

Contents

Introduction	3
Research/Service Evaluation	
Use of electrical impedance tomography to monitor changes in lung air content during intermittent positive pressure breathing	4
<i>Banks A, Shannon H, Main E</i>	
Using the stages of change model to elicit modifications in clinical practice: introduction of a risk scoring model to identify patients at high risk of post operative pulmonary complications following elective general surgery.	10
<i>Anderson J, Greendale S, Hancock A, Green A.</i>	
An evaluation of the use of feedback during respiratory in-service training (IST)	16
<i>Dowds J, O'Hanlon DJ.</i>	
Case Studies	
High frequency chest wall oscillation (HFCWO) to augment airways clearance in a CF patient with copious secretions requiring intensive physiotherapy: A case study.	22
<i>Treacy K</i>	
Airway clearance in bronchomalacia with chronic cough suppression.	28
<i>Gilbert HMA, Haworth CS, Wat, DS, Barker HC.</i>	
Abstracts	
Abstracts from the ACPRC Conference 2010	32
Book Reviews	
Roses RE, Paulson EC, Kanchwala SK, Morris JB (2009) Gowned and Gloved Surgery: Introduction to Common Procedures; Philadelphia; Saunders Elsevier.	37
<i>Thompson C</i>	
Authors' Instructions	38



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Introduction

Welcome to the 2010 journal of the Association of Chartered Physiotherapists in Respiratory Care (ACPRC). The ACPRC mission is focused on promoting best practice in respiratory physiotherapy for the benefit of patients. The ACPRC Journal does this by promoting the exchange of ideas in respiratory care and providing a forum for discussion of findings of research and development in respiratory physiotherapy.

This year we have received a range of submissions for publication which include research, service evaluation and case studies. This diversity helps us realise the scope of practice within respiratory physiotherapy. We hope these challenge our readers and provide some new insight into the influence of research and evaluation on clinical practice.

The ACPRC conference in Nottingham in April this year was excellent. The four best abstract submissions to the conference were selected for oral presentation, and the abstracts from these are included in this edition of the journal. All the other posters disseminating research and service evaluation were available for viewing and discussion and this has provided an excellent forum for stimulating new research ideas in respiratory physiotherapy practice.

As with other ACPRC committee posts our editorial panel changes every three to four years so any future submissions should be directed to Catherine or Leigh as our new co-editors (details below). The continued publication of this Journal is dependant on your support so we would like to encourage all of you to consider submitting your work for the next edition. The ACPRC website provides the authors guidelines for submissions and the deadline for submission to the next journal is Jan 31st 2011.

Best regards

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Use of Electrical Impedance Tomography to monitor changes in lung air content during Intermittent Positive Pressure Breathing

Completed as part of an MSc in Advanced Cardiorespiratory Physiotherapy, University College London; July 2007.

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Summary

The efficacy of IPPB has been questioned as it may preferentially ventilate areas of unaffected lung. However, few tests are available to evaluate this. Electrical Impedance Tomography was used to monitor changes in regional lung air content during IPPB in five cases. The results indicate that EIT is sensitive enough to detect volume changes in an area a quarter of the thoracic size during positive pressure, suggesting it may be appropriate to develop as a research tool.

Keywords

**Electrical Impedance Tomography (EIT)
Intermittent Positive Pressure Breathing (IPPB)**

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Introduction

Recent guidelines on the use of intermittent positive pressure breathing (IPPB) stress the importance of increasing tidal volume during Physiotherapy treatments to ensure a therapeutic effect; clear bronchial secretions or open areas of atelectasis. (Bott et al 2009) Early physiological studies have demonstrated the ability of IPPB to augment tidal volume (Emmanuel et al 1966, Jones, et al 1960, Torres et al 1960) and reduce work of breathing. (Ayres et al 1963)

As well as increasing tidal volume it is important that during IPPB the extra breath is delivered to the specific area of collapse or secretion retention. It has been proposed that local volume increases allow air to get behind secretions via collateral ventilation channels and move them in a cephalad direction, towards the central airways. (Pryor & Prasad 2008)

As with conventional ventilation, there is some concern that IPPB may preferentially ventilate areas of normal lung tissue. An understanding of regional lung air content would clarify the therapeutic potential for IPPB to promote secretion clearance or recruit atelectatic lung areas helping clinicians decide which patients would benefit most from treatment.

Only a few tests are available clinically which can indicate the distribution of air within the thorax and these include computer tomography (CT) scans and X-Rays. These techniques have disadvantages: Patient exposure to harmful radiation, limited information on changes over time and qualitative data analysis only. The nitrogen washout technique can assess ventilation inhomogeneity. However, this technique is not accessible to the majority of Physiotherapists in clinical practice and is not very reliable; the percentage for lung clearance delay (indicating evenness of ventilation) ranges between 0% and 100% in healthy subjects (Bouhuys et al cited by Torres et al 1960).

