Utilization of Positive-Pressure Devices for Breathing Exercises in the Hospital Setting: A Regional Survey in São Paulo, Brazil

Julio F Fiore Junior MSc, Luciana D Chiavegato PhD, Denise M Paisani MSc, and Daniela BB Colucci PT

BACKGROUND: The use of breathing exercises with positive-pressure devices during hospitalization aims to prevent the development of nosocomial pulmonary complications or to facilitate recovery from pulmonary conditions already present. Although this type of intervention has potential benefits and theoretical advantages over more conventional respiratory physiotherapy techniques, the literature on the effects of breathing exercises with positive-pressure is controversial and inconsistent. OBJECTIVE: To evaluate the extension of the use of breathing exercises with positive-pressure devices by physiotherapists in São Paulo, Brazil. METHODS: A list of hospitals located in the city of São Paulo was obtained through the Municipal Secretary of Health. Physiotherapists at 43 hospitals were surveyed about their use of exercises with positive-pressure devices in: patients after abdominal, thoracic, and cardiac surgery; patients with chronic obstructive pulmonary disease; patients with pneumonia; and patients with neuromuscular disease. RESULTS: 120 physiotherapists responded to the questionnaire. All the respondents used breathing exercises with positive-pressure devices in their clinical practice, with all types of patients addressed in the questionnaire. The devices most frequently used were continuous positive airway pressure (78%) and intermittent positive-pressure breathing (73%). The most frequently cited indications for positive-pressure breathing exercises were atelectasis and oxygenation impairment. CONCLUSIONS: Despite a lack of evidence of benefit from breathing exercises with positive-pressure in the hospital setting, this type of intervention is used extensively in clinical practice for a wide variety of patients and conditions.
Key words: breathing exercises; continuous positive airway pressure; intermittent positive-pressure breathing; respiratory physiotherapy; respiratory complications; in-patients. [Respir Care 2010;55(6): 719–724.

Introduction

The use of positive-pressure devices for breathing exercises has as its primary aim to facilitate the expansion of the lungs and thus prevent the development of atelectasis and improve the clearance of pulmonary secretions.[1] As lung collapse[2] and the retention of airway sputum[3,4] are important risk factors for bacterial growth, it is assumed that breathing exercises with positive pressure may prevent pulmonary infections and/or facilitate their treatment. Considering their theoretical benefits, exercises with positive-pressure devices may be useful in the hospital setting to prevent or treat postoperative pulmonary complications,[1,5,6] to facilitate the treatment of community-acquired pneumonia,[1,7] and to facilitate the recovery of patients with chronic conditions exacerbated by lung infection, such as chronic obstructive pulmonary disease (COPD), bronchiectasis, cystic fibrosis, and neuromuscular diseases.[1,8-10] Positive-pressure devices have been part of physiotherapy management since the clinical use of intermittent positive-pressure breathing (IPPB) was first described in the 1940s.[1] Their use became especially popular in the 1980s and 1990s, when other devices, such as continuous positive airway pressure (CPAP), positive airway pressure

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(PEP) mask, and bi-level positive airway pressure (BiPAP), were described and became available in clinical practice.[1]

The benefits of noninvasive ventilation with positive-pressure devices on the outcome of patients with respiratory failure have been well documented in the literature[11,12]; however, studies evaluating the intermittent or periodic use of these devices for breathing exercises have shown controversial and inconsistent results.[5-7,9,13] We hypothesized that, despite the lack of evidence of benefits, breathing exercises with positive-pressure are commonly used in clinical practice. The present study was aimed at evaluating the extent of the use of breathing exercises with positive-pressure devices by physiotherapists in São Paulo, Brazil. We also sought information on the indications for the use of these devices, the types of devices used, and the respondents' impressions of the efficiency of breathing exercises with positive pressure.

Methods

As no validated tool currently existed to survey physiotherapists about the use of breathing exercises with positive-pressure devices in clinical practice, we designed a questionnaire with 12 multiple-choice questions (available on request). The questions sought information about the physiotherapist's hospital service, academic background and clinical experience, type of positive-pressure devices used in their hospital, indications for the use of these devices in various patient groups (abdominal, thoracic and cardiac surgery, COPD, pneumonia, and neuromuscular disease) and respondents' impressions about the efficiency of breathing exercises with positive pressure. The questionnaire addressed only the use of breathing exercises with positive-pressure devices for adult patients. The questionnaire was pilot-tested among 10 physiotherapists in São Paulo Hospital, Federal University of São Paulo. Comments on question design, ambiguities, terminology, structure, and content were obtained and minor changes made.

