



Research

Inspiratory muscle training is used in some intensive care units, but many training methods have uncertain efficacy: a survey of French physiotherapists

Tristan Bonnevie^{a,b,c}, Jean-Christophe Villiot-Danger^d, Francis-Edouard Gravier^{a,e},
Johan Dupuis^f, Guillaume Prieur^{c,g}, Clément Médrinal^{c,g}

^aADIR Association, Bois-Guillaume; ^bService de réanimation chirurgicale; ^cUniversité de Picardie Jules Verne, Amiens; ^dUniversité Joseph Fourier, Grenoble; ^eService réanimation médicale, CHU-Hôpitaux de Rouen, Rouen; ^fADIR Assistance, Isneauville; ^gService de réanimation médico-chirurgicale, Groupe hospitalier du Havre, Montivilliers, France

KEY WORDS

Survey
Respiratory muscle training
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ABSTRACT

Questions: How common is inspiratory muscle training by physiotherapists in the intensive care unit (ICU)? Which patients receive the training? What methods are used to administer the training? Is maximal inspiratory pressure used to evaluate the need for the training and the patient's outcome after training? **Design:** Cross-sectional survey of all ICUs in France. **Participants:** Two hundred and sixty-five senior physiotherapists. **Results:** The response rate was 99% among eligible units. Therapist experience in ICU was significantly associated with the use of inspiratory muscle training ($p = 0.02$). Therapists mainly used inspiratory muscle training either systematically or specifically in patients who failed to wean from mechanical ventilation. The training was used significantly more in non-sedated patients ($p < 0.0001$). The most commonly nominated technique that respondents claimed to use to apply the training was controlled diaphragmatic breathing (83% of respondents), whereas 13% used evidence-based methods. Among those who applied some form of inspiratory muscle training, 16% assessed maximal inspiratory pressure. Six respondents (2%, 95% CI 1 to 5) used both an evidence-based method to administer inspiratory muscle training and the recommended technique for assessment of inspiratory muscle strength. **Conclusion:** Most physiotherapists in French ICUs who apply inspiratory muscle training use methods of uncertain efficacy without assessment of maximal inspiratory pressure. Further efforts need to be made in France to disseminate information regarding evidence-based assessment and techniques for inspiratory muscle training in the ICU. The alignment of inspiratory muscle training practice with evidence could be investigated in other regions. [Bonnevie T, Villiot-Danger J-C, Gravier F-E, Dupuis J, Prieur G, Médrinal C (2015) Inspiratory muscle training is used in some intensive care units, but many training methods have uncertain efficacy: a survey of French physiotherapists. *Journal of Physiotherapy* 61: 204–209]

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Introduction

Admission to an intensive care unit (ICU) for management of a critical illness is common, with between 221 and 595 admissions per 100 000 population in developed countries in Europe, Australasia and North America.^{1–3} Invasive mechanical ventilation is used routinely in ICUs to treat acute respiratory failure. Although this treatment is essential for survival, it has a major disadvantage: the passive state of the respiratory muscles under mechanical ventilation leads to rapid atrophy of the diaphragmatic muscle fibres, which reduces the diaphragm's ability to generate force.⁴ This condition is termed 'ventilator-induced diaphragmatic dysfunction'.⁴

The onset of ventilator-induced diaphragmatic dysfunction is rapid, with the atrophy starting to occur within hours of commencing mechanical ventilation.^{5–7} This atrophy is caused by an imbalance between protein synthesis and proteolysis, and is accompanied by a remodelling of the diaphragmatic muscle

tissue.^{8,9} Furthermore, the contractility of the muscle decreases, reducing the efficiency of the surface area of muscular fibres in the diaphragm for the same size of action potential.¹⁰ These changes lead to a large reduction in the inspiratory pressure generated by the diaphragm. Moreover, the extent of the changes is correlated to the duration of mechanical ventilation.¹¹

Although failure to wean from mechanical ventilation is multifactorial, many authors have identified that respiratory muscle weakness and deconditioning are associated with prolonged mechanical ventilation and difficulty in weaning.^{12–14} It is therefore generally accepted that ventilator-induced diaphragmatic dysfunction contributes to poorer outcomes such as delay in weaning from mechanical ventilation and increased risk of mortality in the ICU.¹⁵

Weakness of the diaphragm and other inspiratory muscles is usually identified by testing maximal inspiratory pressure. In mechanically ventilated patients, measurement of maximal inspiratory pressure should include inspiratory occlusion maintained for

at least 20 seconds.¹⁶ When respiratory muscle weakness is identified, methods of enhancing respiratory muscle function are often instituted, with the aims of preventing further weakness, improving strength and conditioning, and improving clinical outcomes.¹⁷ These methods consist of loading the inspiratory muscles (ie, strength training, such as with a fixed resistor or threshold valve) or maintaining hyperventilation (ie, endurance training, such as with isocapnic hyperpnoea).¹⁷

It has been established for some time that inspiratory muscle training improves inspiratory muscle strength in patients who are weaning from mechanical ventilation in the ICU.¹⁸ After the publication of this finding or of case reports of improved inspiratory muscle strength and weaning after training for patients who had previously failed to wean, many centres instituted this training for some patients.^{19–22} More recently, a systematic review of 10 randomised trials showed that inspiratory muscle training has important clinical benefits in patients who are weaning from mechanical ventilation in the ICU.²³ These benefits included a significantly shorter weaning period, reduced risk of weaning failure (ie, return to mechanical ventilation after extubation), and reduced length of ICU and hospital stay.

