

## Breathing Exercises with Positive Expiratory Pressure after Abdominal Surgery – The Current Physical Therapy Practice in Sweden

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### Abstract

**Objectives:** In Sweden breathing exercises with Positive Expiratory Pressure (PEP) are commonly recommended for the prevention of pulmonary complications after abdominal surgery. Scientific documentation of the effects of PEP treatment is limited. The aim of this national survey was to describe the current physical therapy practice of PEP treatment after abdominal surgery in Sweden.

**Methods:** A questionnaire was sent by e-mail to the 45 physical therapists who work with abdominal surgery patients in all seven university hospitals in Sweden. The questionnaire contained questions about the usage of PEP after abdominal surgery.

**Results:** In total, 24 (54%) of the physical therapists answered the questionnaire. All reported using PEP as a treatment option after abdominal surgery. The most commonly used PEP device was the Blow bottle system and the PEP ventil system connected to a mouthpiece. Recommendations regarding treatment frequency and implementation varied significantly across respondents. The number of breaths per treatment varied considerably.

**Conclusion:** All respondents reported using PEP as a postoperative treatment on abdominal surgery wards. The treatment is most often recommended hourly during the first postoperative days. The common first-choice PEP devices were the Blow bottle system, Pep/Rmt set with mouthpiece or mask, Breathing exerciser/PEP valve system 22, and the Mini-PEP.

**Keywords:** Deep breathing; Physical therapy; Positive expiratory pressure; Pulmonary complication; Surgery

### Introduction

Postoperative pulmonary complications, such as atelectasis, pneumonia, respiratory failure, sputum retention and shortness of breath, is of major concern after abdominal surgery [1]. Few interventions have clearly been shown to reduce the pulmonary complication rate [2]. To prevent or treat these complications, pre- and postoperative chest physical therapy is often prescribed. In some countries, deep breathing exercises with Positive Expiratory Pressure (PEP) are regularly suggested to patients who are unable to take deep breaths after abdominal surgery. The technique provides resistance on expiration and aims to improve lung volumes and to facilitate secretion mobilization, although the physiological explanation for these outcomes is unclear. Several assistive PEP devices have been developed, including the blow bottle system, PEP masks, and valves. The technique can also be carried out through pursed-lip breathing, which does not require equipment.

In a recent systematic review it was concluded that little scientific evidence exists to demonstrate that PEP treatment is better than other physical therapy breathing techniques for patients undergoing abdominal surgery [3]. In addition, the optimal choice of technique and duration of treatment has not been confirmed. The literature varies regarding how the technique should be administered to abdominal surgery patients [4-7]. In order to understand the rationale for postoperative breathing exercises after abdominal surgery, we wanted to establish how the PEP technique is currently utilised in clinical practice in Sweden. The purpose of this national survey was to establish the current physical therapy practice and reasons for using PEP treatment for abdominal surgery patients in Sweden.

### Material and Methods

The study was based on a national postal questionnaire sent to every physical therapist working on abdominal surgery wards and/or in Intensive Care Units (ICUs) in all seven university hospitals in Sweden. The study was carried out between September and December 2009. All 45 physical therapists who had worked with abdominal surgery patients as their main duty during the year were selected. The heads of the physical therapy department or ward supervisors at each of the hospitals gave permission for their physical therapists to consider participating in the study. The e-mail addresses of the selected physical therapists were collected from the head of the clinics. Before the study started, the Central Ethical Review Board in Sweden was consulted and it advised that no formal ethical approval was required. All physical therapists were informed that participation in the study was voluntary and that their identities would be kept confidentially.

The questionnaire was developed for this specific study and contained 11 closed and 3 open questions. A summary of the questions is presented in Table 1. The physical therapists were asked about their age, gender, education level, number of years in practice, and primary

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| Survey questions  |
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| Do you use breathing exercises with PEP in the postoperative care after abdominal surgery?  |
| What is your reason for initiating breathing exercises with PEP?  |
| What kind of PEP device do you usually use in the daily postoperative care?   |
| What is your reason for choosing a specific PEP device?   |
| On what indications do you choose to start breathing exercises with PEP?  |
| How many times a day is the patient instructed to perform the breathing exercises?  |
| How many repetitions (breaths) are the patient instructed to perform at each time?  |
| In your opinion, are there scientific evidence and/or proven experience supporting the use of breathing exercises with PEP after abdominal surgery? |