Electrical Impedance Tomography (EIT) is an imaging technique that allows a non-invasive, indirect measurement of the air content of different lung regions over time. A small current is applied through 16 electrodes on the skin surface and the resulting potential differences are measured. As air and tissue have different electrical properties they conduct electricity with different effectiveness; air filled lung tissue has the highest impedance (Dunlop et al 1996).

Changes in impedance determined by EIT correlate closely with changes in lung volume. Hahn, et al., (1995) found a linear relationship between the change in lung volume and the thoracic impedance during stepwise

increases in volume in mechanically ventilated pigs ($r=0.99$). The correlation data was continued by Frerichs, et al., (2002) who compared EIT with electron beam computer tomography during different tidal volumes and positive end expiratory pressure levels. Six regions of interest were defined for each type of scan and a good correlation was found in all areas and for all volume and pressure levels. These studies demonstrate that EIT is a reliable and valid measure of both global and regional changes in lung volume and demonstrates that EIT overcome some of the issues associated with current imaging techniques.

■ Aims

EIT was used to monitor the effect of deep breathing and IPPB in healthy adults and adult patients with a variety of respiratory conditions. The results were used to investigate:

If EIT can detect changes in global and regional lung air content; suggesting whether it may become a useful research tool.

The effects of IPPB on global and regional ventilation.

■ Methods

The study was carried out as part of an MSc. in Advanced Cardiorespiratory Physiotherapy (University College London). Ethics approval was granted by the Surrey Research Ethics Committee (07/Q1909/34) and

the Research and Development Department at Frimley Park Hospital Foundation Trust. Eligible participants with respiratory disease were identified by Physiotherapists working on the wards at a district general hospital over a three month period. Inclusion and exclusion criteria can be found in Table 1.

Written informed consent was gained, then sixteen electrodes were placed around each participants' chest and back in an elliptical plane (mid-sternum anteriorly and at the level of T8 posteriorly). The electrodes were connected to the EIT device (VIASYS Healthcare, Hochberg, Germany).

Measurements were taken when the subjects were sitting. Following approximately five-minutes acclimatisation, EIT measurements were made at 13 frames a second in one-minute intervals during normal tidal breathing and then during deep breathing. The Physiotherapist responsible for the patient's care decided on the IPPB settings. For the healthy volunteers the pressure was set as high as tolerated and the flow rate was adjusted to synchronise with the participant's respiratory rate. After the participant acclimatised to IPPB a further minute of impedance readings were made. A summary of measurement periods is presented in Table 2.

Specialised software (Auspex V1.4, Viasys Healthcare Inc, Warwick, UK) reconstructed 2-D impedance images over a

Table 1: Inclusion and exclusion criteria

Inclusion criteria	Exclusion criteria
Over the age of 18	Contraindications to treatment with IPPB
Either healthy or patient with respiratory compromise who was receiving treatment with IPPB.	Unable to give written informed consent
Current inpatient on medical or surgical ward	Chest injury or clinical instability preventing placement of the electrodes
	Unable to tolerate treatment with a facemask

Table 2: Summary of measurement periods

Tidal	Rest	Deep breaths	Rest	IPPB 1	Rest	IPPB 2	Tidal
60 secs	2-5 mins	60 secs	2-5 mins	60 secs	2-5 mins	60 secs	2-5 mins

Key: mins – minutes, secs - seconds

32x32 circular matrix, using a mathematical algorithm. The impedance values were expressed as the change in impedance from a reference measurement that was specific to each individual. This gave

information on changes over time. The pixel information was extracted automatically by the software program for four regions of interest: dorsal, ventral, right and left. The change in impedance between maximum

inspiration and maximum expiration was calculated for the whole lung (global impedance) and in the four regions of interest. The impedance change is presented as a mean of the two IPPB treatment sessions.