A list 102 hospitals in São Paulo was obtained through the Municipal Secretary of Health. Each hospital was contacted via telephone. At the hospitals that had physiotherapists on staff, we contacted the physiotherapy coordinator or a senior physiotherapist and informed him or her about the purpose of the research. If he or she agreed to participate, we visited the hospital, and the physiotherapy coordinator or senior physiotherapist signed a formal authorization for distribution of the questionnaire and identified physiotherapists with experience in treating the types of patients addressed. The number of questionnaires completed in each hospital was proportional to the number of professionals with these characteristics. A covering letter explained to each respondent the purpose of the questionnaire, identified the researchers, and assured confidentiality. The letter also made clear that the questionnaire concerned only the use of positive-pressure devices for breathing exercises, not for performing noninvasive ventilation for patients with respiratory failure. Respondents were permitted to mark more than one answer for each question if required. Two weeks were allowed for return of the questionnaires.

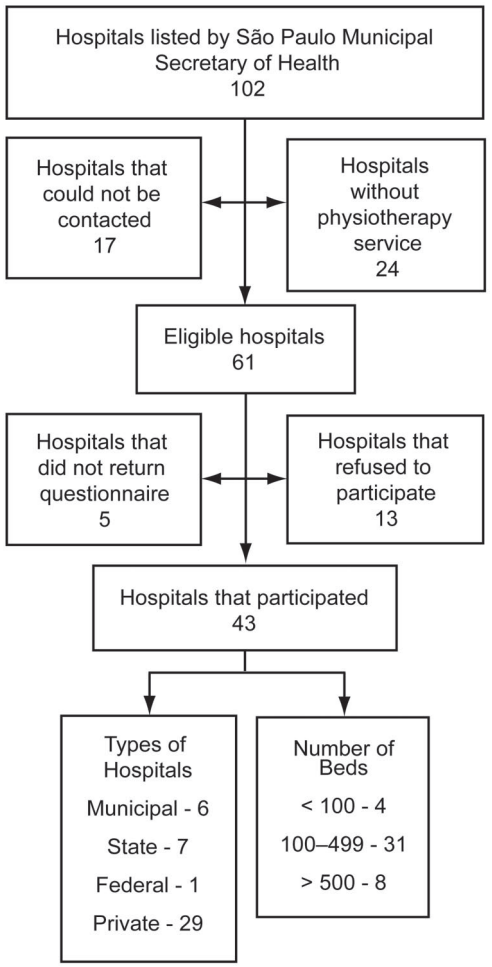

Fig. 1. Flow chart of listed, nonparticipant, and participant hospitals.

The study was authorized by the University City of São Paulo ethics committee. The return of the questionnaire was taken to represent informed consent of the participants.

All the data obtained in the questionnaire were treated as categorical. Descriptive statistics were used to report the results. We used spreadsheet software (Excel, Microsoft, Redmond, Washington) to analyze proportions and to design graphs and table.

Results

Figure 1 shows the characteristics of the hospitals that participated. Of the 102 hospitals listed by the Municipal Secretary of Health of São Paulo, 17 could not be contacted, 24 did not have physiotherapists on staff, and 13 refused to

participate. We visited 48 hospitals between August 2006 and April 2008. Five hospitals did not return any questionnaires.

120 questionnaires were returned from the 43 hospitals that participated (mean 2.8, range 1–6 questionnaires per hospital). Table 1 presents the academic backgrounds and professional experience of the physiotherapists who returned the questionnaire.

All the physiotherapists who returned the questionnaire reported that they used some kind of exercise with positive-pressure devices in their clinical practice. Figure 2 shows the types of positive-pressure devices used. CPAP and IPPB were the most cited devices (78% and 73% of the respondents, respectively), followed by BiPAP (60%) and PEP (50%) devices.

Exercises with positive-pressure devices were used with all the types of patients addressed by the questionnaire. Figure 3 shows the indications for the use of breathing exercises with positive pressure. Atelectasis and oxygenation impairment were the most frequent indications, followed by difficulty performing conventional breathing exercises.

Figure 4 summarizes the physiotherapists' impressions about the efficiency of breathing exercises with positive-pressure devices. Most of the respondents reported that positive-pressure devices are as efficient as (52%) or more efficient than (46%) conventional breathing exercises.

