

Chest Mobility Exercise with Staked Breathing Versus Chest Mobility Exercises with Incentive Spirometry On Chest Expansion with Pleural Effusion Patient: A Comparative Study

Minhaj Tahir ^{*1}, Tahzeeb Fatima ², Devendra Trivedi ³, Manjit Kumar ⁴.

^{*1} Assistant Professor, Department of Physiotherapy, Rama University, Kanpur, Uttar Pradesh, India.

² Assistant Professor, Department of Physiotherapy, Rama University, Kanpur, Uttar Pradesh, India.

³ Assistant Professor, Department of Physiotherapy, Rama University, Kanpur, Uttar Pradesh, India.

⁴ Assistant Professor, Department of Physiotherapy, Rama University, Kanpur, Uttar Pradesh, India.

ABSTRACT

Background: Pleural effusion is one of the commonly seen respiratory conditions in India with approximately 1 million people being diagnosed each year. Twenty to forty percent of hospitalized patients with bacterial pneumonia develop pleural effusion. In India unlike western countries, tuberculosis pleura effusion is common. The pleural cavity is involved in approximately 5% of all patients with tuberculosis. Since there was no literature regarding the effectiveness chest mobility exercise with staked breathing or chest mobility exercises with incentive spirometry in pleural effusion. There was a need to find out as to which approach are the best ones to implement.

Objective: To compare the efficacy of chest mobility exercise with stacked breathing versus chest mobility exercise with incentive spirometry on chest expansion in patients with pleural effusion.

Materials and Method: 20 patients with pleural effusion were selected by easy sampling and randomly assigned into two groups (10 patients each group). Group A received chest mobility exercises and intensive spirometry and group B received chest mobility exercises and stacked breathing. Both groups were instructed to perform the intervention 3 times per day, 8 to 10 times per session for one week. Chest expansion was measured by thoracic flow cytometry before and after one week of intervention.

Result: In group A chest expansion increase from 2.68 to 2.87 which was statistically significant (P value < 0.0023). In Group B the chest expansion increases from 2.94 to 3.09 which was not statistically significant (P value < 0.216).

Conclusion: It was concluded from the result that both chest mobility exercises with intensive spirometry and chest mobility exercise with stacked breathing are equally effective in improving the chest expansion in subject with pleural effusion.

KEYWORDS: Pleural effusion, Chest mobility exercises, Incentive Spirometry, Stacked breathing, Thoracic flow cytometry.

Address for correspondence: Dr. Minhaj Tahir, Assistant Professor, Department of Physiotherapy, Rama University, Kanpur, Uttar Pradesh, India. **E-Mail:** minhajtahirsart@gmail.com

Access this Article online	Journal Information
Quick Response code  DOI: 10.16965/ijpr.2021.155	International Journal of Physiotherapy and Research ISSN (E) 2321-1822 ISSN (P) 2321-8975 https://www.ijmhr.org/ijpr.html DOI-Prefix: https://dx.doi.org/10.16965/ijpr 
	Article Information
	Received: 11 Jun 2021 Peer Review: 15 Jun 2021 Revised: None
	Accepted: 13 Jul 2021 Published (O): 11 Aug 2021 Published (P): 11 Aug 2021

INTRODUCTION

A pleural Effusion is accumulation of excessive fluid in the pleural space, the potential space that surrounds each lung

caused by disturbed osmotic or hydrostatic pressure in the plasma [1,2]. Under normal condition, pleural fluid is secreted by the parietal pleural capillaries at a rate of 0.01 milliliter per kilogram weight per hour, and is cleared by lymphatic absorption leaving behind only 5-15 milliliters of fluid, which helps to maintain a functional vacuum between the parietal and visceral pleurae. Excess fluid within the pleural space can impair inspiration by upsetting the functional vacuum and hydrostatically increasing the resistance against lung expansion, resulting in a fully or partially collapsed lung.

Various kinds of fluid can accumulate in the pleural space, such as serous fluid (hydrothorax), blood (hemothorax), pus (pyothorax, more commonly known as pleural empyema). When unspecified, the term "pleural effusion" normally refers to hydrothorax. A pleural effusion can also be compounded by a Pneumothorax, leading to a hydro-pneumothorax. A pleural effusion may be transudative or exudative. A transudative develops when fluid from the pulmonary capillaries moves into the pleural space. The fluid is thin and watery, containing a few blood cells and little protein. The pleural surfaces are not involved in producing the transudate. In contrast, an exudate develops when the pleural surface are diseased. The fluid has high protein content and a great deal of cellular debris. Exudates are usually caused by inflammation, infection or malignancy [3].

