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Use of lung expansion techniques on drained and non-drained pleural effusion: survey with 232 physiotherapists

Uso de técnicas de expansão pulmonar em derrame pleural drenado e não drenado: estudo com 232 fisioterapeutas

Uso de técnicas de expansión pulmonar en derrame pleural drenado y no drenado: estudio con 232 fisioterapeutas

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Abstract

Introduction: Techniques for lung expansion seem to benefit patients with drained and undrained pleural effusion, but there is a lack of evidence to indicate which technique is best in each situation. Currently, the therapeutic choices of respiratory physiotherapists serving this population are not known. **Objective:** To know which lung expansion techniques are chosen by chest physiotherapists who assist patients with

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drained and non-drained pleural effusion. **Method:** Through the announcement of the Federal Council, 232 physiotherapists who work in hospitals in Brazil were questioned about which techniques they apply to patients with drained and non-drained effusion. **Results:** Initially, 512 were questioned but 232 (45.3%) answered. The physiotherapists associate more than one technique of lung expansion in both types of patients, besides walking. Deep breathing is the most used technique in patients with drained (92%) and non-drained (77%) pleural effusion. Positive pressure exercises in the airways are chosen by 60% of the physiotherapists to treat patients with drained pleural effusion and by 34% to treat patients with non-drained pleural effusion. Yet the incentive spirometry are used with 66% of patients with drained pleural effusion and 42% with non-drained ones. **Conclusion:** Deep breathing is the most applied lung expansion technique in the treatment of patients with drained and non-drained pleural effusion by chest physiotherapists. In addition, there is association between greatest degree and time of professional performance and the chosen techniques.

Keywords: Pleural Effusion. Drainage. Physical Therapy Modalities. Respiratory Therapy. Survey.

Resumo

Introdução: *Técnicas para expansão pulmonar parecem beneficiar pacientes com derrame pleural drenado e não drenado, porém há falta de evidências para indicar qual é a melhor técnica em cada situação. Atualmente, as escolhas terapêuticas dos fisioterapeutas respiratórios que atendem essa população não são conhecidas.* ***Objetivo:*** *Conhecer as técnicas de expansão pulmonar escolhidas pelos fisioterapeutas respiratórios que atendem pacientes com derrame pleural drenado e não drenado.* ***Método:*** *Por meio do anúncio do Conselho Federal, 232 fisioterapeutas que trabalham em hospitais no Brasil foram questionados sobre quais técnicas se aplicam a pacientes com derrame drenado e não drenado.* ***Resultados:*** *Inicialmente, 512 foram questionados, mas 232 (45,3%) responderam. Os fisioterapeutas associam mais de uma técnica de expansão pulmonar em ambos os tipos de pacientes, além de deambular. A respiração profunda é a técnica mais utilizada em pacientes com derrame pleural drenado (92%) e não drenado (77%). Exercícios de pressão positiva nas vias aéreas são escolhidos por 60% dos fisioterapeutas para tratar pacientes com derrame pleural drenado e por 34% para pacientes com derrame pleural não drenado. A espirometria de incentivo é utilizada com 66% dos pacientes com derrame pleural drenado e 42% com não drenado.* ***Conclusão:*** *A respiração profunda é a técnica de expansão pulmonar mais aplicada no tratamento de pacientes com derrame pleural drenado e não drenado por fisioterapeutas respiratórios. Além disso, há associação entre maior titulação e tempo de atuação profissional e as técnicas escolhidas.*

Palavras-chave: *Derrame Pleural. Drenagem. Modalidades de Fisioterapia. Terapia Respiratória. Questionário.*

