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Research paper

Effect of stacked breathing exercise on reducing pulmonary infection and complications for patients with pleural effusion

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Abstract

Background: Chest expansion exercises are widely used for patients with pleural effusion. One of these exercises is stacked breathing exercise which has shown to be effective in mobilizing greater lung volumes and in achieving and sustaining deep inspiration. But it is not known whether it will have similar effects in patients with pleural effusion and if it has effect on reducing pulmonary infection and complications for these patients.
Objective: Was to evaluate the effectiveness of stacked breathing exercise on reducing pulmonary infection and complications for patients with pleural effusion.
Design: A randomized controlled experimental study was used in this study.
Participants: sixty patients with pleural effusion were selected by convenience sample and randomly assigned into two groups; the intervention and control groups (30 patients each).
Method: Three tools were used. Tool I was Pleural effusion assessment tool included demographic and medical history, hemodynamic parameters and assessment of respiratory system. Tool II is stacked breathing exercise tool used to assess the exercise done to the intervention group. Tool III was Patients' outcomes evaluation sheet used to assess the effect of stacked breathing exercise on pulmonary infection score and complications.
Results: There were significant differences in pulmonary infection score and complications between the intervention and control groups. Pulmonary infection score in the intervention group was much lower, and their complications were lower than those in the control group.
Conclusion: implementing stacked breathing exercise had significant effect in reducing pulmonary infection and complications in patients with pleural effusion than the routine hospital care.

Keywords: *Complications; Effect; Pleural Effusion; Pulmonary Infection; Stacked Breathing Exercise.*

1. Introduction

Pleural effusion is a syndrome occurs frequently in hospitalized patients, leading to increased morbidity, mortality, and healthcare expenditure. A pleural effusion represents the disturbance of the normal mechanisms of formation and drainage of fluid from the pleural space. [1]
Pleural effusion is defined as a fluid collection between the pleural leaves due to local/systemic disease of the pleura, lung or extra pulmonary organs. Normally, 0.1 to 0.2 ml/kg of fluid is present in the pleural leaves to facilitate pleural movement. When the balance between the production and reabsorption of this fluid deteriorates, it becomes pleural effusion. [2]
The accumulation of pleural effusion has important effects on respiratory system function. It changes the elastic equilibrium volumes of the lung and chest wall, resulting in a restrictive ventilatory effect, causes reduction of chest expansion and it leads to lung atelectasis, because the capacity of the thorax is limited and excess fluid causes the lungs to collapse. [3-4]
Physiotherapy has been previously proposed as a possible therapeutic approach added to other surgical and non-surgical treatments for pleural effusion. [5] This is an important intervention that prevents and reduces the negative effects of prolonged bed rest during hospitalization and improves the respiratory function. Respiratory physiotherapy usually includes breathing control exercises, postural exercises and mobilizations, sputum clearance techniques, chest expansion exercise and education. [6]
Respiratory physiotherapy is recommended and should be applied during the first weeks of treatment. But while some studies propose treatment with respiratory physiotherapy, no definitive conclusions could be drawn about the success of this treatment relative to improvement in pleural effusion symptoms or its effect on pulmonary infection and complications.
One of the chest expansion exercises which can be applied to pleural effusion patients is the breath stacking technique which has shown to be effective particularly in uncooperative patients following abdominal surgeries [7] and in mobilizing greater lung volumes and in

achieving and sustaining deep inspiration, even in uncoached. [8] But it is not known whether it will have similar effects in patients with pleural effusion and if it has effect on reducing pulmonary infection and complications for these patients.
Therefore, there exists a need to evaluate the effectiveness of stacked breathing exercise on reducing pulmonary infections and complications for patients with pleural effusion. So, present study aims to find out the effectiveness of stacked breathing exercise on reducing pulmonary infection and complications for patients with pleural effusion.

2. Subjects and methods

2.1. Research design

A randomized controlled experimental study was used in this study.

2.2. Setting

The study was carried out in Assiut University Hospital, Egypt, in chest intensive care unit between July 2019, and July 2020.