Table 1. Physiotherapist Respondents

	n	%
Physiotherapists	120	100
Academic Profile		
Physiotherapist non-specialist	17	14
Specialist degree in respiratory physiotherapy	81	68
Masters degree	14	12
PhD degree	3	3
Postgraduate student	5	4
Years of professional experience		
< 1	7	6
1–5	61	51
6–11	34	28
11–19	18	15
> 20	0	0

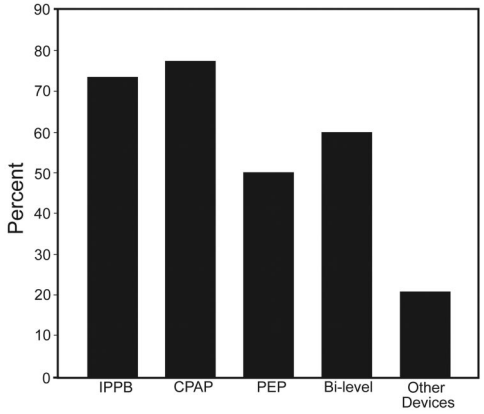

Fig. 2. Positive-pressure devices used by the physiotherapists who responded to the questionnaire. IPPB = intermittent positive-pressure breathing. CPAP = continuous positive airway pressure. PEP = positive expiratory pressure.

Discussion

Respiratory physiotherapy during hospitalization aims to prevent nosocomial pulmonary complications and to treat pulmonary conditions already present and thus to reduce hospital stay and healthcare costs. Although evidence is lacking to support the use of respiratory physiotherapy for most groups of hospitalized patients,[5,6,14,15] this type of intervention appears to be widely used in clinical practice worldwide.[16-18] A wide range of techniques are available to provide lung expansion and clearance of pulmonary secretions. Some interventions can be performed with just the physiotherapist's manual abilities and/or the patient's voluntary effort, such as deep breathing exercises, manual pulmonary clearance techniques, and forced expiration techniques.[5,6,19] Other interventions, such as breathing exercises with positive-pressure, require devices. Breathing exercises with positive-pressure have some potential benefits and theoretical advantages over more conventional respiratory physiotherapy techniques. They may promote greater lung expansion because of higher inspiratory and/or expiratory pressure, and thus increase the airway diameters and the pulmonary elastic recoil during expiration, promoting better pulmonary secretion clearance.[1]

On the other hand, breathing exercises with positive-pressure are considered more laborious and costly than other techniques. It is estimated that, just taking into account the labor cost for the professional providing the therapy, a physiotherapy session with a positive-pressure device is twice the cost of a session with conventional exercises.[6] The positive-pressure equipment also increases the cost. Considering this important disadvantage, the use of positive-pressure devices for breathing exercises in clinical practice should be justified only by strong scientific evidence of a positive impact on clinically relevant outcomes.

Some randomized controlled trials have compared positive-pressure devices to other physiotherapy techniques and no-treatment control groups. However, the low methodological quality of those studies does not allow us to draw clear conclusions about the potential benefit of positive-pressure breathing exercises for most patient groups. Moreover, the majority of those studies evaluated the effect of positive-pressure devices only on physiological outcomes of uncertain clinical relevance (eg, pulmonary function, oxygen saturation, or sputum production).[5,6,8,10] The few studies that have evaluated the effect of positive-pressure breathing exercises on clinically relevant outcomes