Resumen

Introducción: *Técnicas para expansión pulmonar parecen beneficiar a pacientes con derrame pleural drenado y no drenado, pero hay falta de evidencias para indicar cuál es la mejor técnica en cada situación. Actualmente, las opciones terapéuticas de los fisioterapeutas respiratorios que atienden a esa población, no son conocidas.* ***Objetivo:*** *Conocer las técnicas de expansión pulmonar elegidas por los fisioterapeutas respiratorios que atienden pacientes con derrame pleural drenado y no drenado.* ***Método:*** *A través del anuncio del Consejo Federal, 232 fisioterapeutas que trabajan en hospitales en Brasil fueron cuestionados sobre qué técnicas se aplican a pacientes con derrame drenado y no drenado.* ***Resultados:*** *Inicialmente, 512 fueron cuestionados, pero 232 (45,3%) respondieron. Los fisioterapeutas asocian más de una técnica de expansión pulmonar en ambos tipos de pacientes, además de deambular. La respiración profunda es la técnica más utilizada en pacientes con derrame pleural drenado (92%) y no drenado (77%). Los ejercicios de presión positiva en las vías aéreas son elegidos por el 60% de los fisioterapeutas para tratar a pacientes con derrame pleural drenado y por el 34% para pacientes con derrame pleural no drenado. La espirometría de incentivo se utiliza con el 66% de los pacientes con derrame pleural drenado y el 42% con no drenado.* ***Conclusión:*** *La respiración profunda es la técnica de expansión pulmonar más aplicada en el tratamiento de pacientes con derrame pleural drenado y no drenado por fisioterapeutas respiratorios. Además, hay asociación entre mayor titulación y tiempo de actuación profesional y las técnicas elegidas.*

Palabras clave: *Derrame Pleural. Drenaje. Modalidades de Fisioterapia. Terapia Respiratoria. Cuestionario.*

Introduction

Pleural effusion affects more than a million patients only in the United States [1] and presents high mortality rate [2]. The main damages caused by pleural effusion are at gas exchange, pulmonary function and hemodynamics [2]. The treatment indicated for patients with pleural effusion of high quantity or the increase of sensation of dyspnea is the thoracic drainage [3, 4]. Thoracic drainage can present complications such as tube clogging or displacement, subcutaneous emphysema, atelectasis and empyema [5]. The complications and mortality rate related to thoracic drainage reaches 17% in the United Kingdom [6] and 26.8% in Brazil [7].

For these reasons, surgical [8, 9] and clinical [10, 11] strategies have been adopted to accelerate the resolution time for pleural effusion and decrease the time the drain remains in the patients [8, 9, 10]. Even without expert consensus to guide the therapists, chest physiotherapy is one of the clinical strategies widely used at the clinical practice with the objective of expanding the lungs and helping on discharging the excess liquid of the pleural space [12]. However, there are no evidences [13] about the benefits brought to patients with drained and non-drained pleural effusion, promoted by lung expansion techniques, such as deep breathing, exercises with positive pressure and incentive spirometry.

In the absence of guidelines resulting from clinical trials with good methodological quality, chest physiotherapists base their therapeutic choices on their beliefs or knowledge acquired at clinical practice. To get to know the reality of clinical practice, a survey is the indicated investigation method [14]. Therefore, the objective of this study was to know the lung expansion techniques applied by the chest physiotherapists who treat patients with drained and non-drained pleural effusion. Moreover, to match the applied techniques with the graduation time, title and type of hospital the chest physiotherapist works.

Methods

Study design

Survey.

Participants

This study has involved chest physiotherapists who work in Brazil assisting hospitalized patients with drained and non-drained pleural effusion of any origin (infectious, oncological, trauma or surgical). This study received institutional support from the Federal Council of Physical Therapy, which provided the email address of data of 512 professionals chosen by random selection. All data were confidentially analyzed.

The study's sample size was estimated considering the response rate of 41% [15]. Simulations were performed using different samples sizes and maintaining the response rate at 41%. A sample of 512 physiotherapists was determined as a sufficiently stable. The double of sample size would not change the confidence interval [16].

Questionnaire

There was not any adequate questionnaire to collect the necessary information from the target population, so we built a questionnaire based on the previously developed protocol [17]. To assure the best quality for the questionnaire, it was submitted to a specialists' committee, formed by eight physiotherapists specialized in respiratory care and with more than ten years professionally working with this kind of patient. The committee analyzed the content, ambiguities, terminologies and the questionnaire's structure. The questions were analyzed and modified according to the commission's suggestions.