The common transudative causes of pleural effusion are left ventricular failure, cirrhotic liver disease, peritoneal dialysis, hypoalbuminaemia, nephritic syndrome, pulmonary embolism, hypothyroidism, and mitral stenosis, and the common exudative cause are parapneumonic effusion, malignant neoplasm, pulmonary embolism, rheumatoid arthritis, pancreatitis, autoimmune disease etc [4].

When a pleural effusion has been determined to be exudative, additional evaluation is needed to determine its cause, and amylase, glucose; pH and cell count should be measured. Red blood cell counts are elevated in cases of bloody effusion (for example after

heart surgery or hemothorax from incomplete evacuation). Amylase levels are elevated in cases of esophageal rupture, pancreatic pleural effusion, or cancer. Glucose is decreased with cancer, bacterial infections, or rheumatoid pleuritis. PH is low in emphysema (<7.2) and may be low in cancer.

If cancer is suspected, the pleural fluid is sent for cytology. If cytology is negative, and cancer is still suspected, either a thoracoscopy, or needle biopsy of the pleura may be performed [5]. The most common causes of exudative pleural effusion are bacterial pneumonia, cancer, viral infection, and pulmonary embolism. Other common cause is after heart surgery, when incompletely response that causes exudative pleural fluid. Conditions associated with exudative pleural effusion [6]. Parapneumonic effusion due to pneumonia, malignancy, infection, trauma, pulmonary infarction, pulmonary embolism, autoimmune disorder, pancreatitis, Ruptured esophagus, rheumatoid pleurisy, and drug-induced lupus. Pleural effusion may also occur through medical or surgical interventions, including the use of medications, coronary artery bypass surgery, abdominal surgery, endoscopic variceal sclerotherapy, radiation therapy, liver or lung transplant, insertion of ventricular shunt as a treatment method of hydrocephalus [7,8], and intra or extra vascular insertion of central lines.

The physiotherapy management of pleural effusion would include breathing exercises, localized expansion exercises, belt exercises; positioning etc [9]. Chest mobility exercises are effective in improving the mobility of the chest wall, trunk, shoulders, increasing ventilation on that side of the chest, emphasizing depth of inspiration and controlling expiration. These exercises are effective in improving the chest expansion in subjects with pleural effusion. Study [10] concludes that chest mobility exercises have resulted in betterment of respiratory functions such as reduction in dyspnea level and significant improvement in chest expansion when implementing a specific stretching protocol in complications such as secretion retention and pleural effusion following a percutaneous pig tail nephrostomy

[11]. Incentive spirometry has been found to be appropriate for lung expansion following major thoracic surgery [12], but it is not known whether incentive spirometry can produce similar kind of re-expansion in subjects with unilateral pleural effusion. Also, the breath stacking technique has shown to be effective particularly in uncooperative patients following abdominal surgeries [13] and in mobilizing greater lung volumes [14] and in achieving and sustaining deep inspiration, even in uncoached patients [14]. But it is not known whether it will have similar effects in patients with unilateral pleural effusion. Therefore, there exists a need to compare the effectiveness of chest mobility exercises with incentive spirometry and chest mobility exercises with stacked breathing on the chest expansion in patients with unilateral pleural effusion.

MATERIALS AND METHODS

The source of data was Leelamani Hospital, Kanpur. 20 patients with pleural effusion were collected by convenience sampling. Patients of both genders in the age group of 20-50 years, diagnosed as unilateral pleural effusion with asymmetrical chest expansion were included in the study. However, patients with orthopaedic conditions, hypertension, malignancy, cognitive impairments, and pleural effusion due to transudate conditions like liver cirrhosis, CCF etc. and those who refused were excluded. After getting ethical clearance subjects were enrolled in the study. Patients with unilateral pleural effusion were recruited from the medical ward of the hospital. Patients were selected based on the inclusion and exclusion criteria. Following an initial assessment the patients were assigned to one of the two groups by block randomization. After randomizing the patient to one of two groups, before the intervention chest expansion was measured by Thoracic flow cytometry [15].

