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COMPARATIVE STUDY BETWEEN CHEST MOBILITY EXERCISES WITH INCENTIVE SPIROMETRY VERSUS CHEST MOBILITY EXERCISES WITH STACKED BREATHING ON CHEST EXPANSION IN SUBJECTS WITH UNILATERAL PLEURAL EFFUSION

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ABSTRACT

Background: Pleural effusion is one of the commonly seen respiratory conditions in India with approximately 1 million people being diagnosed each year. Since there was no literature regarding the effectiveness of incentive spirometryand stacked breathing in Unilateral 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 exercises and incentive spirometry with that of chest mobility exercises and stacked breathing on chest expansion in subjects with unilateral pleural effusion.

Methodology: 30 subjects with unilateral pleural effusion were selected by convenience sampling and randomly assigned into two groups (15 subjects each). Group A received Chest mobility exercises and Incentive spirometry and Group B received Chest mobility exercises and Stacked breathing. Both groups were instructed to perform the intervention 3 times per day, 7-8 times per session for one week. Chest expansion was measured by Thoracic flow cytometry before and after one week of intervention.

Results: In group A the LZ chest expansion increased from 1.58 to 1.77 which was statistically significant (p value < 0.0001). In group B the LZ chest expansion increased from 1.86 to 2.07 which was statistically significant (p value< 0.0001). However when comparing between groups, mean increase in LZ chest expansion was 1.77 in group A and in group B it was 2.07 which was not statistically significant (p value < 0.191).

Conclusion: It was concluded from the results that both Chest mobility exercises with Incentive spirometry and Chest mobility exercises with Stacked breathing are equally effective in improving the chest expansion in subjects with Unilateral Pleural effusion.

INTRODUCTION

Pleural effusion occurs when there is excess fluid in the pleural cavity, caused by disturbed osmotic or hydrostatic pressure in the plasma, or changes in membrane permeability (Hough Alexandra, 2001). A pleural effusion may be transudative or exudative. A transudate 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 surfaces are diseased. The fluid has a high protein content and a great deal of cellular debris. Exudates is usually caused by inflammation, infection or malignancy (Jardins).

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The common transudative causes of pleural effusion are left ventricular failure, cirrhotic liver disease, peritoneal dialysis, hypoalbuminaemia, nephrotic syndrome, pulmonary embolism, hypothyroidism and mitral stenosis and the common exudative causes are parapneumonic effusions, malignant neoplasm, pulmonary embolism, rheumatoid arthritis, pancreatitis, autoimmune diseases etc (McGrath, 2011). The clinical features of pleural effusion are increased respiratory rate, increased heart rate, cardiac output and blood pressure, chest pain, cyanosis and cough (productive or non-productive). The physical signs include reduced chest wall movement on the affected side, stony dullness on percussion, and reduced or absent breath sounds and vocal resonance. Large effusions cause displacement of the trachea and mediastinum to the opposite side (Jardins, and Colledge *et al*., 2002). In a recent study by Kalantri *et al* 10 in 278 patients (of whom 57% had pleural effusions) asymmetric chest expansion had a sensitivity of 74% and a specificity of 91%.

Furthermore, when the pretest probability of disease based on other clinical findings was applied, symmetrical chest expansion was associated with a very low probability (8%) of pleural effusion (Guzman and Budev, 2008). The physiotherapy management of pleural effusion would include breathing exercises, localized expansion exercises, belt exercises, positioning etc. (Downie, 1987; Darlene Reid, 2004). 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 done by Vikram *et al* (2012) 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 (Ferreira *et al*., 2010). Incentive spirometryhas been found to be appropriate for lung re-expansion following major thoracic surgery (Baker, 1990), 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 (Agostini, 2009) and in mobilizing greater lung volumes[17] and in achieving and sustaining deep inspiration, even in uncoached patients (Vikram, 2012). 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 spirometryand chest mobility exercises with stacked breathing on the chest expansion in patients with unilateral pleural effusion.

Objectives of the Study

- To determine the efficacy of chest mobility exercises and incentive spirometry on chest expansion in subjects with unilateral pleural effusion.
- To determine the efficacy of chest mobility exercises and stacked breathing on chest expansion in subjects with unilateral pleural effusion.
- To compare the efficacy of chest mobility exercises and incentive spirometry with that of chest mobility exercises and stacked breathing on chest expansion in subjects with unilateral pleural effusion.

Research Hypothesis

There will be no significant difference between the effectiveness of chest mobility exercises with incentive spirometryand chest mobility exercises with stacked breathing on chest expansion in subjects with unilateral pleural effusion.

MATERIALS AND METHODS

The source of data wereESI Hospital, Rajajinagar, Bangalore and K C General Hospital, Malleshwaram, Bangalore. 30 subjects with Pleural effusion were collected by Convenience sampling. The type of study was an Experimental study with pre post test design and the duration of study was 6 months. Materials used in the study were a couch, paper, pen, incentive spirometer, measuring tape and the measuring tool was Thoracic flow cytometry (with measuring tape in cms.) Subjects 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, subjects with orthopaedic conditions, hypertension, malignancy, cognitive impairments, pleural effusion due to transudate conditions like liver cirrhosis, CCF etc. and those who refused were excluded.

Procedure

Intervention to be done on the participants

After getting ethical clearance subjects were enrolled in the study. Patients with unilateral pleural effusion were recruited from the medical ward of the hospital. Subjects 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 according to Kakizaki *et al*. (1999). 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 according to guidelines given by Kisner (Milojević, 2003) and the AARC (AARC Clinical Practice Guideline. 1991).
- **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 (*http://www.providencecare.ca/obkects/content_revision/download.cfm/revision_id-4/Breath%20Stacking%20handbook.pdf/2008;1-11*).

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.