The questionnaire consisted of questions divided into five sections: 1) demographic information and type of hospital they work (private, public or university); 2) time since graduation and professional performance (less than 5 years, between 5 and 10 years, between 11 and 20 years, between 21 and 30 years or more than 30 years); 3) highest degree (graduation, specialization, master's degree or doctor's degree); 4) therapeutic techniques used in patients with non-drained pleural effusion (deep breathing, incentive spirometry, exercises with positive pressure and walking); 5) therapeutic used in patients with drained pleural effusion (deep breathing, incentive spirometry, exercises with positive pressure and walking). The chest physiotherapists could choose more than one technique in each situation, without prioritizing the order of using.

Procedure

The data collection was performed by questionnaire applied through Survey Monkey

website. The questionnaire was forwarded to chest physiotherapists via e-mail, which contained the invitation to join the study and information about its objective, ethics committee approval, confidentiality assurance, contact of the authors for further clarifications and link to the online questionnaire.

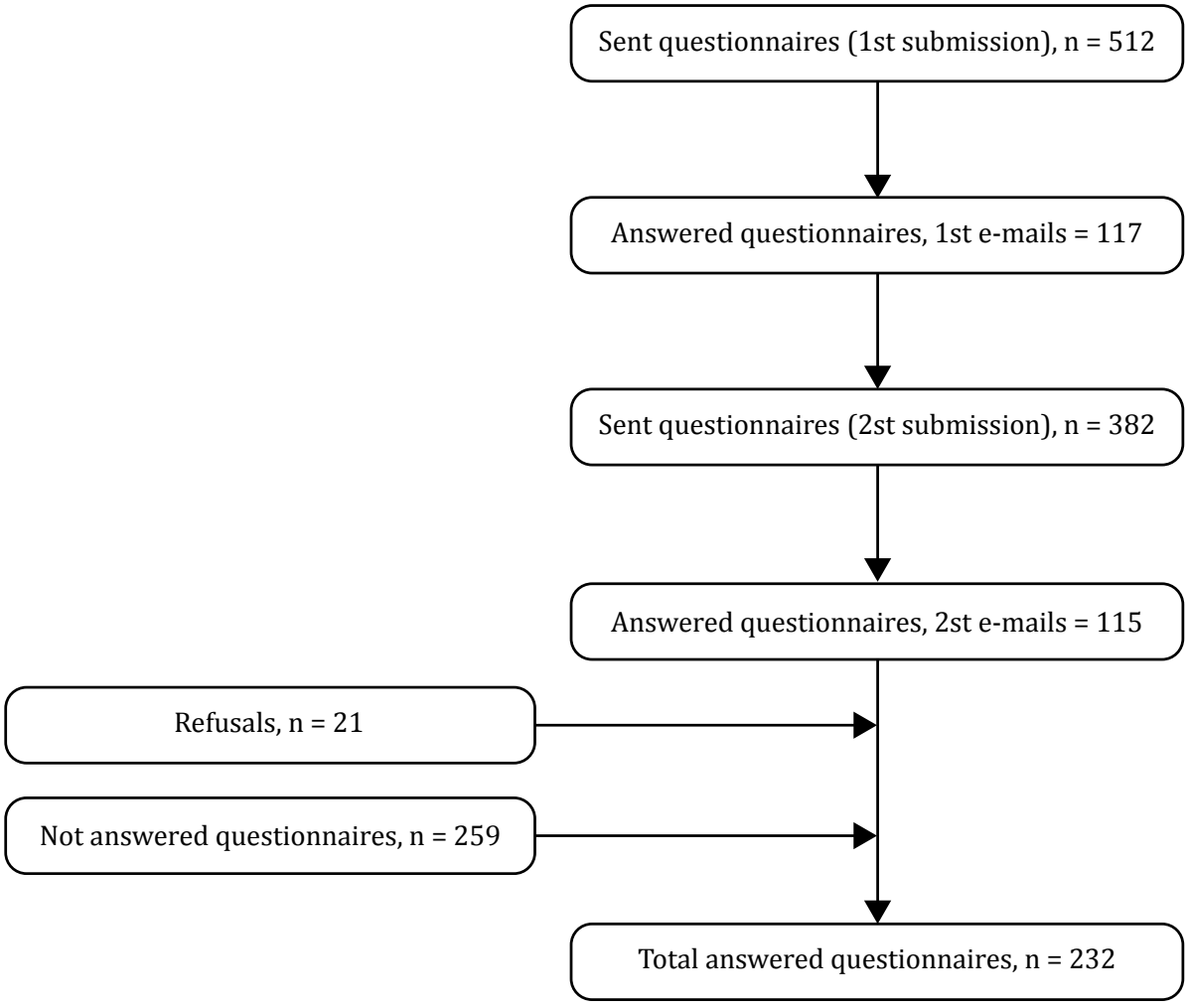
After the questionnaires had been sent, the participants had three weeks to answer. For the ones who did not answer within this period it was sent a new e-mail with a two-week period for answering, considered as the last chance to answer the questions.