Basal expansions were determined by using a tape measure as it is known that pleural effusion accumulates in the lower zones. Each measurement was obtained after maximal expiration followed by maximum inspiration

and another maximal expiration. Measurements were taken twice and the mean of the two values was recorded. Group A received chest mobility exercises with incentive spirometry [16] and the AARC [17]. Group B received chest mobility exercises with stacked breathing according to guidelines given by Kisner (Milojević *et al.*, 2003) and breath stacking technique explained by Providence Care. Both groups were instructed to perform the intervention 3 times per day, 7-8 times per session for one week. Thoracic flow cytometry was repeated after one week. Data analysis was performed by SPSS. Alpha value was set as 0.05. Paired t test was used to find out significant differences for the chest expansion within the groups. Unpaired t test was used to find out significant differences for the chest expansion between the groups.

RESULTS

Data are mean \pm standard deviation. In group A the mean age was 37.50 and sd was 5.86 and in group B the mean age was 38.36 and sd is 6.20 which is not statistically significant (p value greater than 0.631). In group A there were 6 males and 7 females, in group B there were 7 males and 6 females which was not statistically significant (p value greater than 0.604). In group A there were 9 right sided and 4 left sided pleural effusion and in group B there were 8 right sided and 5 left sided pleural effusion which was statistically not significant (p value greater than 0.604). In summary demographic variables were homogeneous between groups.

Table 1: Base line data for demographic variables.

S. No.	Variable	Group A	Group B	P value
1	Age	37.50 \pm 5.86	38.36 \pm 6.20	>0.631
2	Gender	6/7	7/6	>0.604
3	Side	9/4	8/5	>0.604

Table 2: Baseline Data for outcome variables.

S. No.	Variable	Group A	Group B	P value
1	Upper zone	0.18 \pm 0.41	0.14 \pm 0.22	>0.725
2	Middle zone	0.44 \pm 0.42	0.68 \pm 0.22	>.024
3	Lower zone	0.47 \pm 0.41	0.75 \pm 0.58	>0.110

Data are mean \pm standard deviation. In group A the mean upper zone chest expansion was 1.29 and sd was 0.41, and in group B it was 0.14 and sd was 0.22 which was not

statistically significant (p value greater than 0.725). In group A the mean middle zone chest expansion was 0.44 and sd was 0.42, and in group B it was 0.68 and sd was 0.22 which was not statistically significant (p value greater than 0.024). In group A the mean lower zone chest expansion was 0.47 and sd was 0.41, and in group B it was 0.75 and sd was 0.58 which is not statistically significant (p value greater than 0.110). In summary the outcome variables were homogeneous between groups.

Table 3: Pre post difference with in group A.

S. No.	Variable	Pre	Post	P value
1	Upper zone	0.18±0.41	0.20±0.40	>0.053
2	Middle zone	0.44±0.42	0.46±0.42	>0.078
3	Lower zone	0.47±0.41	0.66±0.41	<.0001

Table 4: Pre post difference with in group B.

S. No.	Variable	Pre	Post	P value
1	Upper zone	0.14±0.22	0.50±0.26	<.0001
2	Middle zone	0.68±0.22	0.71±0.23	>.003
3	Lower zone	0.75±0.58	1.06±0.56	<.0001

Table 5: Mean difference between groups.

S. No.	Variable	Group A	Group B	P value
1	Upper zone	0.20±0.40	0.50±0.26	>.056
2	Middle zone	0.46±0.42	0.71±0.23	>.020
3	Lower zone	0.66±0.41	1.06±0.56	<.080

However when comparing between groups, the mean increase in upper zone chest expansion in group A was 0.20 with sd 0.40 and in group B it was 0.50 with sd 0.26 which was not statistically significant (p value greater than 0.056). Mean increase in middle zone chest expansion in group A was 0.46 with sd 0.42 and in group B was 0.71 with sd 0.23 which was not statistically significant (p value greater than 0.020). Mean increase in lower zone chest expansion was 0.66 with sd 0.41 in group A and in group B it was 1.06 with sd 0.56 which was statistically significant (p value less than 0.080).

DISCUSSION

The objective of this study was to compare the efficacy of chest mobility exercises and incentive spirometer with that of chest mobility exercises and stacked breathing on chest expansion in subjects with unilateral pleural effusion. Group A which has undergone chest mobility exercises with incentives spirometer has shown statistically significant increase in chest expansion in the lower zones.

Group B which has undergone chest mobility exercises with stacked breathing has shown statistically significant increase in chest expansion in the upper and lower zones. However, results did not show any statistically significant difference between group A and group B. A study done by Vikram *et al* who evaluated the effects of chest mobility exercises as an adjunct modality in post operative pulmonary management and concluded that chest mobility exercises can enhance the chest wall elevation, thus increasing expansion [10].

