Review Article

Chest Physical Therapy and Outcomes in Primary Spontaneous Pneumothorax: A Systematic Review

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Objective: An intercostal chest drainage (ICD) is a treatment in large or symptomatic primary spontaneous pneumothorax (PSP). Chest physical therapy strategies may be beneficial in patients with PSP in terms of reducing ICD duration. The present study aimed to evaluate if any physical therapy strategies provided good outcomes in patients with PSP.

Materials and Methods: The present study was a systematic review. The inclusion criteria were articles published in literature databases conducted in children or adults, had at least one arm of physical therapy strategies, and had the outcomes of either duration of ICD treatment or admission duration. The authors searched five databases in this review. The final search was performed on April 28, 2021. For both outcomes of the present study, mean differences between experimental and control group were calculated and reported with their 95% confidence interval (CI).

Results: There were 1,153 articles from five databases after duplication removal. In total, there were 264 articles eligible for full-text article review. Of those, only one article met the study criteria published by Kim and Park in 2012. The study was conducted in 40 patients with pneumothorax compared systematic breathing exercise program or experimental group and control group. The experimental group had significantly better two outcomes than the control group with mean differences of duration of ICD treatment and admission were -2.05 (95% CI: -3.26 to -0.84) and -1.85 (95% CI: -3.08 to -0.62).

Conclusion: Chest physical therapy may shorten duration of ICD treatment and reduce length of hospital stay in patients with PSP.

Keywords: Deep breathing exercise; Incentive spirometry; Range of motion exercise; Walking exercise; Feedback

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Primary spontaneous pneumothorax (PSP) is defined as pneumothorax presenting without any causes. Its prevalence is different between sexes; more prevalent in males than females (18/100,000/year vs. 6/100,000/year)[1]. The male:female ratio is 79%: 21%[2]. Factors associated with PSP occurrence include subpleural blebs, smoking both cigarette and cannabis, genetic predisposition, and atmospheric conditions such as air pollutants and atmospheric pressure[3].

Treatment of PSP depends on several conditions such as symptoms or size of pneumothorax. An intercostal chest drainage (ICD) either by chest tube or catheter thoracostomy is a treatment in large or symptomatic PSP. The ICD treatment is painful and invasive. A previous study found that deep breathing exercise improved force vital capacity (FVC), vital capacity (VC), force expiratory volume in one second (FEV1), and maximal voluntary ventilation (MVV) after five days of intervention in patients with pneumothorax[4]. For example, the FVC increased from 72.29% to 85.94%. Therefore, chest physical therapy strategies may be beneficial in patients with PSP in terms of reducing ICD duration, improving pulmonary parameters, and quality of life. The present study aimed to evaluate if any physical therapy strategies provided good outcomes in patients with PSP.

Materials and Methods

This study was a systematic review. The inclusion criteria were articles published in literature databases conducted in children or adults, had at least one arm of

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physical therapy strategies, and had the outcomes of either duration of ICD treatment or admission duration. The studies were either observational or randomized controlled trial studies with two groups: intervention and comparator group. We excluded studies with any of the following: conference paper, study protocol, case report, case series, or commentary.

We searched five databases in this review: Pubmed, Central database, Scopus, CINAHL Plus, and Web of Science. Search terms included pneumothorax, chest, physiotherapy, physical therapy, drainage, randomized controlled trial, non-randomized controlled trial, or quasi experimental. The final search was performed on April 28, 2021. After duplication removal, initial screening was carried out for non-relevant articles. Of these, any articles met the study criteria were included in the final analysis. Data extraction and the full-text reviewed were performed by two independent authors (PN, TS). A prima flow chart of article searching and included studies was shown in Figure 1.

Eligible studies were reviewed for clinical features and outcomes. For both outcomes of the present study, mean differences between experimental and control group were calculated and reported with their 95% confidence interval (CI). Heterogeneity was computed and reported as and I square (I^2) when appropriate. A forest plot of each comparison was created. Biases of eligible studies were performed according to study design. For observational studies, the Newcastle-Ottawa Scale adapted for cross-sectional studies was applied to evaluate study quality. Those randomized controlled trials were evaluated six domains including sequence generation, allocation concealment, blinding of participants/personnel and outcome assessors, incomplete outcome data, selective outcome reporting, and other potential sources of bias. Risk of biases categorized as low, unclear, or high risk. Biases or study quality were evaluated by two authors independently (PT, TS). Disagreements were reviewed and reported by a third reviewer (SK). All analyses were performed by Review Manager 5.4.

Results

There were 1,153 articles from five databases after duplication removal. In total, there were 264 articles eligible for full-text article review. Of those, only one article met the study criteria. The reasons for excluding article were shown in the Prisma flow chart (Figure 1) including systematic review (248 articles), non-experiment trials (7 articles), no physical therapy or outcome (5 articles), and non PSP (3 articles).