Statistical analysis

Data was submitted to descriptive analysis. Chi-square test was used to compare the indication of each technique for the drained and non-drained pleural effusions. The influence of the chosen techniques, time since graduation and chest physiotherapist's highest degree were analyzed by Odds Ratio. The software Sigma Plot 12.25 (San Jose, CA, USA) was used.

Results

232 chest physiotherapists who assist patients with drained and non-drained pleural effusions answered this survey. The answer rate of collected data through the first e-mail was 22.8% (117/512 with 13 physiotherapists' refusals). E-mails were sent again to 382 chest physiotherapists who had not answered the first email with 30.1% (115/382) answers with confirmed participations. Thus, the total answer rate was 45.31% (232/512). Figure 1 shows the flowchart of the phases of the study.



Note: n: sample number.

Figure 1 – Study flowchart.

The average age of the questioned chest physiotherapists was 31.8 ± 7.17 years old. Most of them were female, specialists in respiratory or hospital physical therapy, with time since graduation between 5 and 10 years and working at public hospitals. (Table 1).

Table 1 – Chest physiotherapists demographic characteristics (n=232)

Characteristics	n (%)
Sex	
Female	162 (70%)
Time since graduation	
Less than 5 years	71 (31%)
Between 5 and 10 years	100 (43%)
Between 11 and 20 years	51 (22%)
Between 21 and 29 years	9 (4%)
More than 30 years	1 (0.4%)
Time of professional performance	
Less than 5 years	103 (44%)
Between 5 and 10 years	85 (37%)
Between 11 and 20 years	36 (16%)
Between 21 and 29 years	7 (3%)
More than 30 years	1 (0.4%)
Highest degree	
Graduation	37 (17%)
Specialist	151 (65%)
Master	26 (11%)
Doctor	17 (7%)
Type of hospital	
University	30 (13%)
Private	79 (34%)
Public	123 (53%)

Note: n: absolute number.

Lung expansion techniques applied to patients with drained and non-drained pleural effusion

Deep breathing was the most chosen lung expansion technique for the treatment of patients with drained and non-drained pleural effusion. Yet, exercises with positive pressure was the technique least chosen in both situations, however, more applied to patients with drained effusion than to the ones with non-drained effusions (Table 2).

Table 2 – Technique applied by physiotherapists for lung expansion to patients with pleural effusion (n = 232)

Lung expansion techniques	Non-drained effusion	Drained effusion	P
	n (%)		
Deep breathing	179 (77%)	214 (92%)	<0.0001
Walking	133 (57%)	176 (76%)	<0.0001
Incentive Spirometry	98 (42%)	152 (66%)	<0.0001
Exercises with positive pressure	79 (34%)	139 (60%)	<0.0001

Note: n: sample number; p from chi-square test.

Time since graduation, highest degree and type of hospital are associated with the technique choice applied to patients with drained and non-drained pleural effusion. Being only graduated decreases the chances of the chest physiotherapist choosing exercises with positive pressure, deep breathing and walking as treatment techniques (Table 3).

Table 3 – Odds Ratio of lung expansion techniques and demographic characteristics of the chest physiotherapists taking care of patients with drained and non-drained pleural effusion (n = 232)

Associated variables		Drained			Non-drained		
Dependent variable	Exposition	p valor	OR	95% IC	p valor	OR	95% IC
Deep breathing	Graduation degree	NS	NS	NS	0.02*	0.41	0.20-0.88
Exercises with PP	Performance time between 5 and 11 years	0.01*	2.22	1.20-4.12	NS	NS	NS
Exercises with PP	Type of public hospital	0.01*	2.20	1.18-4.14	0.01*	2.32	1.29-4.17
Exercises with PP	Graduation degree	0.001*	0.25	0.11-0.56	0.001*	0.14	0.04-0.46
Walking	Graduation degree	NS	NS	NS	0.003*	0.33	0.16-0.70
Walking	Performance time between 5 and 11 years	0.03*	2.15	1.08-4.26	NS	NS	NS
Walking	Type of university hospital	0.04*	3.55	1.02-12.31	NS	NS	NS

Note: OR: odds ratio; IC: confidence interval; PP: positive pressure; NS: not significant; *p < 0.05.