Figure 1: Global Impedance Change for All Participants

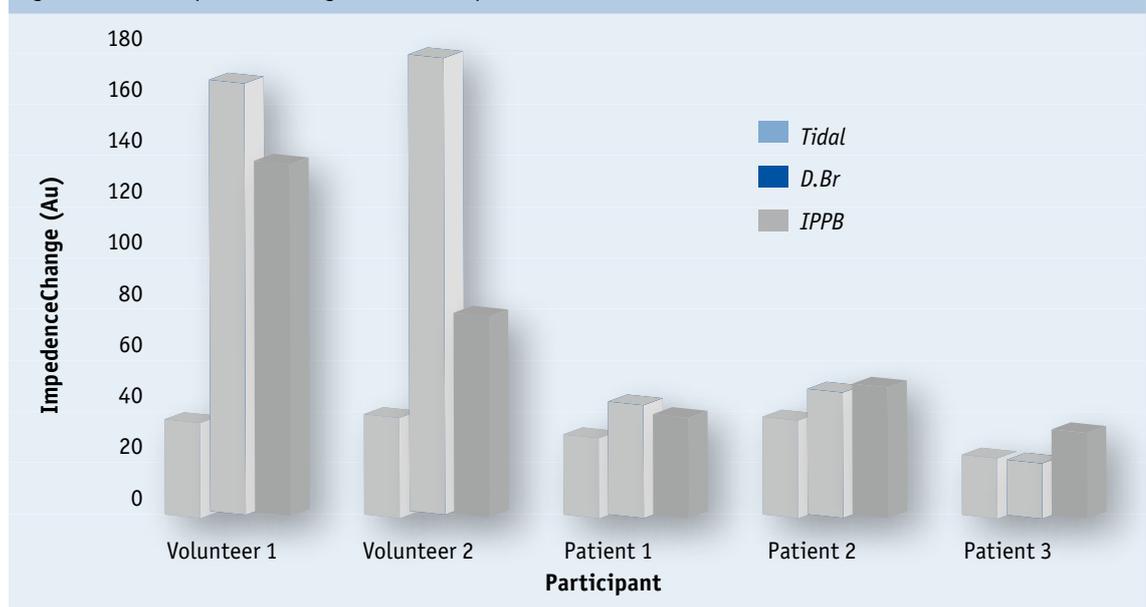
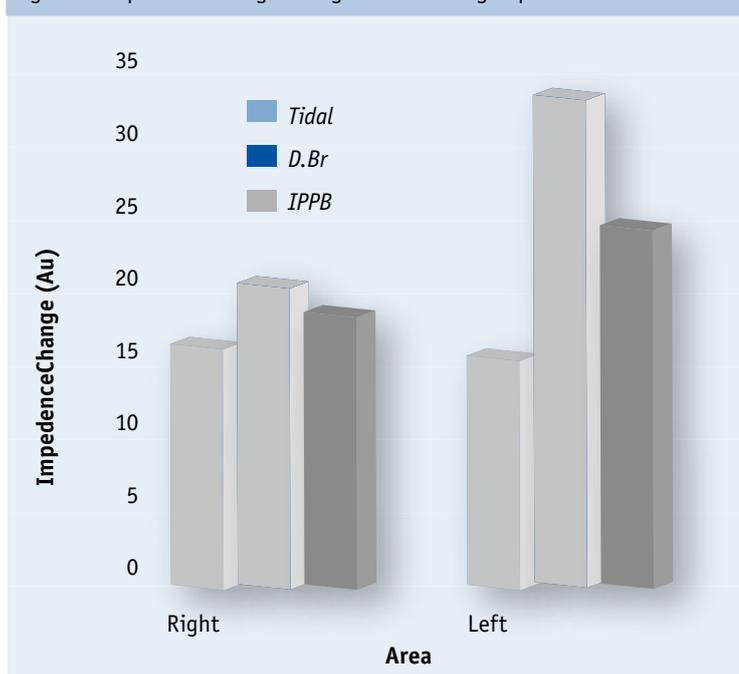


Figure 2: Impedance changes in right and left lung in patient 1



Results

Three patients with respiratory disease were recruited. A further two healthy adult volunteers were also recruited from a convenience sample.

Global Impedance

EIT was able to detect an increase in impedance during both deep breathing and IPPB when compared to tidal breathing in both healthy volunteers. Impedance was greatest during deep breathing, suggesting a larger tidal volume during deep breathing than IPPB (figure 1).

In the patient population

(n=3) the impedance changes from tidal breathing were a lot smaller in magnitude than the healthy volunteers (n=2). Differences, however, were still detectable. Patient 1 had a larger increase in impedance during deep breathing than IPPB, suggesting that tidal volume was greatest during spontaneous deep breathing. The opposite was true for patient 2; impedance changes were largest during IPPB. Patient 3 had a small reduction in impedance when deep breathing suggesting difficulty in increasing lung volume independently. During IPPB there was an increase in global impedance indicating that this device helped patient 3 to increase his lung volumes.

Regional Impedance

In the healthy volunteers an increase in impedance was seen in all four regions during both deep breathing and IPPB. This indicates that ventilation was distributed evenly throughout the lungs.

Patient 1 was a 43 year old male who had anterior rib fractures causing a haemothorax and right lower lobe collapse. IPPB treatment pressures were 25cmH₂O.

An increase in impedance was seen during deep breathing and IPPB in the left lung, although the increase was less marked during IPPB (figure 2). In contrast, in the right, affected, lung there was minimal change in impedance during both deep breathing and IPPB when compared to tidal breathing.

Patient 2 was a 70 year old female who had pneumonia and consolidation in both lower lobes. The pressure used for IPPB treatment was 25cmH₂O.