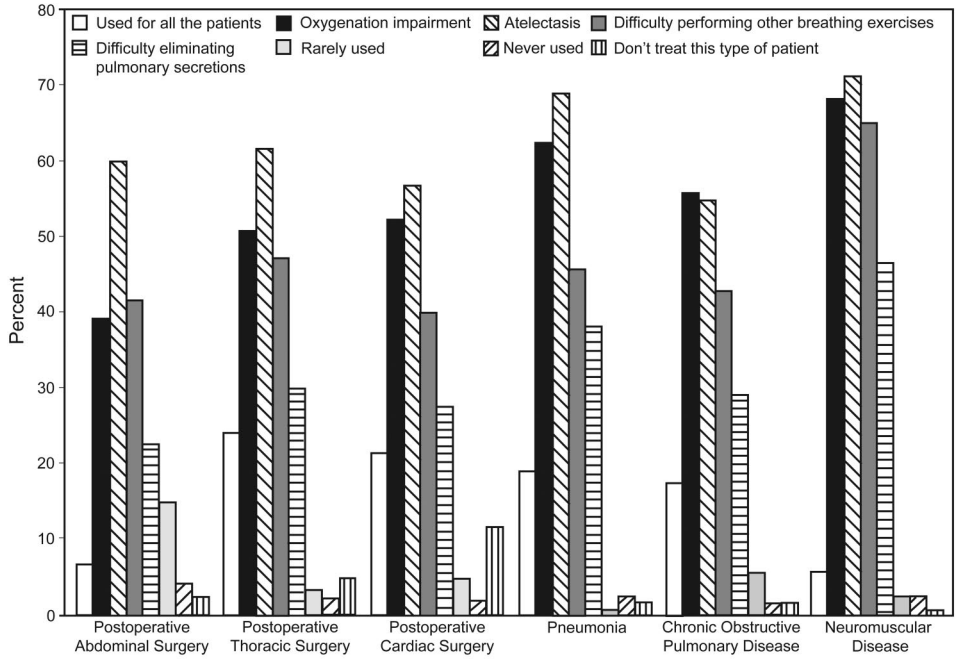

Fig. 3. Indications for the use of breathing exercises with positive-pressure devices.

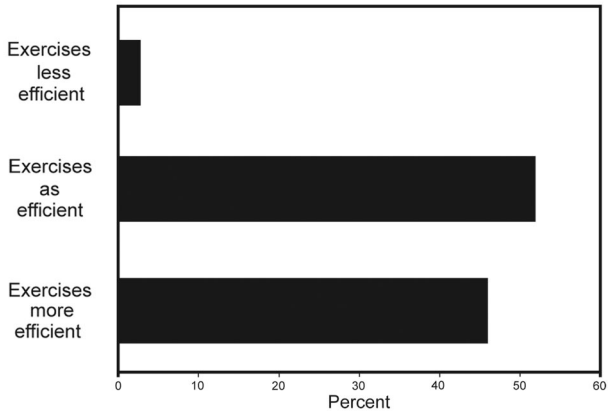

Fig. 4. Impression of the physiotherapists about the efficiency of breathing exercises with positive-pressure devices.

(eg, nosocomial pulmonary complications or hospital stay) have also had important methodological limitations. Most of them did not describe details about the methods of randomization and follow-up or report whether the outcome assessors were blinded.[5,6] Descriptions of the techniques and dosage were also often inadequate.[1,5,6] The present survey results show that, despite the inconsistent and controversial literature findings, breathing exercises with positive-pressure devices are extensively used in clinical practice.

Our response rate was quite satisfactory; of the 61 eligible hospitals, 43 (70%) participated. That a member of the research team visited each hospital to deliver the questionnaire and explain the research purposes may have helped us to achieve this response rate. All the physiotherapists who responded to the questionnaire used breathing exercises with positive-pressure devices in their clinical practice. The devices most frequently used were CPAP and IPPB. Exercises with positive-pressure devices were used in all groups of patients included in the questionnaire and for a wide range of indications. Physiotherapists seemed to have high expectations about the potential benefits of breathing exercises with positive-pressure devices, as 46% of the respondents had the impression that these exercises were more efficient than conventional breathing exercises.

The popularity of the CPAP and IPPB devices may be explained by their relative simplicity. CPAP is usually applied with a flow generator attached to a face mask and an expiratory resistor (PEP valve), and IPPB is usually delivered with a respirator (eg, Bird Mark 7, Viasys/CareFusion, Palm Springs, California) attached to a face mask.[1] As exercises with BiPAP can only be performed with a high-cost microprocessor-controlled mechanical ventilator, BiPAP is not as popular as IPPB or CPAP, but our results show that BiPAP is still widely used. Although exercise with PEP mask involves only a face mask attached to an expiratory resistor, and for this reason is potentially cheaper and less laborious than exercise with any other positive-pressure device, PEP mask was not used by most respondents. Not many studies have compared the effects of the various positive-pressure devices used for breathing exercises. Overall, the studies that have compared the application of positive-expiratory-pressure devices (CPAP, BiPAP, or PEP mask) have found them equally effective in improving physiological outcomes (lung

volumes and oxygenation).[20-22] None of the devices has been shown to provide superior patient outcomes.[20-22] Although IPPB is used extensively in clinical practice, most of the clinical studies evaluating the effect of IPPB did not show any physiological or clinical benefit.[7,9,23-25]

