prevalence rates are 0.49 ± 0.13/year and 6.2 cases per million, respectively.[2] A whole-lung lavage (WLL) has been the cornerstone of PAP therapy since it was first described. The importance of a multidisciplinary team during WLL has been emphasized recently.[3-5] Chest physiotherapy during WLL can help a clinician to drain more lipoproteinaceous material from the lung so that the patient's clinical condition shows greater improvement. Literally, the chest physiotherapy method during WLL varies a lot. The type of chest physiotherapy depends on the demand of the multidisciplinary team and within the bounds of possibility. Chest physiotherapy during WLL may include tapotement, vibration, positional changes, and even an oscillation device.[1,3-5] The purpose of this study was to compare the effects of chest physiotherapy in a right WLL procedure to those without chest physiotherapy in a left WLL procedure with a 2-week break between the WLLs in the same PAP case. Tapotement – performed after instillation of saline – and vibration – while draining the saline, with positional changes, were preferred for chest physiotherapy as the consensus of the multidisciplinary team.

Case Report

A 33-year-old male patient with a history of a previous diagnostic thoracotomy and five

Department of Physiotherapy, Gayrettepe Florence Nightingale Hospital, Istanbul, [1]Department of Physiotherapy and Rehabilitation, Faculty of Physical Therapy and Rehabilitation, Ankara, Turkey

Address for correspondence:
Umut Bahcaci PT, Msc, Department of Physiotherapy, Gayrettepe Florence Nightingale Hospital, Cemil Aslan Guder Sk., No: 8, Besiktas, Istanbul 34349, Turkey.
E-mail: umutbahcaci@gmail.com

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lung lavages was admitted to the hospital. His complaints included difficulty breathing, coughing, and dyspnea. His peripheral capillary oxygen saturation (SpO_2) was 84% on room air, his temperature was 36.7°C (fever), and his pulse rate was 80 beats/min. The computed tomography (CT) results revealed crazy-paving ground-glass opacity superimposed septal thickening on both lungs [Figure 1]. A granulocyte-macrophage colony-stimulating factor (GM-CSF) antibody concentration test was conducted at a clinical research laboratory in the USA, and the results showed a high value (117.9 μg/ml). Therefore, the patient was diagnosed as having idiopathic PAP, and GM-CSF inhalation therapy was planned. Despite the GM-CSF treatments and previous lung lavages, the lesions had progressed on the CT scans after the treatments. Thus, the left and right WLLs were planned 2 weeks apart. Chest physiotherapy was planned for these WLLs even though it had not been used in the previous lung lavages.

Left whole-lung lavage procedure

The patient was sedated and intubated via a double-lumen Carlens tube for the left WLL procedure. The right main bronchus was ventilated via the obstruction of the main carina. Flexible bronchoscopy was performed to ensure that the right lung was inhalated and the left lung was open for lavage. The patient was placed in the left decubitus position, and bronchoscopy was performed again to fix any malpositioning. Then, 0.9% saline at 37°C was delivered to the left lung in 1000 ml portions. After delivering each saline to the lung, the patient was moved to the Trendelenburg position to allow the fluid to drain freely back into the saline collection bottles. No chest physiotherapy was performed during the WLL in this session at the physician's demand. Twenty bottles of saline (1000 ml) were used for the left WLL, and 90% of the fluid delivered was drained. Drained proteinosis was rarely observed in the saline collection bottles.

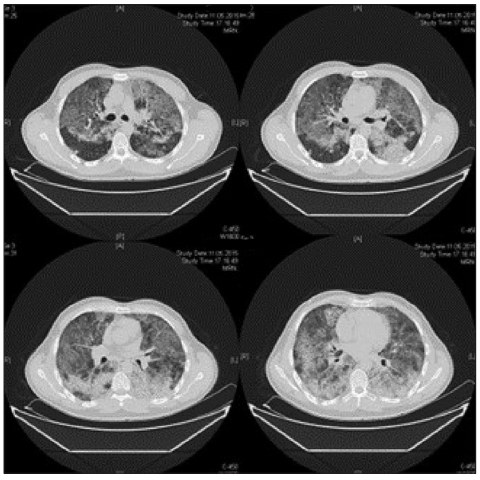

Figure 1: Computed tomography scan showing crazy-paving ground-glass opacity superimposed septal thickening

Right whole-lung lavage procedure and physiotherapy intervention

The right WLL was performed 2 weeks after. All the procedures applied for the left lung (as mentioned above) were also applied for the right lung; in addition, chest physiotherapy was performed at another physician's demand. The chest physiotherapy was performed in the form of 5 min of both manual tapotement and vibration ([2 min of tapotement and 30 s of vibration] × 2). First, 1000 ml of 0.9% saline was delivered to the right lung. Then, the manual tapotement and vibration were performed by the physiotherapist from the posterior of the right lung, while the patient was in the right lateral decubitus position. Afterwards, the vibration continued throughout draining the fluid back in the position with a 15°–30° incline with the patient's feet elevated above his head. This final position was used to drain the fluid more effectively. This lavage procedure was continued until the fluid remained clear. Twenty-two bottles of saline were used for the right lung lavage, and 97% of the fluid delivered was recovered. The physiotherapy method chosen for this procedure was discussed and agreed upon by both the physician and the physiotherapist.