2.3. Study subjects

Patients were allocated in 1: 1 ratio into the two study groups using a web-based randomizer (https://www.randomizer.org/) to generate codes placed within sealed, opaque, sequentially numbered envelopes to assign patients into one of the two groups; intervention or control groups (30 patients each). All participants or their guardians signed informed consent prior to inclusion in the study.

2.3.1. Inclusion and exclusion criteria

All patients 18-60 years old, of both gender, diagnosed as pleural effusion with asymmetrical chest expansion and agreed to participate in the study were included and patients who have malignant condition or with cognitive impairment were excluded.

2.3.2. Sample size

A power calculation estimated that in order to detect an effect size of 0.29 difference in mean of pulmonary function between the two studied groups, with a p-value < 0.05 and 80 % power, confidence level 0.95, a sample size of 20 patients for each group was needed. However, 60 patients were attempted in this research work to avoid non-response rate (30 for each group). This calculated using G Power 3.1. [9]

2.4. Tools

Three tools were used to collect data related to the study.

2.4.1. Tool I

The first tool was Pleural effusion assessment tool used to monitor hemodynamic parameters included (mean arterial pressure (MAP) taken from bed side monitor, heart rate (HR), temperature, respiratory rate and CVP readings, assessment of respiratory system consisted of: Chest examination done every shift before and after exercise, chest x-ray assessment, Sputum and blood culture assessment, assessment of pleural procedures done, assessment of clinical pulmonary infection score, fluid balance assessment., assessment of laboratory findings in addition to socio-demographic and medical data.

2.4.2. Tool II

The second tool is stacked breathing exercise tool: was developed by the researcher and used to assess the exercise done to the intervention group.

2.4.3. Tool III

The third tool is Patients' outcomes evaluation sheet which was developed by the researcher and used to assess the effect of stacked breathing exercise on pulmonary infection score and complications.

2.5. Method

- Research proposal was approved by Ethics Committee of the faculty of medicine, Assiut University, Egypt (IRB no.: 17300442).
- The current study registered at www.clinicaltrials.gov (NCT04553315 identifier).
- An official permission to conduct the study was obtained from the director of Chest Intensive Care Unit (CICU) at Assiut University Hospital to collect data from critically ill patients admitted to (CICU).
- Written informed consent was obtained from each patient after explaining the aim and nature of the study. The investigators emphasized that the participation is maintaining confidentiality and anonymity of the patients will be assured through data coding.
- Patients were assured that they can withdraw from the study at any time without any rational.
- A pilot study was conducted on 6 patients to test the feasibility and applicability of the tools and the analysis of the pilot study revealed that minimal modifications are required, these necessary modifications were done and the pilot study subjects were excluded from the actual study.
- Content validity: The tools were tested for content related validity by jury of 5 specialists in the field of critical care nursing and critical care medicine from Assiut University then the tools were designed in their final format and tested for reliability using internal consistency for all of the tools which was measured using cronbach`s test. The tools proved to be reliable (0.823).

- After randomizing the patient to one of two groups, before the intervention chest examination was done for both groups by assessing dyspnea, orthopnea, cough (if present; assess its strength, detect its type productive or dry and sputum color), pain with breathing, wheezing and crepitations. Also, before the intervention chest x-ray was done for both groups to detect the site of pleural effusion and chest ultrasound was done by radiologist to assess the amount of pleural fluid. Also, assessment of ABG, WBCs, serum Na, serum K, serum creatinine and Hematocrit in addition to assessment of hemodynamics (temperature, MAP, heart rate, respiratory rate, CVP and GCS).
- Intervention group was received breath stacking technique explained by [10] as it was done in a sitting position or semi-sitting position. If sitting: rest against the back of a chair and keep the patient's shoulders, arms and hands relaxed. By using the mouthpiece, the lips were placed tightly around the mouthpiece to create a tight seal and the patient was instructed to take a deep breath and hold that breath and attention was paid to possible leaks between the mouthpiece and the mouth then the bag was squeezed gently, stacking another breath on top of the first and taking more air in.
- Take in even more air as the bag was squeezed again. The bag was squeezed 2-5 times until the patient felt that the lungs are full of air, the patient should feel a stretch across the front of his/her chest and the patient was instructed to hold the air in as long as was comfortable then the mouthpiece was removed and the patient was instructed to hold the breath for 3-5 seconds before gently exhaling. If phlegm was present, the patient was instructed to try to produce a strong cough.
- The patient in the intervention group was instructed to perform the exercise 3 times per day (21 sessions) for one week. The exercise were given in the form of 4 breaths per minute (18-20 breaths in one session) and each treatment session lasted for 10-15 minutes including rest period. Ensure that the patient fully hydrated by maintaining normal daily water requirement in the form of (30-35ml/kg/day) with restriction of intravenous fluids.
- After 1hr of the intervention in both group chest examination, chest x-ray, ABG and hemodynamics were reassessed. Statistical, analysis
- The data were tested for normality using the Anderson-Darling test and for homogeneity variances prior to further statistical analysis. Categorical variables were described by number and percent (N, %), where continuous variables described by mean and standard deviation (Mean, SD). Chi-square and fisher exact tests used to compare between categorical variables where compare between continuous variables by unpaired t-test and ANOVA (parametric tests) for normally distributed variables. A two-tailed $p < 0.05$ was considered statistically significant. All analyses were per-formed with the IBM SPSS 20.0 software and MedCalc 14.