In the systematic review that established that inspiratory muscle training improves maximal inspiratory pressure, facilitates weaning and shortens length of stay,²³ all of the included studies used either a threshold pressure valve or sensitivity adjustment of the ventilator's inspiratory trigger. It is believed that, to date, these are the only techniques that have been demonstrated to improve inspiratory muscle strength (as measured by maximum inspiratory pressure) in mechanically ventilated ICU patients. Therefore, we would consider these to be evidence-based techniques in the ICU population. A fixed resistor has also been effective in inducing improvements in inspiratory muscle strength in other clinical populations;²⁴ however, this method has the drawback that patients can learn to exert their inspiratory muscles less by inhaling more slowly. Therefore, although it may also induce a training effect, the fixed resistor is not an ideal method with which to train the inspiratory muscles. Similarly, isocapnic hyperpnoea has been used to train the inspiratory muscles,²⁵ but this method typically involves enthusiastic cooperation of the patient voluntarily trying to match a visual target level of ventilation; this method may not be applicable to many patients in ICU.

Given that the effect of inspiratory muscle training in the ICU on some important clinical outcomes has only recently been established,²³ it is pertinent to determine whether the current use of the training is consistent with this evidence. Therefore, the aim of this study was to survey the use of inspiratory muscle training in ICUs, via a telephone survey of physiotherapists working in ICUs in France.

Therefore, the main research questions for this survey were:

1. How common is inspiratory muscle training by physiotherapists in the ICU?
2. Which patients receive the training?
3. What methods are used to administer the training?
4. Is maximal inspiratory pressure used to evaluate the need for the training and the patient's outcome after training?

Method

Design

The items to be included in the questionnaire were selected, based on the latest literature on the subject, by two physiotherapists experienced in inspiratory muscle training of patients receiving mechanical ventilation. An English-language translation of the questionnaire is presented in Appendix 1 on the eAddenda. The first section included questions about the demographic characteristics of the physiotherapist being interviewed and the ICU in which he/she worked. The next questions focused on reasons for use, type of

patients and training techniques. The respondents were asked to nominate the inspiratory muscle training methods that they used, rather than choosing them from a list. The remaining questions related to the assessment of maximal inspiratory pressure.

The survey was conducted by telephone between 1 November 2013 and 31 June 2014. Six investigators were trained to carry out the survey; they practised administering the questionnaire on six physiotherapists who worked, or had previously worked, in ICU. Following the testing, the telephone administration of the questionnaire was standardised in order to avoid influencing respondents. The only changes made to the questionnaire during standardisation concerned age ranges and experience. The respondents were offered no financial compensation for participating.

Participants, therapists and centres

A national inventory of French hospitals (from the website of the Fédération Hospitalière Française) was used to find all of the adult ICUs in France and their telephone numbers. Each investigator was allocated an equal number of hospitals to contact. Only one questionnaire was filled in for each ICU and only the principal physiotherapist of the ICU was questioned. If a physiotherapist practised in more than one ICU department, only one response was recorded. Respondents remained anonymous.

In case of absence, a telephone appointment was made. After all of the physiotherapists were contacted, the ones who initially refused to participate were contacted again and were strongly encouraged to participate in the survey.

Data analysis

Overall results were summarised using descriptive statistics. Data were summarised as count, percentages, or both. To determine the precision of some estimates, 95% CI were also calculated. Some results were also stratified according to the respondent's age, experience in ICU, type of ICU, and the patient:physiotherapist ratio in the ICU. Where the data required for stratification were unavailable, the respondent's data were removed from that stratified analysis. With regard to the reasons for use of inspiratory muscle training, if respondents stated that they systematically used inspiratory muscle training, no other answer was registered. If they responded that they did not use it systematically, more than one reason for use could be chosen. For comparisons between stratified groups, a Chi-squared test or Fisher's exact test were used where appropriate. A p -value < 0.05 was considered statistically significant.

Results

Flow of therapists and centres through the survey

In total, 298 hospitals and centres with ICUs were identified and contacted. Among them, eight had the same referent physiotherapist, so only one response was required. Another 22 had no (or very rare) physiotherapist intervention in the department, so none of the remaining questions in the survey were relevant. Therefore, one physiotherapist from each of 268 ICUs was eligible to respond to the full questionnaire. Questionnaires were completed by the physiotherapist in 265 of these ICUs, giving a 99% response rate among eligible centres (Figure 1). The remaining three ICU physiotherapists refused to participate. Table 1 shows the demographic characteristics of the respondents.

How common is inspiratory muscle training by physiotherapists in the ICU?

In total, 36% (95% CI 31 to 42) of the respondents stated that they used inspiratory muscle training. The reasons given by the other respondents for not using inspiratory muscle training are presented in Table 2.

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