In this patient the impedance change was largest during IPPB in both the dorsal and ventral areas. However, most of the impedance change was occurring in the ventral area during both

Figure 3: Impedance change in the ventral and dorsal areas in patient 2

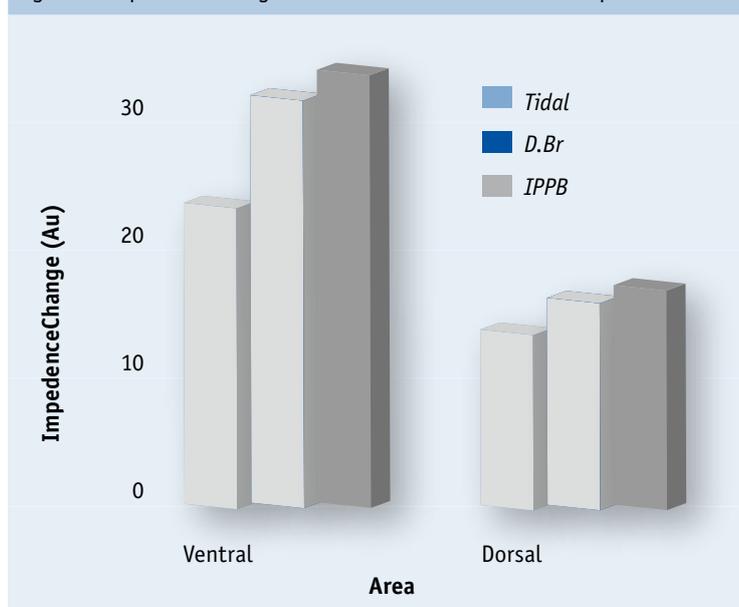
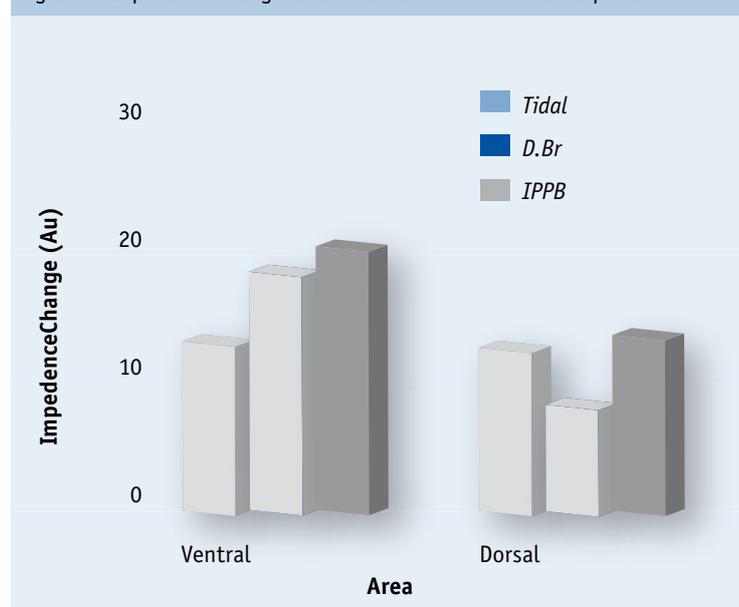


Figure 4: Impedance change in the ventral and dorsal area in patient 3



deep breathing and IPPB. (Figure 3)

Patient 3 was a 73 year old male with an exacerbation of severe chronic obstructive pulmonary disease. IPPB was being used with pressures between 16 and 19 cmH₂O, because the patient was unable to clear his bronchial secretions due to fatigue and being unable to increase his tidal volumes independently. During deep breathing and IPPB a change in impedance was only seen in the ventral, and not the dorsal area.

Discussion

This study was conducted to assess whether EIT could be used to detect changes in regional lung air content during deep breathing and during IPPB, and if so, the effects in healthy volunteers and in patients with respiratory disease.

Due to the small sample size and heterogeneity of the conditions studied extrapolation of the results to other subjects and populations should be made with caution. However, the results do give insight into

the ability of EIT to monitor the effect of IPPB on global and regional changes in lung air content.

Global Impedance Change

In the healthy volunteers EIT was able to detect large volume changes during both deep breathing and IPPB that were greater during deep breathing than during IPPB. This indicates that the healthy participants were able to increase their tidal volumes to a greater degree spontaneously than during IPPB. This is in agreement with Torres et al (1960) who reported increases in tidal volume during both voluntary hyperventilation and IPPB.

In the patient population, EIT only detected an increase in global impedance in two patients during deep breathing. This suggests that the other patient (patient 3) was unable to increase tidal volume independently. This is likely, as the guidelines suggest IPPB is used if a patient is too weak or tired to increase tidal volumes to cough effectively (Bott et al 2009). It was also the reason stated by the Physiotherapist for the use of IPPB in that instance.

During IPPB EIT detected an increase in lung air content in all three patients. This is in agreement with other authors who have found that IPPB can increase tidal volume in patients with kyphoscoliosis (Sinha & Bergofsky 1972) and patients with acute spinal cord injury (Stiller et al 1992). The increase in volume was, however, only greater than spontaneous deep breathing in two patients, suggesting that IPPB did not confer any additional benefit over deep breathing for patient 1.

Regional Impedance Changes

In patient one only the left lung saw a notable increase

in impedance during deep breathing and IPPB. This suggests that neither deep breathing nor IPPB were effective at opening areas of collapse in this instance. This finding is in contrast to O'Donohue (1979) who reported a resolution of collapse with IPPB, assessed by chest x-rays and arterial blood gases taken three days after commencing IPPB. Therefore, other factors may have assisted this improvement in outcome. Also, O'Donohue, (1979) used higher pressures than the present study; around 35 cmH₂O therefore, the studies are not comparable.