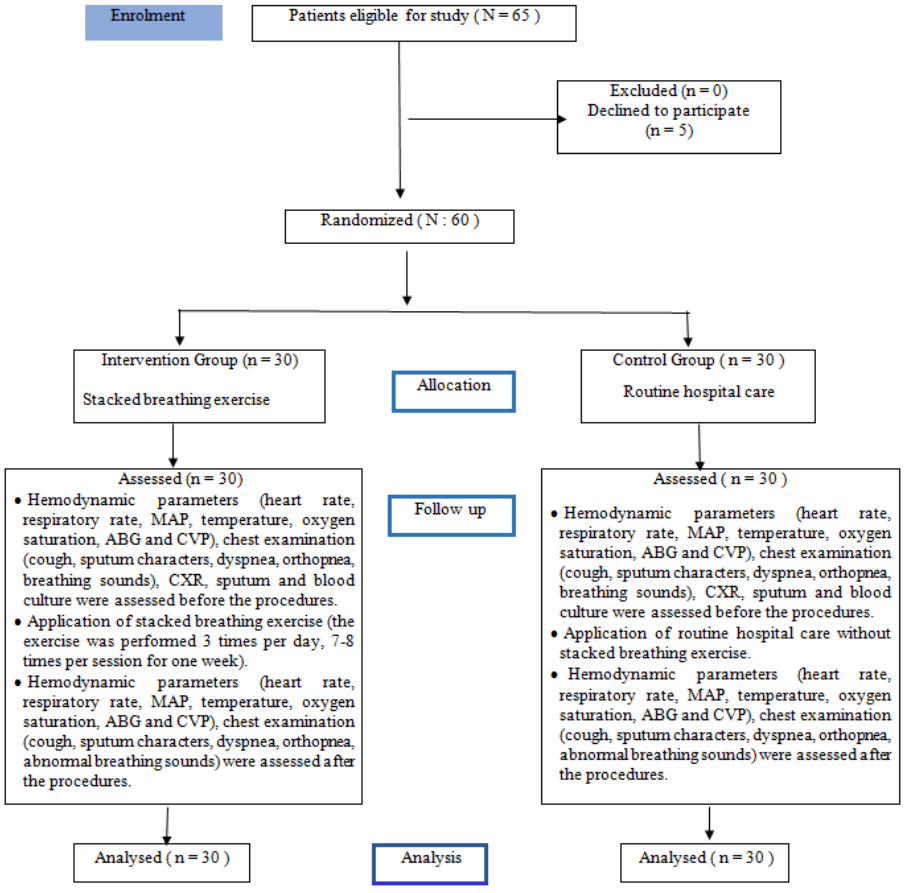

Fig. 1: CONSORT Flow Diagram of Randomized Controlled Trial.