The eligible article was published in Journal of Korean Critical Care nursing by Kim and Park in 2012[5]. The study was conducted in 40 patients with pneumothorax compared systematic breathing exercise program or experimental group and control group. The experimental group received deep breathing exercise with incentive spirometry, range of motion exercise in shoulder joint, walking exercise and feedback, while the control group received deep breathing exercise using incentive spirometry. Each group comprised of 20 patients. There was no significant difference on baseline characteristics between both groups (Table 1). The experimental group had significantly better two outcomes than the control group (Table 1). The mean differences of duration of ICD treatment and admission were -2.05 (95% CI: -3.26 to -0.84) and -1.85 (95% CI: -3.08 to -0.62) as shown in Figure 2 and 3, respectively. Most bias items were unclear with low risk for bias in two items (Figure 4).

Discussion

This systematic review showed that systematic breathing exercise program significantly reduced the ICD duration and length of hospital stay in patients with PSP than the control procedures.

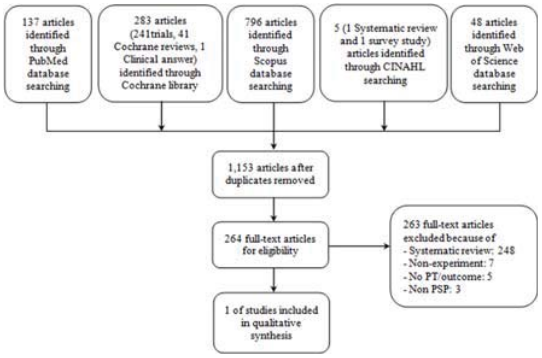

Figure 1. Prisma study flow chart for article searching in five databases to evaluate effects of chest physical therapy (PT) in primary spontaneous pneumothorax (PSP).

Table 1. Characteristics and outcomes of patients with pneumothorax treated with SBEP versus DBEIS

Factors	SBEP n=20	DBEIS n=20	p-value
Male sex, n (%)	19 (95.0)	17 (85.0)	0.605
Age, years	20.8 (6.15)	20.9 (5.63)	0.979
Smoking, n (%)	8 (40.0)	7 (35.0)	0.744
Duration of ICD treatment, days	4.80 (1.20)	6.85 (2.48)	0.002
Duration of admission, days	6.05 (1.23)	7.90 (2.53)	0.007

Data presented as mean (SD) unless indicated otherwise.
SBEP = systematic breathing exercise program; DBEIS = deep breathing exercise using incentive spirometry; ICD = intercostals chest drainage

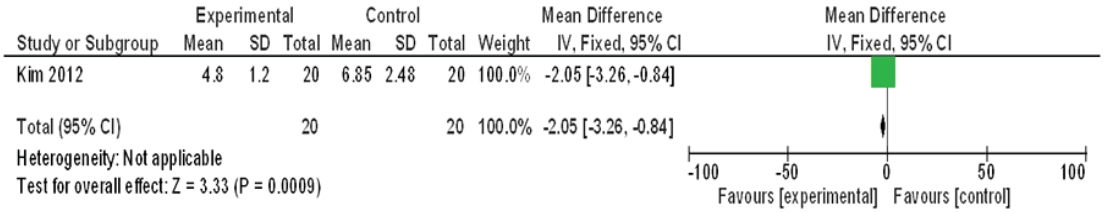

Figure 2. Forest plot of patients with pneumothorax treated with systematic breathing exercise program (SBEP) or experimental group versus deep breathing exercise using incentive spirometry (DBEIS) or control group showed mean difference of duration of intercostals chest drainage treatment in days.

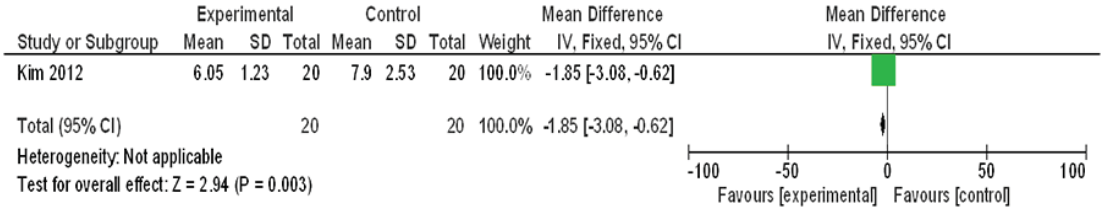

Figure 3. Forest plot of patients with pneumothorax treated with systematic breathing exercise program (SBEP) or experimental group versus deep breathing exercise using incentive spirometry (DBEIS) or control group showed mean difference of duration of admission in days.