**Table 1:** Summary of the survey questions.

duties. Questions were asked about the usage of PEP in the treatment of postoperative abdominal surgery patients and the main purpose of PEP (open). Furthermore, questions were asked about which PEP assistive devices were available on the ward, which assistive devices they typically used, why they chose those devices (open) and what the indications for PEP treatment were (open). A final question was asked whether the respondent considered there to be scientific and/or empirical evidence to justify using PEP in the postoperative treatment of abdominal surgery patients. A pilot test of the questionnaire was carried out with two clinically active physical therapists (with former experience from postoperative care) at Uppsala University Hospital being asked to fill out the questionnaire and to return it by e-mail. They returned the completed pilot questionnaires and did not recommend any changes. The testers were not included in the final analysis. The questionnaire was sent by e-mail to the physical therapists accompanied by a cover letter describing the purpose of the study and providing instructions for completing the questionnaire and returning it by e-mail. After two weeks, a reminder e-mail, which included the questionnaire, was sent to the non-responders.

Version 15.0 of the SPSS software package (SPSS Inc., Chicago, IL, USA) was used for the descriptive statistical analysis.

## Results

Of the 45 physical therapists contacted, one failed to meet the inclusion criteria (not working with abdominal surgery patients). Of the remaining 44 physical therapists, 24 (54%) returned the questionnaire, representing all seven university hospitals. The respondents comprised 23 (96%) women and 1 man (4%). The physical therapists' ages ranged from 25 to 64 years with a mean age of 43 years. The number of years in clinical practice as a physical therapist ranged from 1 to 38, with a mean of 15 years. The level of education varied between a 2 year physical therapy programme (n=4), a 2.5 year physical therapy programme (n=3), a 3-year physical therapy programme (n=13), a master's degree (n=3), and a doctoral degree (n=1). Sixteen physical therapists worked in the abdominal surgery ward, 6 worked in the ICU, and 2 worked in both the abdominal surgery ward and the ICU.

All respondents (n=24) stated that they used PEP as a treatment option in postoperative care after abdominal surgery. The reasons (open question) for using PEP treatment were: prevention of pulmonary complications (n=14), secretion mobilization (n=13), treatment of pulmonary complications (n=12), increasing the Functional Residual Capacity (FRC) (n=11), optimizing the breathing pattern (n=9), improving oxygen saturation (n=6), decreasing arterial carbon dioxide tension (n=4), lowering the closing capacity (n=1), and aiding the patient during weaning from the ventilator (n=1). Some physical therapists gave several reasons.

For patients receiving PEP treatment, the most common first-choice PEP devices on the wards were the Blow bottle (n=6) (Figure 1) and the PEP/RMT set with mouthpiece (Astra Tech AB, Mölndal, Sweden) (n=6). These were followed by the breathing exerciser/PEP valve system 22 (Rium medical, Åkersberga, Sweden) (Figure 2), the Mini-PEP (Dolema AB, Täby, Sweden) (n=5), the Breathing exerciser (Anmedic AB, Stockholm, Sweden) (n=5), and the PEP/RMT set with mask (Astra Tech AB, Mölndal, Sweden) (n=3) (Figure 3). Pursed-lip breathing was not commonly reported as a first-choice treatment (n=1).

The reasons reported for choosing a certain PEP device were the patient's status (ability to use the assistive device independently or to carry out the treatment) (n=20), hygienic/bacterial aspects (n=5),



**Figure 1:** The Blow bottle system and a pressure manometer. The pressure is adjusted by varying the quantity of water in the bottle.



**Figure 2:** Breathing exerciser/PEP valve system 22, Rium Medical AB, Åkersberga, Sweden.



**Figure 3:** The Positive expiratory pressure/respiratory muscle trainer; PEP/RMT set with mask by Astra Tech AB, Mölndal, Sweden.

purpose of the treatment (n=3), cost (n=3), and availability (n=1). The recommendations for how often patients should perform PEP treatment each day varied: once an hour (n=19), 6-10 times per day (n=4), and once every other hour during the daytime (n=1). The number of breaths per treatment session varied between 6-10 breaths (n=8), 11-15 (n=4), 16-20 (n=0), 21-30 (n=9), and greater than 31 (n=3). A total of 11 (46%) reported in freeform text that the patient should perform three sets of 10 or more breaths. On the question of whether “there is scientific evidence and/or proven experience of using PEP as a treatment in the postoperative care after abdominal surgery”, all the respondents (n=24) answered yes.