3. Results

3.1. Comparison of personal characteristics and present illness between the groups

Descriptive characteristics of the patients in the intervention and control groups were evaluated. Regarding to sex, it was noticed that more than one half on both groups were female. As regard to age, it was noticed that the mean age in the intervention and control groups are nearly similar (41.87 ± 11.05& 42.80 ± 11.54) respectively. No significant statistical difference was put into evidence between the two studied groups in relation to sex and age (Table 1) and there was no a significant statistical difference between the two groups in relation to present illness Figure (2).

3.2. Comparison of hemodynamic monitoring and APACHE II Score between the groups

Hemodynamic monitoring were evaluated every day and APACHE II Score was evaluated in the first 24hrs of admission for intervention and control groups. In the first day of the study, it can be noted that there was no statistically significant difference between the two groups regarding the majority items of hemodynamic monitoring except MAP and WBC. As regard to MAP, it was noticed that there was a statistical significant difference between intervention and control groups (P=0.010). As regard to WBC, it was found that there was a statistical significant difference between intervention and control groups (P=0.023) Table (2).

After three days of the study, it was found that there was no statistically significant difference regarding the majority items of hemodynamic monitoring between the two groups except the respiratory rate, serum K and FIO2. As regard to respiratory rate, it was noticed that there was a statistical significant difference between intervention and control groups (P=0.007). As regard to serum K, it was found that there was a statistical significant difference between intervention and control groups (P=0.040). As regard to FIO2, it was a statistical significant difference between intervention and control groups (P=0.005) Table (2).

At discharge or on the last day of the study, it was found that there was no statistically significant difference regarding the majority items of hemodynamic monitoring between the two groups except heart rate, respiratory rate, CVP, WBC and serum Na which show that there was a statistical significant differences between intervention and control groups ($p < 0.05$) Table (2).

3.3. Comparison of chest examination between the groups

Chest examination was evaluated twice daily, before and after the exercise. Before the exercise in the first day of the study, It can be noted that there was no a statistical significant difference between intervention and control groups (P-value > 0.05) Table (3). After the exercise in the first day of the study, it was noticed that there was no a statistical significant difference was put into evidence between the two studied groups regarding the majority items of chest examination except cough strength, dyspnea and orthopnea as results show that (P=0.000 &P= 0.000 & P=0.000) respectively Table (3).

Before the exercise after three days of the study. It was noticed that there was a statistical significant difference between the two studied groups in relation to dyspnea, orthopnea, pain with breathing and wheezing (P =0.000 & P=0.000 & P=0.020 & P=0.006) respectively Table (4). After exercise after three days of the study, there was highly statistical significant difference between intervention and control groups regarding the majority items of chest examination ($p <0.05$) except cough, sputum color and bronchospasm Table (4).

Before the exercise on discharge or on the last day of the study, there was highly statistical significant difference between intervention and control groups regarding dyspnea and orthopnea (P=0.000). Also it was noticed that there was a statistical significant difference between intervention and control groups in relation to cough and wheezing (P=0.044 & P=0.003) respectively. There was no statistically significant difference between intervention and control groups in relation to cough strength, sputum color, pain with breathing, crepitation and bronchospasm (P value > 0.05) Table (5).

After the exercise on discharge or on the last day of the study, there was highly statistical significant difference between intervention and control groups regarding dyspnea (P=0.000). Also it was noticed that there was a statistical significant difference between intervention and control groups in relation to orthopnea and wheezing (P=0.002& P=0.005) respectively Table (5).

3.4. Comparison of complications between the groups

Results show that there was no a significant statistical difference between the two groups regarding the majority items of complications except pulmonary edema (P= 0.028) figure (5).

3.5. Comparison between the two studied groups in relation to clinical pulmonary infection score (CPIS) and blood and sputum culture

Results show that there was highly statistical significant difference between the two groups in relation to CPIS in the last day of the study figure (3) and there was no a significant statistical difference between the two groups in relation to blood and sputum culture figure (4).

3.6. Comparison of complications between the groups

Results show that there was no a significant statistical difference between the two groups regarding the majority items of complications except pulmonary edema (P= 0.028) figure (5).