Discussion

Our study shows that chest physiotherapists, who work with respiratory care of patients with pleural effusion, have been graduated for 5 to 10 years, having specialist degrees and working in public hospitals. Deep breathing was the most chosen technique and exercises with positive pressure was the least chosen one by the physiotherapists to deal with pleural effusion. Besides, highest degree and time since graduation seem to be associated to the technique choice for lung expansion.

Chest physiotherapists characteristics

Like other countries, in our Brazilian sample, there was a predominance of chest physiotherapists of the female sex [18], however, this factor does not seem to interfere in the therapeutic choices. On the other hand, higher degree [19, 20], which is associated to time since graduation, were connected to techniques chosen by the chest physiotherapists. Possibly, more years of professional education, with consequent increase of degree level, allow the chest physiotherapist to associate a larger number of techniques to the treatment of the patient. This fact positively affects the health system [21], once the chest physiotherapist himself will be able to identify his needs at the clinic practice [22].

Lung expansion techniques applied by chest physiotherapists

In patients with drained pleural effusion, the lung expansion techniques, in descending order, were: deep breathing, incentive spirometry and positive pressure exercises, consecutively. Most of the chest physiotherapists associate lung expansion techniques with walking.

Exercises with deep breathing, when applied at the pre-operative period, decrease hospitalization time and lung complications after open-heart surgeries [23]. However, there is no evidence of the long-term benefit of this technique after hospital discharge [24]. The low cost, easy use, and the possibility of association with other techniques can be the justification for the interviewed chest physiotherapists' high choice percentage of exercises with deep breathing for the treatment of patients with drained and non-drained pleural effusion.

While the deep breathing seems to benefit patients submitted to heart surgeries, the use of incentive spirometry instigators seems to present positive effects in different clinic situations [25, 26]. On the other hand, one of the negative aspects of the incentive spirometry use is the low treatment adherence [27]. Probably this low adherence occurs because, unlike in Brazil, where the use of this equipment is incorporated to the therapy and monitored by the therapist, in other places of the world, the patient is only instructed to use the equipment hourly [26].

Regarding the use of positive pressure, despite many studies having been testing the benefits of its application in surgical patients [28-31], the results are still controversial [32]. We believe that, besides the weak evidence of the positive pressure use in patients with pleural effusion [19], the little familiarity with the use of this technique and the risk of Broncho pleural fistula might have restricted the choice for this lung expansion technique [33, 34].

In patients with non-drained pleural effusion, deep breathing, incentive spirometry, and exercises with positive pressure were consecutively chosen as treatment techniques for them. In this population, walking also seems to be motivated by most of the chest physiotherapists, associated to the use of lung expansion technique. Walking on the first day after lung surgeries seems to have some benefits [35], including the early removal of the thoracic drainage tube [36]. The mobilization of patients submitted to thoracic surgeries seems to positively impact the recuperation of the patients' functionality [37, 38]. It is possible that these benefits have also influenced the chest physiotherapists' answers regarding the non-drained patients. Although the most applied technique for the respiratory care was deep breathing and the least used was exercise with positive pressure, in both conditions we observed that, in patients with drained pleural effusion, all the techniques were considerably mentioned because they are probably applied jointly and not individually. Besides, we believe that when breathing therapy involves two or more techniques, it improves patient adherence to the treatment because the therapy is less monotonous and their confidence in overcoming the challenges proposed by the therapist increases.