The results of the present survey show that breathing exercises with positive-pressure devices were used for all types of patients addressed in the questionnaire. In the literature, most of the studies of the usefulness of these devices in the hospital setting involved patients undergoing cardiac, thoracic, or abdominal surgeries. In postoperative patients the use of positive-pressure devices, especially those involving the application of positive expiratory pressure (CPAP, BiPAP, and PEP mask) seems to increase pulmonary volume in the short term, which often improves gas exchange.[5,6,26] The clinical benefits of such physiological changes, however, remain unclear, since the randomized controlled trials of the effects of exercises with positive-pressure devices on the incidence of nosocomial pulmonary infections and hospital stay have had controversial results.[5,6,13]

Some studies found a marked positive effect on clinically relevant outcomes,[26-29] but most of the studies found no effect.[5,6] Differences in the methods and patient selection might be responsible for these inconsistent results.[13] Studies of the effect of breathing exercises with positive-pressure devices in other groups of hospitalized patients are scant. IPPB did not provide any benefit for patients hospitalized for pneumonia or exacerbation of COPD.[7,9] One study found that PEP mask may increase the amount of secretions expectorated by COPD patients using noninvasive ventilation,[8] but the clinical relevance of this outcome is not clear.[30] Although some cohort studies have found that the ambulatory use of positive-pressure devices in patients with neuromuscular diseases can prevent pulmonary infections and reduce the number of hospitalizations,[31,32] the possible benefits of using these devices during hospitalization, to our knowledge, have not been evaluated in randomized controlled trials.

When our respondent physiotherapists were asked about the criteria they used to indicate exercises with positive-pressure devices for each group of patients, a wide variety of conditions were identified. It is hard to draw clear conclusions about the effect of positive-pressure devices for such specific indications, since most of the studies in the literature recruited patients based on the main reason for hospitalization (eg, abdominal surgery, exacerbation of COPD) and did not evaluate the effect of positive-pressure breathing exercises for specific conditions presented by these patients (eg, patients who developed atelectasis after surgery, or COPD patients with difficulty eliminating secretions). For all types of patients addressed in the questionnaire, the most cited indications for the use of exercises with positive-pressure devices were atelectasis and oxygenation impairment. Although exercises with positive-pressure devices are usually cited as an effective treatment for atelectasis, conventional exercises, such as deep breathing exercises, may be equally effective.[1] The benefits of exercises with positive-pressure devices in improving gas exchange are well documented in the literature,[5,20] but the clinical benefits of that gas-exchange improvement in patients who do not have severe hypoxemia (ratio of P_{aO_2} to $F_{IO_2} < 300$ mm Hg) is debatable.[13] Another criterion frequently cited as an indication for the use of positive-pressure devices was the difficulty in performing other breathing exercises. There is no evidence in the literature that patients in this situation would benefit from using these devices; however, guidelines from the American College of Physicians consider this an indication for patients undergoing non-thoracic surgery.[33]

Limitations

This study is subject to the limitations common to survey research. The response rate may be higher among more motivated professionals and those with specific interest in the subject. Moreover, the fact that a physiotherapy coordinator or a senior physiotherapist was responsible for choosing the physiotherapists qualified to answer the questionnaire may have been another source of selection bias. Another possible limitation concerns the survey instrument. Although the recommendations suggested by Rubenfeld[34] were implemented to ensure easy completion and a high response rate, it is difficult to ascertain whether respondents fully understood the questions and responded to them according to their daily practice. This survey also did not cover the use of positive-pressure devices for patients hospitalized because of other conditions commonly treated with respiratory physiotherapy, such as bronchiectasis or cystic fibrosis. Because this survey was carried out in only one city in Brazil, the results may not be generalizable to other regions. In Brazil, physiotherapists are responsible for provide breathing exercises with positive-pressure devices. It would be interesting to compare our results to future surveys studies performed in other countries, especially where other healthcare professionals, such as respiratory therapists, are responsible for this part of patient management.

Conclusions

The evidence to support the use of breathing exercises with positive-pressure devices in the hospital setting remains scant. Considering the inconsistency of the literature findings about its effects, the use of this type of intervention should be limited. This survey study, however, shows that breathing exercises with positive-pressure devices are extensively used in clinical practice, for a wide variety of patients and conditions. While there is no clear evidence of benefit from breathing exercises with positive pressure devices, the use of this

type of intervention may be increasing the cost of care without improving patient outcome.

We expect this survey study to stimulate debate regarding breathing exercises with positive-pressure devices, among physiotherapists, respiratory therapists, nurses, and physicians responsible for the respiratory care of hospitalized patients. This survey should encourage future randomized controlled trials adequately designed to answer clinically relevant research questions concerning this topic.

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