Table 1: Distribution of Personal Characteristics of Study and Control Groups, (Total Patients' Number = 60)

Personal characteristics	Intervention(n= 30) N. (%)	Control(n= 30) N. (%)	P-value
Sex:			
Male	12(40.0)	13(43.3)	0.793
Female	18(60.0)	17(56.7)	
Age: (years)			
Mean ± SD	41.87 ± 11.05	42.80 ± 11.54	0.750
Range	22.0 – 60.0	23.0 – 56.0	

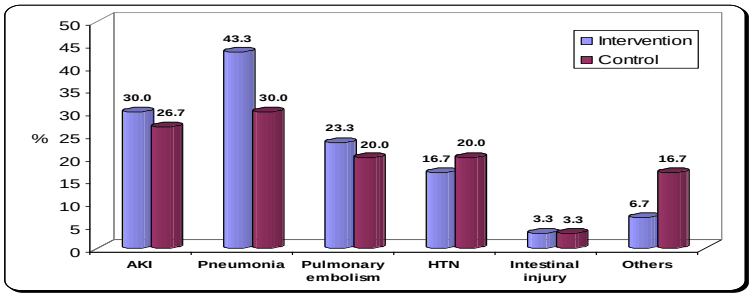

Fig. 2: Comparison between the Two Studied Groups in Relation to Present Illness.

Table 2: Distribution of Intervention and Control Groups in Relation to Hemodynamic Monitoring, (Total Patients' Number = 60)

Hemo-dynamics	Intervention (n= 30) Mean ± SD			Control (n= 30) Mean ± SD			P-value		
	1st day	After 3 days	In last day	1st day	After 3 days	In last day	1st day	After 3 days	In last day
Temp.	37.61 ± 0.57	37.31 ± 0.35	37.24 ± 0.31	37.65 ± 0.65	37.32 ± 0.52	37.37 ± 0.48	0.800	0.883	0.207
HR	109.93 ± 23.26	97.10 ± 16.65	94.97 ± 18.98	106.57 ± 23.41	103.87 ± 20.91	106.23±18.87	0.579	0.171	0.025*
MAP	94.57 ± 15.74	90.17 ± 13.34	85.07 ± 12.76	84.43 ± 13.62	83.90 ± 11.75	82.67 ± 11.65	0.010*	0.058	0.450
R.R	25.33 ± 6.74	18.83 ± 4.19	15.63 ± 3.22	24.37 ± 6.18	23.47 ± 8.05	22.63 ± 8.16	0.565	0.007*	0.000*
CVP	17.07 ± 5.90	14.40 ± 3.72	13.23 ± 3.76	14.63 ± 7.55	15.47 ± 5.02	16.07 ± 6.10	0.170	0.353	0.034*
GCS	14.83 ± 0.46	15.00 ± 0.00	15.00 ± 0.00	14.83 ± 0.65	15.00 ± 0.00	15.00 ± 0.00	1.000	--	--
WBC	17.67 ± 7.50	12.75 ± 5.11	10.00 ± 3.70	13.41 ± 6.60	15.05 ± 7.52	14.61 ± 6.86	0.023*	0.171	0.002*
Na	137.98 ± 5.23	137.19 ± 3.43	136.65 ± 3.90	136.28 ± 4.95	138.94 ± 4.70	139.36 ± 3.95	0.201	0.105	0.010*
K.	3.89 ± .51	3.74 ± 0.57	3.94 ± 0.54	4.04 ± 0.81	4.09 ± 0.72	3.89 ± 0.57	0.411	0.040*	0.743
Creat.	137.04 ±141.87	133.11±119.25	107.77 ± 92.26	151.32 ± 112.14	168.31 ±148.50	185.04±196.08	0.667	0.316	0.056
Hemat.	31.90 ± 7.98	33.18 ± 7.50	34.08 ± 5.79	35.20 ± 8.95	36.33 ± 8.31	36.31 ± 7.63	0.137	0.128	0.207
FIO_2	43.30 ± 9.80	32.11 ± 8.76	37.00 ± 18.38	46.95 ± 11.05	41.81 ± 11.05	44.35±13.36	0.252	0.005*	0.483
PH	7.41 ± 0.09	7.43 ± 0.08	7.40 ± 0.06	7.39 ± 0.07	7.39 ± 0.09	7.40 ± 0.07	0.236	0.092	0.789
$S.HCO_3$	19.91 ± 5.58	21.99 ± 3.76	23.00 ± 3.72	20.72 ± 7.22	22.06 ± 8.06	22.56 ± 6.84	0.629	0.969	0.756
PO_2	100.04 ± 35.57	104.07 ±30.33	82.22 ± 18.09	103.19 ± 38.20	89.53 ± 28.56	83.21 ± 23.22	0.742	0.061	0.854
PCO_2	32.04 ± 9.21	30.65 ± 6.60	33.21 ± 4.38	33.50 ± 14.52	32.33 ± 14.75	31.88 ± 11.34	0.644	0.571	0.552