Factors that influence in the choice of therapeutic techniques

This survey shows that there is association between the graduation degree in physical therapy and the choice for deep breathing, indicating that being solely graduated

decreases the chance of electing this technique for the treatment of non-drained pleural effusion patients. It is possible that the academic degree influences the therapeutic choices because, as the physiotherapist acquires more information, more scientific criteria should be used on making a decision. There also is association connecting the time of professional performance between 5 and 11 years to the choice of the walking and positive pressure exercise techniques, indicating that the physiotherapists with this time of performance are more prone to indicate these two practices when compared to non-drained patients. Thus, the higher their experience with clinic practice, higher will be their perception of the need of practices considered as remedial. This requires physiotherapists to be not only competent in their therapeutic choices, but also able to apply the knowledge based on evidence when handling and treating patients [39]. The beneficial potential of the use of positive pressure exercises has been reported at the prevention of complications and treatment of patients submitted to thoracic surgery, being associated to the physiotherapist's experience on dealing with these resources [40].

The fact of the working environment of most chest physiotherapists being the public hospital increases the chances of using positive pressure exercises on respiratory care of drained and non-drained patients. The hypothesis to this end is the great demand for servicing, once the use of positive pressure seems to increase the lung ventilation by pressure difference [40] more efficiently than deep breathing exercises, which would optimize the result of the therapy. The university hospital environment increases the chances to indicate walking as the therapy for drained patients, stimulating the functioning based on scientific evidences [41]. In addition, the strong benefit indicators of walking at the post-surgery period of placing thoracic tube support these findings [42].

In the attempt of implementing the best treatment strategy in patients with drained and non-drained pleural effusion, there are some barriers at the enforcement of practice based on evidence. Among these barriers, which should always be investigated at each service in order to be identified and overcome, there is the full download of scientific articles and the language of the published article [43].

One of the main limitations of this study was the answering rate of 45.31%, which, despite matching with the ones found in the literature [18, 44-48], may not be representative of the whole wide world. Another limitation was the physiotherapists' questioning through a multiple choice and not through an open answer questionnaire. However, due to the regional differences in nomenclature, we opted to try to homogenize the answers by means of a quantitative technique survey. Finally, we have not questioned the chest physiotherapists the reasons for their choices, but opted for a short questionnaire to increase the adhesion to the survey.

Conclusions

Our results show that deep breathing associated to walking is the treatment most applied by chest physiotherapists on assisting patients with drained and non-drained pleural effusion. Moreover, highest educational degrees, time of professional performance, and the type of hospital where the chest physiotherapists work seem to interfere in their therapeutic choices. Our results suggest that, besides the search for evidences that support the assistance to this population, experience time and more time investment in studying can improve the professional practice in this field.

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References

1. Thomas R, Jenkins S, Eastwood PR, Lee G, Singh B. Physiology of breathlessness associated with pleural effusion. Curr Opin Pulm Med. 2015;21(4):338-45.

2. Letheulle J, Kerjouan M, Bénézit F, De Latour B, Tattevin P, Piau C, et al. Parapneumonic pleural effusions: epidemiology, diagnosis, classification and management. Rev Mal Respir. 2015;32(4):344-57

3. Hogg JR, Caccavale M, Benjamin Gillen B, McKenzie G, Vlaminck J, Fleming CJ. Tube thoracostomy: a review for the interventional radiologist. Semin Intervent Radiol. 2011;28(1):39-47.

4. Brims FJH, Lansley SM, Waterer GW, Lee YCG. Empyema thoracics: new insights into an old disease. Eur Respir Rev. 2010;19(117):220-8.

5. Kesieme EB, Dongo A, Ezemba N, Irekpita E, Jebbin N, Kesieme C. Tube thoracostomy: complications and its management. Pulmon Med. 2012;2012:1-10.

6. Harris A, O'Driscoll BR, Turkington PM. Survey of major complications of intercostal chest drain insertion in the UK. Postgrad Med J. 2010;86(1012):68-72.

7. Rezende-Neto JB, Pastore Neto M, Hirano ES, Rizoli S, Nascimento Júnior B, Fraga GP. Management of retained hemothoraces after chest tube thoracostomy for trauma. Rev Col Bras Cir 2012;39(4):344-9.

8. Bohanes T, Szkorupa M. Chest drainage systems and the complications associated with drainage. Rozhl Chir. 2013;92(11):672-8.

9. McDermott S, Levis DA, Arellano RS. Chest drainage. Semin Intervent Radiol. 2012;29(4):247-55.

10. Chiumello D, Chevallard G, Gregoretti C. Non-invasive ventilation in postoperative patients: a systematic review. Intensive Care Med. 2011;37(6):918-29.