In patient 2 the main increase in impedance during IPPB was seen in the ventral area, which was likely to be the unaffected area. This is what we would expect to see if IPPB preferentially inflated areas of healthy lung tissue, although no firm conclusions can be drawn. Impedance results from the dorsal area are likely to reflect changes in the lower lobes, where the consolidation was located, as the posterior electrodes were positioned over this area. A small change in impedance was seen in the dorsal area but it is difficult to comment on how clinically meaningful it is.

Deep breathing and IPPB caused an increase in impedance change in the ventral area only in patient 3. The patient had hyperinflation therefore would have an unevenness of ventilation, with an apical bias, which would explain these findings. The results suggest that the uneven distribution of ventilation was not corrected by either deep breathing or IPPB in this patient.

This finding is in contrast to Torres et al (1960) who found that the uniformity of ventilation improved with IPPB. It is difficult to compare the results because the nitrogen

washout method, a very different technique from EIT, was used. Also, Torres et al (1960) only observed improvements in 10% of the total ventilation area which may be too small to detect using EIT. EIT only studies a small transverse area, whereas the nitrogen washout method studies the whole lung.

EIT is a similar process to having an electrocardiogram (ECG) and was well tolerated by all the participants. In this study it was sensitive enough to detect volume changes in an area quarter of the size of the thorax during positive pressure. This indicates that it would be feasible to develop as a research tool to assess changes in lung air content over time.

■ Limitations

The biggest limitations of this study were the sample size and heterogeneity of the population. This makes it very difficult to draw any firm conclusions.

Also, concurrent volume measurements were not recorded, therefore the significance of the impedance results were reduced. However, the results from this study are still interesting as previous studies have found a good correlation ($r=0.99$) between EIT and volume measurements (Hahn et al 1995).

EIT does have some technical limitations. Due to the location of electrode placement measurements are only taken from one transverse section of the lung. Monitoring may not have been entirely in the area where treatment changes were occurring. This was unavoidable as the electrode positioning was determined by other viscera, such as the heart and liver. In this study the electrodes were placed in an elliptical plane, with the posterior electrodes lower down in an attempt to monitor the lower lobes.

■ Future research

Further work should be conducted on the reliability and validity of this assessment technique in a healthy population and patients with respiratory diseases. Following on from this, EIT could be used to evaluate treatment effects on regional ventilation in a homogeneous patient population.

■ Conclusions

This small study indicates that EIT may be able to detect changes in lung air content in regions one quarter the thoracic size during deep breathing and IPPB in both healthy individuals and patients with respiratory diseases. Therefore, it may be appropriate to develop as an outcome measure for research.

During IPPB regional ventilation was evenly distributed in all volunteers whereas in the patient population it was dependent on the underlying pathophysiology. Larger trials evaluating the effect of IPPB on regional ventilation in homogeneous patient populations will help improve knowledge about the effectiveness of this therapy in airway clearance and recruitment.

EIT may be an appropriate outcome measure to assess the effect of Physiotherapy interventions for airway clearance or lung recruitment.

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Using a stage of change model to elicit modifications in clinical practice

Introduction of a risk scoring model to identify patients at high risk of post operative pulmonary complications following elective general surgery.

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Summary

This paper aimed to share the experience of introducing and evaluating a risk scoring model for patients undergoing elective general surgery. It describes the stages involved leading to its successful implementation, the positive effects on allocation of physiotherapy resources, and also how a stage of change model guided.

Keywords

change management, physiotherapy, general surgery, risk

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Introduction

In 2007, a UK Hospital Trust reorganised its general surgical services, resulting in an increase in elective general surgery beds on one site. Patients undergoing respiratory physiotherapy were often prioritised above those with functional difficulties due to capacity and demand limitations. Respiratory physiotherapy was routinely delivered according to surgery type, regardless of the confirmation of a post operative pulmonary complication (PPC) (Browning 2007, Mackay 2005, Brooks – Brunn 1997).

Physiotherapy staff noticed some patients who had no known pre operative mobility impairment or risk factors deemed to increase the risk of PPC, often required minimal intervention, without subsequent development of respiratory or mobility complications. This prompted staff to wonder whether routine post operative physiotherapy was necessary for all patients. They wished to explore other ways of working that would assist in bridging the gap between capacity and demand.

Aims and Objectives

The aim of this paper is to share the experience of introducing and evaluating a risk scoring model for patients undergoing elective general surgery. It describes the stages undertaken to implement service redesign using a stage of change model.

It also aims to clinically justify the risk scoring model used.

The objective of this paper is to present a strategy by which to introduce significant change in clinical working practice. It is hoped this will assist and encourage others to critically evaluate their own service and embrace change if felt necessary, especially when there is a strong belief that change will be beneficial.

■ The Evidence

Certain pre operative factors increase the risk of development of PPC in patients undergoing non cardiothoracic surgery. These include age, obesity, duration of anaesthesia, type of surgery, current smoking status, cardiovascular and respiratory co morbidity and functional dependence (Qaseem et al 2006, Smetana et al 2006).