Note: Data is represented as mean ± standard deviation

-Temp.: temperature -HR: Heart rate -MAP: Mean arterial pressure -R.R: Respiratory rate
-CVP: central venous pressure -GCS: Glasgow coma scale was not applicable for sedated patients. -WBC: white blood cells
-Creat. Creatinine -Hemat. : Hematocrit -PH: acid base balance
-$Paco_2$: partial pressure of carbon dioxide -Pao_2: partial pressure of oxygen -Hco_3: bicarbonate

Table 3: Distribution of Intervention and Control Groups According to Chest Examination in the First Day of the Study, (Total Patients' Number = 60)

Chest examination	Intervention (n= 30) N. (%)		Control (n= 30) N. (%)		P-value	
	Before exercise	after exercise	Before exercise	After exercise	Before exercise	After exercise
Cough:						
No cough	9(30.0)	8(26.7)	15(50.0)	15(50.0)	0.285	0.096
Dry cough	8(26.7)	5(16.7)	6(20.0)	6(20.0)		
Productive cough	13(43.3)	17(56.7)	9(30.00	9(30.0)		
Cough strength:						
Weak	17(81.0)	2(9.1)	12(80.0)	12(80.00	1.000	0.000*
Strong	4(19.0)	20(90.9)	3(20.0)	3(20.0)		
Sputum color:						
No sputum	11(52.4)	5(22.7)	6(40.0)	6(40.0)		
Whitish	4(19.0)	7(31.8)	3(20.0)	4(26.7)	0.889	0.119
Whitish with blood	1(4.8)	2(9.1)	1(6.7)	0(0.0)		
Yellowish with blood	5(23.8)	3(13.6)	5(33.3)	5(33.3)		
Dyspnea	26(86.7)	5(16.7)	24(80.0)	26(86.7)	0.488	0.000*
Orthopnea	23(76.7)	5(16.7)	20(66.7)	21(70.0)	0.390	0.000*
Pain with breathing	17(56.7)	8(26.7)	13(43.3)	12(40.0)	0.302	0.273
Wheezing	15(50.0)	8(26.7)	9(30.0)	12(40.0)	0.114	0.273
Crepitation	8(26.7)	1(3.3)	4(13.3)	4(13.3)	0.197	0.353
Bronchospasm	5(16.7)	0(0.0)	6(20.0)	4(13.3)	0.739	0.112

Notes: Data is represented as number (percentage).

Table 4: Distribution of Intervention and Control Groups According to Chest Examination after Three Days of the Study, (Total Patients' Number= 60):-

Chest examination	Intervention (n= 30) N. (%)		Control (n= 30) N. (%)		P-value	
	Before exercise	After exercise	Before exercise	After exercise	Before exercise	After exercise
Cough:						
No cough	14(46.7)	15(50.0)	16(53.3)	17(56.7)	0.729	0.374
Dry cough	5(16.7)	4(13.3)	3(10.0)	1(3.3)		
Productive cough	11(36.7)	11(36.7)	11(36.7)	12(40.0)		
Cough strength:						
Weak	6(37.5)	0(0.0)	10(71.4)	8(61.5)	0.063	0.000*
Strong	10(62.5)	15(100.0)	4(28.6)	5(38.5)		
Sputum color:						
No sputum	5(31.3)	4(26.7)	3(21.4)	1(7.7)		
Whitish	6(37.5)	7(46.7)	7(50.0)	8(61.5)	0.458	0.220
Whitish with blood	2(12.5)	2(13.3)	0(0.0)	0(0.0)		
Yellowish	3(18.8)	2(13.3)	4(28.6)	4(30.8)		
Dyspnea	8(26.7)	1(3.3)	25(83.3)	25(83.3)	0.000*	0.000*
Orthopnea	5(16.7)	0(0.0)	20(66.7)	21(70.0)	0.000*	0.000*
Pain with breathing	4(13.3)	1(3.3)	12(40.0)	11(36.7)	0.020*	0.001*
Wheezing	5(16.7)	0(0.0)	15(50.0)	13(43.3)	0.006*	0.000*
Crepitation	2(6.7)	0(0.0)	5(16.7)	6(20.0)	0.424	0.024*
Bronchospasm	2(6.7)	1(3.3)	3(10.0)	2(6.7)	1.000	1.000