Figure 1. Chest Mobility Exercises

Figure 2. Chest Mobility Exercises

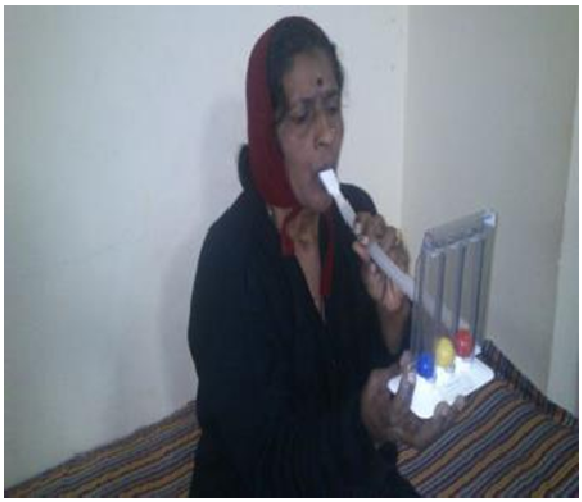

Figure 3. Incentive spirometry

Figure 4. Stacked Breathing

Outcome Measure

Chest expansion.

Figure 5. Thoracic flow cytometry

Data Analysis

Data analysis was performed by SPSS (version 17) for windows. 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 ± standard deviation (sd). In group A the mean age was 38.60 and sd was 6.97 and in group B the mean age was 39.47 and sd is 7.30 which is not statistically significant (p value greater than 0.742). In group A there were 7 males and 8 females, in group B there were 8 males and 7 females which was not statistically significant (p value greater than 0.715). In group A there were 10 right sided and 5 left sided pleural effusion and in group B there were 9 right sided and 6 left sided pleural effusion which was statistically not significant (p value greater than 0.705) In summary demographic variables were homogeneous between groups.

Table 1. Base line data for demographic variables

Sl No	Variable	Group A	Group B	P value
1	Age	38.60±6.97	39.47±7.30	>.742
2	Gender(M/F)	7/8	8/7	>.715
3	Side	10/5	9/6	>.705

Data are mean ± standard deviation (sd). In group A the mean age was 38.60 and sd was 6.97 and in group B the mean age was 39.47 and sd is 7.30 which is not statistically significant (p value greater than 0.742). In group A there were 7 males and 8 females, in group B there were 8 males and 7 females

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Table 2. Baseline Data for outcome variables

Sl No	Variable	Group A	Group B	P value
1	Upper Zone	1.29±0.52	1.25±0.33	>.836
2	Middle Zone	1.55±0.53	1.79±0.33	>.135
3	Lower Zone	1.58±0.52	1.86±0.69	>.220

Data are mean ± standard deviation (sd). In group A the mean UZ chest expansion was 1.29 and sd was 0.52, and in group B it was 1.25 and sd was 0.33 which was not statistically significant (p value greater than 0.836). In group A the mean MZ chest expansion was 1.55 and sd was 0.53, and in group B it was 1.79 and sd was 0.33 which was not statistically significant (p value greater than 0.135). In group A the mean LZ chest expansion was 1.58 and sd was 0.52, and in group B it was 1.86 and sd was 0.69 which is not statistically significant (p value greater than 0.220). In summary the outcome variables were homogeneous between groups.

Table 3. Pre post difference with in group A

Sl No	Variable	Pre	Post	P value
1	Upper Zone	1.29±0.52	1.30±0.50	>.164
2	Middle Zone	1.55±0.53	1.57±0.53	>.189
3	Lower Zone	1.58±0.52	1.77±0.52	<.0001

Table 4. Pre post difference with in group B

Sl No	Variable	Pre	Post	P value
1	Upper Zone	1.25±0.33	1.61±0.37	<.0001
2	Middle Zone	1.79±0.33	1.82±0.34	>.104
3	Lower Zone	1.86±0.69	2.07±0.67	<.0001

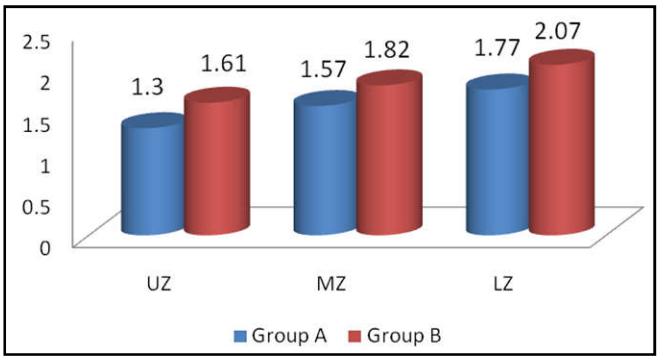
Table 5. Mean difference between groups

Sl No	Variable	Group A	Group B	P value
1	Upper Zone	1.30±0.50	1.61±0.37	>.067
2	Middle Zone	1.57±0.53	1.82±0.34	>.131
3	Lower Zone	1.77±0.52	2.07±0.67	<.191

However when comparing between groups, the mean increase in UZ chest expansion in group A was 1.30 with sd 0.50 and in group B it was 1.61 with sd 0.37 which was not statistically significant (p value greater than 0.067). Mean increase in MZ chest expansion in group A was 1.57 with sd 0.53 and in group B was 1.82 with sd 0.34 which was not statistically significant (p value greater than 0.131). Mean increase in LZ chest expansion was 1.77 with sd 0.52 in group A and in group B it was 2.07 with sd 0.67 which was statistically significant (p value less than 0.191).

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 incentive 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.



Graph 1. Mean difference between groups

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 (Vikram *et al*., 2012). 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. Therefore either of the two above mentioned techniques must be incorporated in the treatment of Unilateral Pleural effusion in order to regain lung re-expansion.

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