A systematic review of respiratory physiotherapy for prevention of PPC after abdominal surgery questioned the justification for providing routine respiratory physiotherapy (Pasquina et al, 2006). Evidence supports the inclusion of post operative lung expansion manoeuvres to reduce the risk of PPC (Lawrence et al 2006). Pasquina et al (2006) suggested the use of risk stratification to target respiratory physiotherapy to high risk patients, concurring with recommendations that post operative regimes should include respiratory physiotherapy for patients who are predicted to be at high risk of developing PPC (Qaseem et al 2006).

■ Method

Scholes et al (2009) developed an "upper abdominal surgery post operative pulmonary complications prediction scoring model" (UASPPC). By weighting scores derived from the presence of five known risk factors (type of surgery,

length of anaesthetic time, smoking behaviour, presence of respiratory co morbidity and V02 status), patients could be categorised into 'high' or 'low' risk groups according to the likelihood of developing PPC's. V02 is calculated by a self report activity questionnaire corrected according to age, height and weight, thus taking other known risk factors into consideration. Not only is chronological age considered, but also biological age, via functional dependence scores, oxygen consumption and metabolic activity related to age. This model has undergone preliminary clinimetric testing and correctly predicted 82% of participants as high risk who subsequently developed PPC (Scholes et al 2009).

The physiotherapy team recognised the need to identify risk factors which deemed patients at high risk of PPC but also wished to be able to identify patients with significant pre operative functional impairment (e.g. difficulty performing transfers or poor mobility in general), which may also require the skill of the physiotherapist post operatively to facilitate timely discharge.

It was felt the UASPPC could highlight both groups of patients and positively influence input and allocation of resources. This provided justification to begin to redesign the physiotherapy service to the elective general surgical wards, trialling the UASPPC and evaluating the effects of the redesign.

The stages and tasks undertaken to introduce the UASPPC were based on a model of behavioural change consisting of five interchangeable stages (Prochaska and DiClemente 1982). This model is represented in Figure 1, with the practical components of the service redesign process positioned in relation to where they fell within the change model and the order in which they were completed

to assist in guiding the reader through the text.

■ Contemplation to preparation

The physiotherapy team identified preparatory steps required to inform any change as:

1. Audit activity of the current service
2. Review the evidence base concerning risk factors which predispose to the development of PPC following non cardiothoracic surgery.

■ Audit of current service

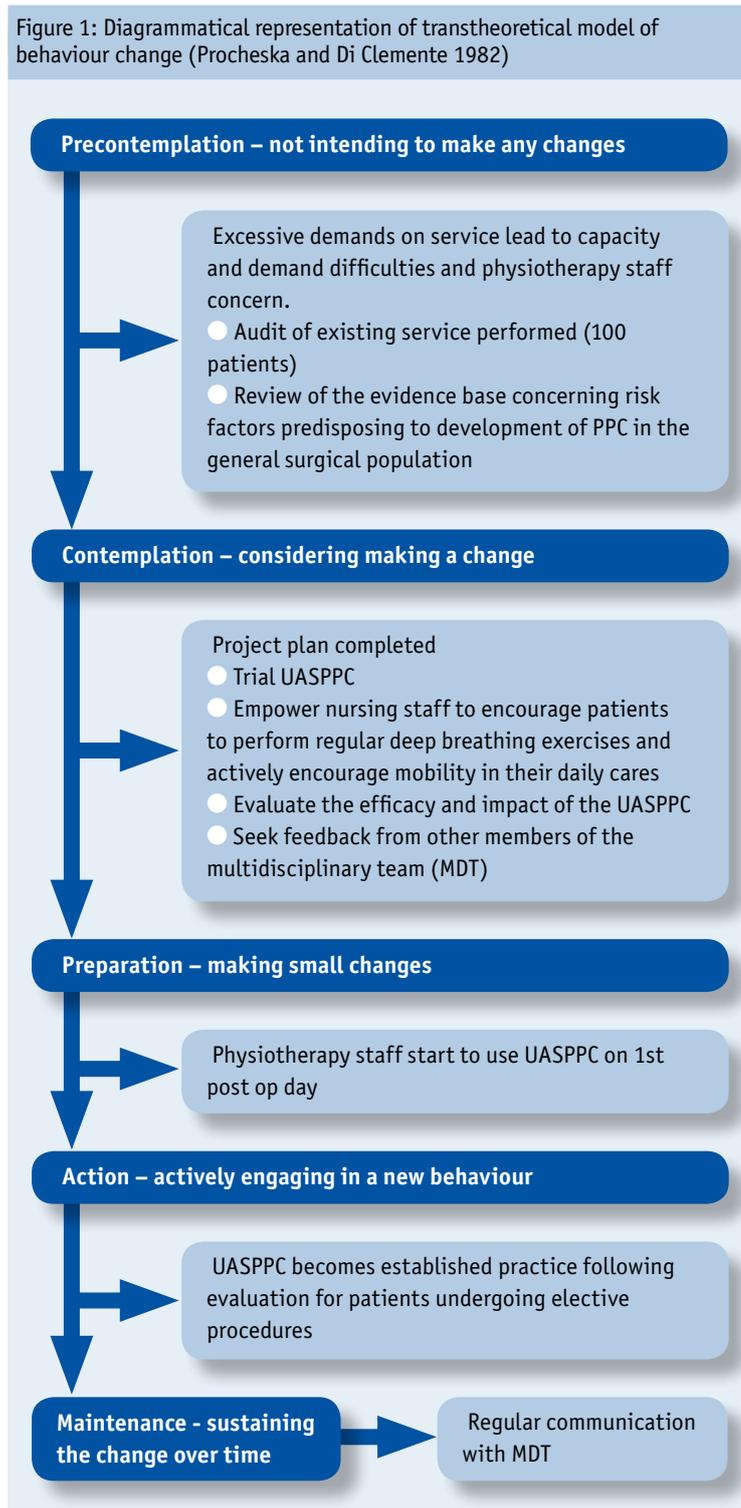
Permission was granted from the Trust Clinical Audit Department to evaluate the physiotherapy records of 100 consecutive patients who had undergone various general surgical procedures. The population was representative of usual clinical practice and included patients who had undergone elective or emergency procedures.