Notes: Data is represented as number (percentage)

Table 5: Distribution of Intervention and Control Groups Regarding Chest Examination on the Last Day of the Study, (Total Patients' Number = 60)

Chest examination	Intervention (n= 30) N. (%)		Control (n= 30) N. (%)		P-value	
	Before exercise	After exercise	Before exercise	After exercise	Before exercise	After exercise
Cough:						
No cough	25(83.3)	25(83.3)	16(53.3)	17(56.7)	0.044*	0.079
Dry cough	3(10.0)	2(6.7)	8(26.7)	5(16.7)		
Productive cough	2(6.7)	3(10.0)	6(20.0)	8(26.7)		
Cough strength:						
Weak	1(20.0)	0(0.0)	7(50.0)	6(46.2)	0.338	0.114
Strong	4(80.0)	5(100.0)	7(50.0)	7(53.8)		
Sputum color:						
No sputum	3(60.0)	2(40.0)	7(50.0)	5(38.5)	0.524	0.628
Whitish	2(40.0)	2(40.0)	4(28.6)	4(30.8)		
Yellowish	0(0.0)	0(0.0)	3(21.4)	3(23.1)		
Dyspnea	1(3.3)	0(0.0)	20(66.7)	18(60.0)	0.000*	0.000*
Orthopnea	0(0.0)	0(0.0)	11(36.7)	9(30.0)	0.000*	0.002*
Pain with breathing	0(0.0)	0(0.0)	5(16.7)	3(10.0)	0.052	0.237
Wheezing	1(3.3)	0(0.0)	10(33.3)	8(26.7)	0.003*	0.005*
Crepitation	0(0.0)	0(0.0)	2(6.7)	2(6.7)	0.492	0.492
Bronchospasm	1(3.3)	0(0.0)	5(16.7)	2(6.7)	0.195	0.492

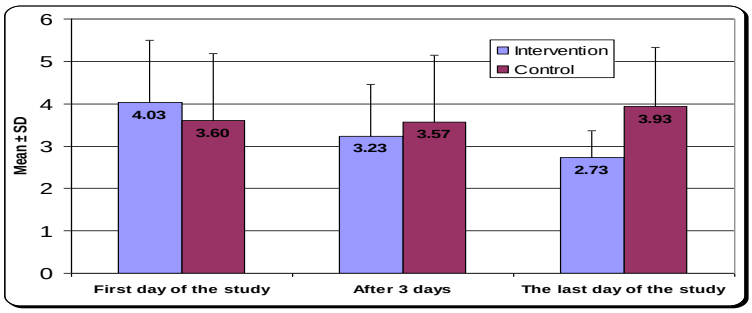

Fig. 3: Comparison between the Two Studied Groups in Relation to CPIS.

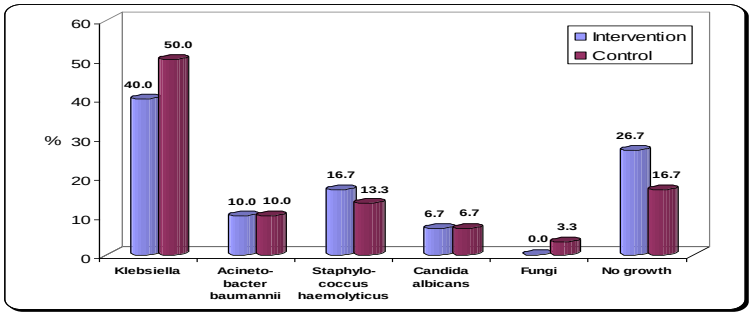

Fig. 4: Comparison between the Two Studied Groups in Relation Blood and Sputum Culture.