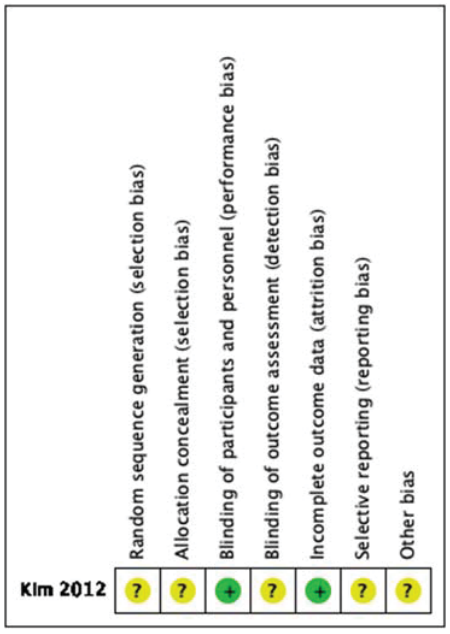

Figure 4. Risk of biases of an included study evaluated by the authors: + indicated low risk; ? indicated unclear; - indicated high risk.

As previously reported, deep breathing exercise with and without an incentive spirometer improved pulmonary parameters after five days of interventions including FVC, VC, FEV1, and MVV. Even though these parameters were not significantly different between those with and without the incentive spirometer, using incentive spirometer seems to have better outcomes than those without incentive spirometer. The VC was 86.24% in the incentive spirometer group which was higher than the non- incentive spirometer group (81.18%)[4]. Kim study conducted by not only provided the incentive spirometer, other physical therapy treatments were applied such as range of motion exercise in shoulder joint and walking exercise[5]. These physical therapy strategies may improve lung expansion in patients with PSP resulting in shorter duration of ICD treatment and length of hospital stay by approximately two days (Figure 2 and 3). This study also showed that multiple physical therapy strategies were better than only one method.

There are some limitations in the present study. First, only particular physical therapy was included in this systematic review. Second, study population was specific to only patients with PSP. Those patients with pneumothorax from other causes were not studied as well as other clinical related factors[6-9]. Third, five bias items were questionable (Figure 4)[10]. Finally, experimental group had only one included study resulting in unable to calculate as a meta-analysis. Therefore, further studies of chest physical therapy in a randomized controlled fashion are needed to conclude its role in PSP.

Conclusion

Chest physical therapy may shorten duration of ICD treatment and reduce length of hospital stay in patients with PSP. Further studies are required to add additional comparisons and also other interventions.

What is already known on this topic?

Physical therapy such as breathing exercise may improve pulmonary function parameters such as vital capacity in patients with primary spontaneous pneumothorax.

What this study adds?

Chest physical therapy may shorten duration of an intercostal chest drainage treatment and reduce length of hospital stay in patients with primary spontaneous pneumothorax.

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Potential conflicts of interest

The authors declare no conflict of interest.

References

1. Mitani A, Hakamata Y, Hosoi M, Horie M, Murano Y, Saito A, et al. The incidence and risk factors of asymptomatic primary spontaneous pneumothorax detected during health check-ups. BMC Pulm Med 2017;17:177.
2. Comelli I, Bologna A, Ticinesi A, Magnacavallo A, Comelli D, Meschi T, et al. Incidence of primary spontaneous pneumothorax is not associated with microclimatic variations. Results of a seven-year survey in a temperate climate area. Monaldi Arch Chest Dis 2017;87:793.
3. Park JH, Lee SH, Yun SJ, Ryu S, Choi SW, Kim HJ, et al. Air pollutants and atmospheric pressure increased risk of ED visit for spontaneous pneumothorax. Am J Emerg Med 2018;36:2249-53.
4. Park HS, Lee WJ, Kim YS. The effects of deep breathing methods on pulmonary ventilatory function of pneumothorax patients undergoing a thoracotomy. Taehan Kanho Hakhoe Chi 2006;36:55-63.
5. Kim YR, Park SY. The effects of the systematic breathing exercises program on recovery of patients with pneumothorax. J Korean Crit Care Nurs 2012;5:28-36.
6. Sawunyavisuth B. What are predictors for a continuous positive airway pressure machine purchasing in obstructive sleep apnea patients? Asia Pac J Sci Technol 2018;23:APST-23-03-10.
7. Buttichak A, Leelayuwat N, Bumerraj S, Boonprakob Y. The effects of a yoga training program with fit ball on the physical fitness and body composition of overweight or obese women. Asia Pac J Sci Technol 2019;24:APST-24-02-07.
8. Perera A, Mudannayake SD, Azamathulla HM, Rathnayake U. Recent climatic trends in Trinidad and Tobago, West Indies. Asia Pac J Sci Technol 2020;25:APST-25-02-05.
9. Chaiear N, Nirarach K, Kawamatawong T, Krisorn P, Burge PS. Proportion of workers having work-related asthma symptoms in a cassava factory, Nakhon Ratchasima province, Thailand. Asia Pac J Sci Technol 2020;25:APST-25-02-08.
10. Khamsai S, Chindaprasirt J, Chotmongkol V, Tiamkao S, Limpawattana P, Senthong V, et al. Clinical features of eosinophilic meningitis caused by Angiostrongylus cantonensis in Thailand: a systematic review. Asia Pac J Sci Technol 2020;25:APST-25-02-09.