■ Audit findings

The audit revealed several important findings:

1. Patients who had emergency surgery required the most intensive respiratory physiotherapy and had the highest mortality rate.
2. Patients undergoing major upper gastrointestinal (GI) surgery required the second greatest intensity of respiratory physiotherapy and the greatest amount of rehabilitation for post operative mobility impairment.
3. Patients undergoing colorectal surgery required the least intensity of respiratory physiotherapy.
4. People who underwent emergency surgery required the same amount of rehabilitation

Figure 1: Diagrammatical representation of transtheoretical model of behaviour change (Procheska and Di Clemente 1982)



to improve mobility as those who had elective colorectal surgery.
 5. In line with current evidence most patients who developed PPC were current smokers or had ceased smoking within a couple of weeks prior to surgery (Blanchard et al 2006, Qaseem et al 2006, Smetana et al 2006).
 Information gained enabled

the physiotherapy team to develop a project plan:
 1. Trial the UASPPC on the elective upper abdominal surgery population.
 2. Empower nursing staff to promote regular mobility, deep breathing and supported coughing as part of their daily cares to all patients who had undergone upper abdominal

surgery.
 3. Evaluate the efficacy and impact of physiotherapy reallocation on patient care.

■ Implementation of the UASPPC

An introductory period was allocated to train physiotherapy assistants to administer the scoring system. The tool was then piloted on all patients who underwent elective procedures as illustrated in Figure 2.