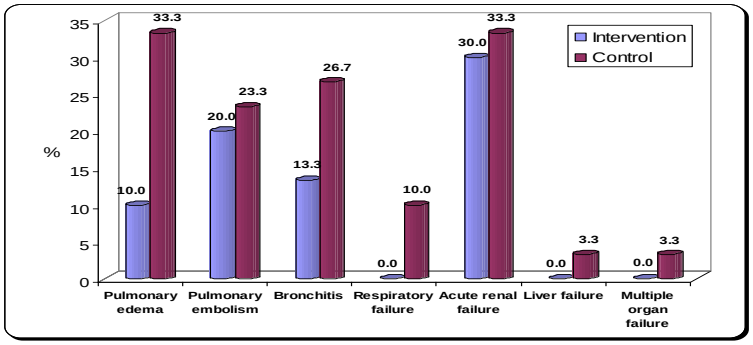

Fig. 5: Comparison between the Two Studied Groups in Relation Complications.

4. Discussion

In the current study, it was observed that patients with pneumonia, acute kidney injury (AKI) and pulmonary embolism were the high risk group for pleural effusion, and it was observed that pneumonia as the most common cause contributing to pleural effusion in less than half of patients in intervention group and in one third of patients in control group. Similar to this observation, study done by (Rahul & Nick, 2015) [10] who reported that an exudate is most likely to be associated with pneumonia. Estimates suggest that up to 57% of patients with pneumonia will develop pleural fluid.

In the current study, AKI was a significant cause of pleural effusion as it was responsible for pleural effusion in one third of patients in intervention group and less than one third of patients in control group. This come in inferior of study done by (Clare et al, 2010) [11] who documented that renal disease is less common cause of pleural effusion.

In the current study, it was noticed that there was no a statistical significant difference between intervention and control groups in the first day of the study regarding vital signs except MAP, this is related to that both groups received care which maintained patients in stabilized condition and there are other multifactors affect vital signs rather than pleural effusion.

In the current study, it was noticed that there was a statistical significant difference between intervention and control groups after three days of the study and the last day of the study regarding respiratory rate, this is related to that patients received stacked breathing exercise have improvement in pulmonary functions which reflected on respiratory rate as patients in intervention group after three days of the study and in the last day of the study has normal respiratory rate, inferior of this was happened on control group.

Pleural effusion is a common clinical problem that frequently causes dyspnea and orthopnea. Stacked breathing exercises help to prevent and reduce the negative effects of prolonged bed rest during hospitalization and improves the respiratory functions with improvement of dyspnea and orthopnea.

The results of the current study confirmed this which showed that there was a statistical significant difference between intervention and control groups after exercise regarding dyspnea and orthopnea in all over the period of the study, this in line with study done by Vikram et al (2012) [8] concluded 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. [12]

In the current study, it was observed that klebsiella is the most common organism in both groups as it represents less than half in intervention group and half of control group.

In the current study, it was noticed that there was highly statistical significant difference between intervention and control groups in relation to CPIS, this is related to that stacked breathing exercise has a positive effect in preventing pulmonary infection.

In the current study, it was found that one third of patients in control group developed pulmonary edema and less than one third of patients in the intervention group had developed pulmonary edema with a statistical significant difference between intervention and control groups in relation to developing pulmonary edema. This may be attributed that close follow up of urine output and CVP and administering or restricted fluids according to them helped more in reducing occurrence of pulmonary edema in intervention group.

Finally, it can be concluded that using stacked breathing exercise with keeping the patient in good hydration state by using oral fluids and restrict intravenous fluids had significant and good outcomes than the routine hospital care.

5. Conclusion

Based on the results of this study, it could be concluded that : implementing stacked breathing exercise with keeping the patient in good hydration state by using oral fluids and restrict intravenous fluids had significant effect in reducing pulmonary infection and complications in patients with pleural effusion than the routine hospital care.

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Conflict of interest

We declare that we have no conflict of interest

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