Physiotherapy examination and results

Along with the clinical findings mentioned above, 6-min walking test (6-MWT) and pulmonary function test were also performed before and after the second (right) WLL. The 6-MWT showed 26% desaturation, and the pulmonary function test revealed moderate obstruction and moderate restriction (forced expiratory volume in 1 s [FEV_1] = 55% and FEV_1/forced vital capacity [FVC] = 104%). The physician consulted with the patient for preoperative pulmonary rehabilitation before the right WLL procedure.

After each WLL, the patient was transferred to the intensive care unit for overnight observation. His SpO_2 values were 88% and 92% during the first and second WLLs, respectively. The drained proteinaceous material in the saline bottles was much more obvious in the second WLL than in the first WLL [Figure 2]. The patient's difficulty breathing, coughing, and dyspnea decreased after both lavages, but they were slightly more decreased after the second lavage. In addition, the patient described a reduction in his

Figure 2: Drained bottles after left (a) and right (b) lung lavages

symptoms and an improvement in his quality of life. These subjective findings were supported by chest X-ray [Figure 3] and auscultation. The 6-MWT was performed 6 days after the right WLL, and the patient exhibited only 15% desaturation at the end of the test. However, the pulmonary function test demonstrated approximately the same results as the pretest parameters (FEV_1 = 54% and FEV_1/FVC = 105%). The lower limit of normal distance was calculated from the reference equation for the 6-MWT in healthy adults, and the results were 568 m and 571 m for the first and second tests, respectively. The patient could not reach the desired distance in each 6-MWT, but the distance increased by 42 m after the second (right) lung lavage. After 5 days of follow-up in the hospital, the patient was discharged in good condition. Written informed consent was obtained from the patient for the publication of the case report and the accompanying images.

Discussion

Few studies have recommended a WLL for the treatment of PAP since it was first mentioned.[6-8] Chest physiotherapy techniques, which have not yet been standardized, could be utilized during a WLL treatment. Kumar *et al*. recommended the use of a "vest" oscillation system, which vibrates the lung mechanically, to help with mobilizing the secretions. They also mentioned that using the oscillation system could decrease the total operating room time by 86 min.[1] Hammon *et al*. compared manual and mechanical chest tapotement techniques for the clearance of alveolar material in a patient with PAP, and they reported that the manual chest tapotement was significantly superior to the mechanical tapotement.[9] In this case, a manual technique was preferred due to the absence of a mechanical oscillation system. The tapotement and vibration were performed after instilling the saline and up to 5 min before draining. In addition, the vibration continued while the saline was drained from the lung. Based on the similarities and differences of the studies mentioned above, improvements in the operational and clinical outcomes were found when using the manual physiotherapy technique. Although the use of the mechanical technique has an advantage regarding the labor force, the manual technique can be used effectively if no mechanical device is available.

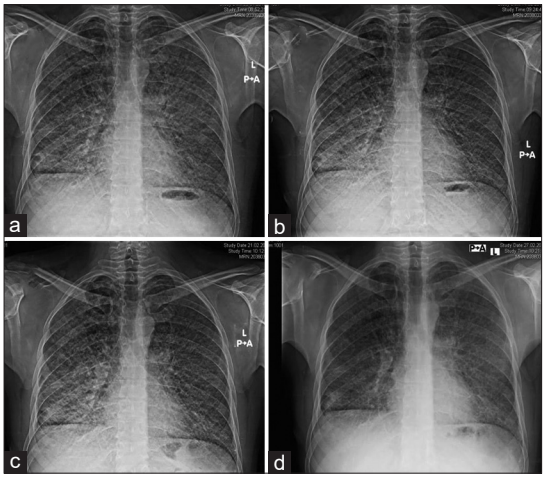

Figure 3: Chest radiograph before (a) and after (b) left lung lavages, and before (c) and after (d) right lung lavages

The pulmonary function test demonstrated no difference in the results after the second lung lavage. When the 6-MWT test results were compared with the pulmonary function test results, it was determined that the improvement in the functional capacity could be more considerable for this patient.

The WLL procedure for PAP treatment requires a multidisciplinary team, including pulmonologists, anesthetists, and physiotherapists.[3-5] The benefit of the multidisciplinary work is well observed in this case. Multidisciplinary approaches should be encouraged for the WLL procedure in the treatment of PAP.

The operation outcomes demonstrated the increased effects of the tapotement and vibration procedure (e.g., visually detectable lipoproteinaceous material in the saline bottles, improved chest radiography, increased vital parameters, and improved functional capacity). However, there are no standardized techniques or guidelines for the tapotement or vibration procedures; therefore, we thought that it would be effective to perform the tapotement and vibration with positional changes after instilling and while draining the saline. It is necessary to expand the study group in the future to establish a high level of evidence for this treatment procedure.

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Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest
There are no conflicts of interest.

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