11. Santos EC, Lunardi AC. Efficacy of the addition of positive airway pressure to conventional chest physiotherapy in resolution of pleural effusion after drainage: protocol for a randomised controlled trial. J Physiother. 2015;61(2):93.

12. Hyeon Yu. Management of pleural effusion, empyema, and lung abscess. Semin Intervent Radiol. 2011;28(1):75-86.

13. Scurlock-Evans L, Upton P, Upton D. Evidence-based practice in physiotherapy: a systematic review of barriers, enablers and interventions. Physiotherapy. 2014;100(3):208-19.

14. Danner BC, Koerber W, Emmert A, Olgemoeller U, Doerge H, Quintel M, et al. Non-invasive pressure support ventilation in major lung resection for high risk patients: does it matter? Open Journal of Thoracic Surgery. 2012;2(3):63-71.

15. Asch DA, Jedrziewski MK, Christakis NA. Response rates to mail surveys published in medical journals. J Clin Epidemiol. 1997;50(10):1129-36.

16. PEDro Physiotherapy Evidence Database. Confidence interval calculator [cited 2014 Dec 25]. Available from: https://bit.ly/2BUUGHs.

17. Conti EJ, Monteiro SG. Encuesta sobre kinesiología respiratoria: situación actual en Argentina. Rev Am Med Resp. 2009;9(1):14-20.

18. Lomi C, Westerdahl E. Physical therapy treatment after cardiac surgery: a national survey of practice in Greece. J Clin Exp Cardiolog. 2013;S7(004):1-5.

19. Junior JFF, Chiavegato LD, Paisani DM, Colucci DBB. Utilization of positive-pressure devices for breathing exercises in the hospital setting: a regional survey in São Paulo, Brazil. Respir Care 2010;55(6):719-24.

20. Jette DU, Bacon K, Batty C, Carlson M, Ferland A, Hemingway RD, et al. Evidence-based practice: beliefs, attitudes, knowledge, and behaviors of physical therapists. Phys Ther. 2003;83(9):786-805.

21. Mystri Y, Francis C, Haldane J, Symonds S, Uguccioni E, Brooks D, et al. Attitudes toward master's and clinical doctorate degrees in Physical Therapy. Physiother Can. 2014;66(4):392-401.

22. Mathur S. Doctorate in Physical Therapy: is it time for a conversation? Physiother Can. 2011;63(2):140-2.

23. Shakouri SK, Salekzamani Y, Taghizadieh A, Sabbagh-Jadid H, Soleymani J, Sahebi L, et al. Effect of respiratory rehabilitation before open cardiac surgery on respiratory function: a randomized clinical trial. J Cardiovasc Thorac Res. 2015;7(1):13-7.

24. Westerdahl E, Urell C, Jonsson M, Bryngelsson I, Hedenström H, Emtner M. Deep breathing exercises performed 2 months following cardiac surgery: a randomized controlled trial. J Cardiopulm Rehabil. 2014;34(1):34-42.

25. Al-Mutairi FH, Fallows SJ, Abukhudair WA, Islam BB, Morris MM. Difference between continuous positive airway pressure via mask therapy and incentive spirometry to treat or prevent post-surgical atelectasis. Saudi Med J. 2012;33(11):1190-5.

26. Restrepo RD, Wettstein R, Wittnebel L, Tracy M. Incentive Spirometry: 2011. Respir Care. 2011;56(10):1600-4.

27. Narayanan ALT, Hamid SRGS, Supriyanto E. Evidence regarding patient compliance with incentive spirometry interventions after cardiac, thoracic and abdominal surgeries: A systematic literature review. Can J Respir Ther. 2016;52(1):17-26.

28. Stéphan F, Barrucand B, Petit P, Rézaiguia-Delclaux S, Médard A, Delannoy B, et al. High-flow nasal oxygen vs noninvasive positive airway pressure in hypoxemic patients after cardiothoracic surgery: a randomized clinical trial. JAMA. 2015;313(23):2331-9.

29. Torres MF, Porfirio GJ, Carvalho AP, Riera R. Noninvasive positive pressure ventilation for prevention of complications after pulmonary resection in lung cancer patients. Cochrane Database Syst Rev. 2015;9:CD010355.