## Discussion

All physical therapists active on abdominal surgery wards at the university hospitals in Sweden reported that they used PEP as a treatment method for abdominal surgery patients. The most commonly stated purposes for using PEP postoperatively were to prevent pulmonary complications, treat pulmonary complications, improve secretion mobilization, increase FRC, optimize the breathing pattern and improve oxygenation, which are consistent with the reasons described in the literature [8,9]. After abdominal surgery, which involves anaesthesia and immobilization, there is a risk of procedure-related postoperative pulmonary impairments [1]. Furthermore, the ability to clear secretions might be affected by the surgical site and pain during coughing and deep breathing [1,12]. In many patient groups, PEP treatment is often used to facilitate secretion mobilization [10,11]. Compared to other respiratory aids, however, only limited evidence exists on the effectiveness of PEP treatment after abdominal surgery [3,5]. According to Qaseem et al. the suggested treatment strategies for preventing postoperative complications after noncardiothoracic surgery include any type of lung expansion intervention, because this is better than no prophylaxis at all [12].

Postoperative chest physical therapy in Scandinavia often includes resistive breathing such as PEP or Continuous Airway Pressure (CPAP) [6,13-15]. Applying resistance during expiration increases the pressure in the airways and slows expiration. In the literature, an increase of resting lung volumes seems to be the major factor for justifying the use of PEP [4,5,7,8]. With the Blow bottle, the pressure is adjusted by varying the quantity of water in the bottle. When using a mask or a mouthpiece, the resistance is created by nipples or small lumens, and the pressure can be monitored with a manometer. A pressure of 10-20 cm H<sub>2</sub>O is typically recommended postoperatively [5,13]. Unfortunately, we did not ask about recommended pressure in the present survey. The patients are instructed to inspire and then expire through the PEP device to achieve an expiratory pressure. The instructions given to the patient on when and how to perform the PEP technique are important to consider. In the survey, the respondents reported different instructions for duration and frequency. Depending on the purpose of the treatment, the instructions provided to the patient may vary significantly. No clear guidelines are available on which device to use and how to perform the technique. The PEP technique is used in several patient groups but no clear evidence has been presented showing that PEP is more effective than other forms of physical therapy after abdominal or thoracic surgery [3,16,17].

Pulmonary complications occurring after abdominal surgery persist as a major problem, even though improvements in surgical and anaesthetic techniques have led to improvements in postoperative recovery and outcome [2]. The use of PEP in postoperative care is primarily intended to increase pulmonary volume, reduce atelectasis and facilitate secretion mobilization [8]. The PEP technique is an

expiratory method, but may be used to facilitate inspiration. Performing a maximal inspiration before expiration has been shown to reduce atelectasis in cardiac surgery patients, but currently there is no scientific evidence or consensus regarding the optimal technique to increase lung volumes and prevent pulmonary complications in abdominal surgery patients. Of the PEP devices used on the wards, the Blow bottle, PEP valve/mouthpiece and PEP mask system were reported to be the first choices, while pursed-lip breathing was reportedly used to a lesser degree. In the literature, no studies have evaluated pursed-lip breathing after abdominal surgery, and no studies have demonstrated the superiority of any technique, or indeed of PEP, over any other form of breathing intervention in surgical patients [3,18].

PEP treatment was most often recommended hourly during the first postoperative days. The number of breaths with PEP per treatment varied from 6 to more than 30. Few studies offer guidelines for how often PEP treatment should be used in postoperative care after abdominal surgery to achieve optimal results but a higher frequency of breaths during a session has been reported to improve oxygenation in the initial phase after cardiac surgery [19,20]. More research concerning technique, device, and strategy is warranted.

The 56% response rate was low, but considering that all university hospitals in Sweden were represented, the results could achieve satisfactory external validity. We believe the survey provides a valid picture of how physical therapists at university hospitals in Sweden use PEP treatment for abdominal surgery patients. However, results may not reflect physical therapy practice at non-university hospitals or primary care facilities. The response rate to questionnaires sent by e-mail has been reported to vary between 9 and 94% [21]. For this survey, various strategies were used to obtain a high response rate were applied: Cover letters were included in the e-mails, and a reminder e-mail was sent out. It is possible that a postal survey would have resulted in a higher response rate. The advantages of e-mail questionnaires include cost-effectiveness, simplicity of administration and a rapid response from participants.

All respondents at the university hospitals in Sweden reported using PEP as a choice of treatment for patients undergoing abdominal surgery, although the scientific evidence for its effectiveness in preventing postoperative pulmonary complications is limited. The PEP technique is, to our knowledge, not commonly used postoperatively in many other countries. Further studies on the effectiveness of PEP for abdominal surgery patients are required.

## Conclusion

All of the responding physical therapists at the seven university hospitals in Sweden stated that they used PEP treatment as a treatment option in postoperative care after abdominal surgery. The reason for using PEP treatment was primarily to prevent postoperative complications, and various PEP devices were used. Hourly treatment was most often recommended during the first postoperative days, but the number of breaths during each training session differed.

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