In the present study chest mobility exercises were carried out in both the groups. This could have resulted in equal improvement within group for lower zones and since both groups have undergone chest mobility exercises there was no difference between groups. Another possible mechanism could have been an equivalent increase in the trans-pulmonary pressure both during incentive spirometry in group A and stacked breathing in group B because of which there was no statistically significant difference between the groups for lower zones. This study has many limitations. Length of hospital stay and the medications varied for each individual. BMI was not considered which could have influenced the study because if the patient is obese the chest expansion is restricted. Small number of subject with unilateral pleural effusion was taken in each group, which decreases the applicability to whole populations. There was no method undertaken in the study to ensure that the subject perform regular exercises without fail on a regular basis as there was no reliable and valid method found to ensure their regular follow up or to keep a check on their compliance to exercise.

CONCLUSION

The study concludes that both the techniques were equally effective in improving the chest expansion in subjects with unilateral pleural effusion.

Conflicts of interest: None

REFERENCES

- [1]. Hough Alexandra 2001. Physiotherapy in respiratory care. An evidence based approach to respiratory and cardiac management 3rd ed. P.98.

- [2]. Gupta A.K, berry, M. Ventriculo-peritoneal shunt presenting with recurrent pleural effusion; Report a new complication. *Pediatric Radiology*. 1994;24(2). Dio: 10.1007/bf02020178. ISSN 030-0449. PMID 8078722. S2CID 29-16135.
- [3]. Jardins, T.D., Burton, G.G. clinical manifestation and assessment of respiratory disease. 5th ed. p. 319-323.
- [4]. McGrath, E.E., Anderson, P.B. Diagnosis of pleural effusion: A systematic Approach. *American journal of critical care*.2001;March; 20(2).
- [5]. De Menezes Lyra R. A modified outer cannula can help thoracentesis after pleural biopsy". *Chest*. 1997;112(1):296. Doi; 10.1378/ chest. 112.1.296. PMID 9228404.
- [6]. Galagan et al. color atlas of body fluids.CAP press, Northfield, 2006
- [7]. Light RW, Girard WM, Jenkinson SG, George RB, Parapneumonoc effusion. *A.M J Med* 1980; 69:507-12.
- [8]. Squire, LUCY Frank; Novelline, Robert A. (2004). "Squire fundamental of radiology ". Cambridge: Harvard University Press. PP. 132-3. ISBN 0-674-01279-8.
- [9]. Downie, P.A. 1987.Cash's textbook of chest, heart and vascular disorders for physiotherapy. 4th ed. P. 533.
- [10]. Vikram, M., Leonard, J.H. and Kamaria, K. Chest Wall Stretching Exercise as an Adjunct Modality in Post Operative Pulmonary Management.2012; Mar 4.
- [11]. Ferreira, G.M., Haeffner, M.P, Barreto, S.S., Dall'Ago, P. Incentive spirometry with expiratory positive airways pressure brings benefits after myocardial revascularization. 2010 Feb; 94(2):230-5, 246-51, 233-8.
- [12]. Baker, W.L., Lamb, V.J., Marini, J.J. Breathstacking increases the depth and duration of chest expansion by incentive spirometry. 1990 Feb; 141(2):343-6.
- [13]. Agostini, P. and Singh, S. Incentive spirometry following thoracic surgery: what should we be doing? 20o9 Jun; 95(2):76-82. Epub 2009 Mar 3.
- [14]. Vikram, M., Leonard, J.H. and Kamaria. Chest Wall Stretching Exercise as an Adjunct Modality in Post Operative Pulmonary Management. Mar 4.2012.
- [15]. Kakizaki, F., Shibuya, M., Yamazaki, T., Yamada, M., Suzuki H. and Homma, I. Preliminary report on the effects of respiratory muscle stretch gymnastics on chest wall mobility in patients with COPD. *Respir Care*, 1999;44:409-14.
- [16]. Milojeviæ, M., Kuruc, V.Laser biostimulation in the treatment of pleurisy. 2003 Nov-Dec; 56 (11-12):516-20.
- [17]. AARC Clinical Practice Guideline; Reprinted from the December 1991 issue of *Respiratory Care* [Respir Care 1991;36(12):1402–1405.

How to cite this article: Minhaj Tahir, Tahzeeb Fatima, Devendra Trivedi, Manjit Kumar. Chest Mobility Exercise with Staked Breathing Versus Chest Mobility Exercises with Incentive Spirometry On Chest Expansion with Pleural Effusion Patient: A Comparative Study. *Int J Physiother Res* 2021;9(4):3949-3953. DOI: 10.16965/ijpr.2021.155