30. Roceto Ldos S, Galhardo FD, Saad IA, Toro IF. Continuous positive airway pressure (CPAP) after lung resection: a randomized clinical trial. Sao Paulo Med J. 2014;132(1):41-7.

31. Köhnlein T, Windisch W, Köhler D, Drabik A, Geiseler J, Hartl S. et al. Non-invasive positive pressure ventilation for the treatment of severe stable chronic obstructive pulmonary disease: a prospective, multicentre, randomised, controlled clinical trial. Lancet Respir Med. 2014;2(9):698-705.

32. Orman J, Westerdahl E. Chest physiotherapy with positive expiratory pressure breathing after abdominal and thoracic surgery: a systematic review. Acta Anaesthesiol Scand. 2010;54(3):261-7.

33. Ziarnik E, Grogan EL. Post-lobectomy early complications. Thorac Surg Clin. 2015;25(3):355-64.

34. Mao R, Ying P, Xie D, Dai C, Zha J, Chen T, et al. Conservative management of empyema-complicated post-lobectomy bronchopleural fistulas: experience of consecutive 13 cases in 9 years. J Thorac Dis. 2016;8(7):1577-86.

35. Harada H, Yamashita Y, Handa Y, et al. Assessment of feasibility of early ambulation and food-intake on the operative day after lung resection. Kyobu Geka. 2015;68:801-8.

36. Dumans-Nizard V, Guezennec J, Parquin F, et al. Feasibility and results of a fast-track protocol in thoracic surgery. Minerva Anestesiol. 2016;82:15-21.

37. Baddeley RA. Physiotherapy for enhanced recovery in thoracic surgery. J Thorac Dis. 2016;8(Suppl 1):S107-S110.

38. Scarci M, Solli P, Bedetti B. Enhanced recovery pathway for thoracic surgery in the UK. J Thorac Dis. 2016;8(Suppl 1):S78-S83.

39. Biesheuvel S. How do we measure the quality of a respiratory therapy education program? Can J Respir Ther. 2014;50(1):15-6.

40. Cabrini L, Plumari VP, Nobile L, Olper L, Pasin L, Bocchino S, et al. Non-invasive ventilation in cardiac surgery: a concise review. Heart Lung Vessel. 2013;5(3):137-41.

41. Lovas A, Németh MF, Trásy D, Molnár Z. Lung recruitment can improve oxygenation in patients ventilated in continuous positive airway pressure/pressure support mode. Front Med. 2015;2(25):1-7.

42. Kraus DR, Bentley JH, Alexander PC, Boswell JF, Constantino MJ, Baxter EE, et al. Predicting therapist effectiveness from their own practice-based evidence. J Consult Clin Psychol. 2016;84(6):473-83.

43. Silva TM, Costa LC, Costa LO. Evidence-based practice: a survey regarding behavior, knowledge, skills, resources, opinions and perceived barriers of Brazilian physical therapists from São Paulo state. Braz J Phys Ther. 2015;19(4):294-303.

44. Nonoyama ML, Mathur S, Herbet R, Jenkins H, Lobchuk M, McEvoy M. Past, present and future of respiratory research: a survey of Canadian health care professionals. Can Respir J. 2015:22(5):275-81.

45. Yeole UL, Chand AR, Nandi BB, Gawali PP, Adkitte RG. Physiotherapy practices in Intensive Care Units across Maharashtra. Indian J Crit Care Med. 2015;19(11):669-73.

46. Reid WD, Stanton SJ, L. Kelm LC. Factors associated with physiotherapists' interest in cardiorespiratory continuing education using computer-assisted learning: a survey. Physiother Can. 2008;60(1):80-91.

47. Baidya S, Acharya RS, Coppieters MW. Physiotherapy practice patterns in Intensive Care Units of Nepal: a multicenter survey. Indian J Crit Care Med. 2016;20(2):84-90.

48. Mbada CE, Hakeem BO, Adedoyin RA, Awotidebe TO, Okonji AM. Knowledge, attitude and practice of cardiopulmonary resuscitation among Nigerian physiotherapists. Jour Resp Cardiov Phy Ther. 2015;2(2):52-62.

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