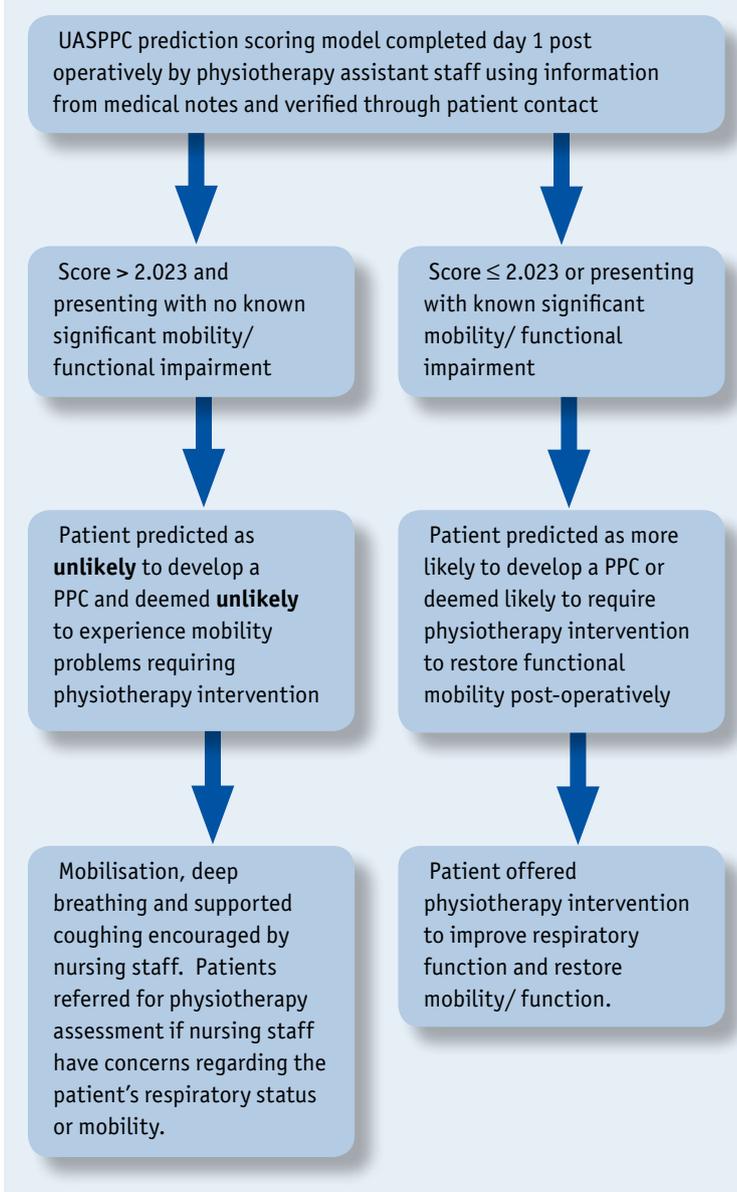
■ Results

164 consecutive patients undergoing elective general surgical procedures during a four month data collection period were evaluated. Only patients who underwent elective procedures underwent evaluation. Permission was granted again from the trust Clinical Audit Department to perform evaluation of this data set.

Patients resided on one of 2 wards. One ward was predominantly a colorectal ward. Only 19% (22/117) of patients on this ward received routine post operative assessment after being classified as high risk. The other ward was an upper GI surgical ward where patients underwent surgery such as Whipple's procedures and oesophagogastrectomy. Such patients were often functionally limited prior to surgery due to the debilitating nature of their disease. 38% (29/47) scored high risk on this ward. The surgical category domain of the UASPPC identifies upper GI surgery as the greatest risk group.

Overall 113/164 patients (69%) were deemed at low risk of PPC. 12 (10.6%) of these patients required respiratory physiotherapy assessment following referral from nursing or medical staff at daily handover or

Figure 2: Diagram to illustrate how the UASPPC prediction scoring model was used in clinical practice (Scholes et al 2009)



through the evening or weekend respiratory on call service. No patients from the low or high risk group required transfer to higher levels of care due to significant respiratory deterioration during the period of evaluation.

Patients were routinely assessed post operatively if the VO₂ scoring alone suggested concerns regarding post operative functional ability. A further 10% of patients from the low risk group were routinely assessed post operatively following identification of pre operative functional limitations.

■ Discussion

Although new patient numbers reduced by approximately 50% following introduction of the UASPPC, the average number of monthly physiotherapy treatment interventions remained unchanged. Service redesign successfully permitted patients at high risk for development of PPC or those with impaired function to receive a greater intensity of physiotherapy input, often consisting of more than one session per weekday. Service

allocation was targeted to those patients who would benefit the most from physiotherapy contact.

The UASPPC can be used effectively in a busy elective general surgical environment (Scholes et al 2009). Information is easy to locate from patient's notes, communication with nursing staff or the patient themselves, with minimal encroachment on clinical time. It can be reliably completed by assistant staff, allowing qualified clinical staff maximum time for patient contact.

The tool has been successful in identifying patients most in need of routine respiratory assessment and assistance in recovery of function post operatively. This information was fed back to members of the MDT in organised discussion sessions to assist in the maintenance phase of the change model (Procheska and Di Clemente 1982).

The initial period, following introduction of the UASPPC was a learning experience for the entire multidisciplinary team. It required physiotherapists to be more discerning regarding which patients received post operative assessment, required modification of nurses working practices, trust in the risk model and in other team members to select patients deemed most likely to develop respiratory complications. This was a challenging time, requiring considerable modification of working practices witnessed over time by nursing and medical staff to be 'the norm'.

The UASPPC could assist national drivers such as the enhanced recovery after surgery (ERAS) programme for patients undergoing colorectal surgery. These programmes have promoted earlier recovery, quicker discharge from hospital and more rapid return to normal activities. Quality is improved by reduction of complications, and the move towards more

minimally invasive techniques enables an accelerated return to function (Eskicioglu et al 2009). Physiotherapy resources could be targeted to groups deemed most at risk of pulmonary complications post operatively and may assist in reducing mean lengths of stay.

■ Limitations

Although the UASPPC demonstrated reliability in the elective general surgical environment, these results may not be able to be extrapolated to other surgical groups (e.g. urological, vascular or renal surgery).

Patients found some of the questions on the VO2 scoring system difficult to answer as they either had no requirement to perform the specific task or didn't really understand the question. Discussion and explanation played an important part in gaining reliable information.

■ Further research

Further research is required using the UASPPC locally to evaluate the reliability of the tool in all the surgical environments it encompasses e.g. vascular, renal and urological surgery, to assess reliability and further validate the model. Further evaluation of its use in the acute/ emergency setting is also required.

Further work is also required to assess the reliability of its completion in pre admission clinics to identify patients at an earlier stage that may require an increased intensity of input post operatively. This also may assist in pre-empting and signposting the need to involve other disciplines early to facilitate discharge planning e.g. occupational therapy or social services.

■ Conclusion

Use of a stage of change model can greatly assist in informing each stage of change when considering service redesign and the steps required to be implemented in order to achieve and sustain it. The UASPPC can guide physiotherapists in the elective general surgical wards in directing resources appropriately in the post operative period.

By adopting an evidence based approach, incorporating the use of the UASPPC, allocation of physiotherapy resources on an elective general surgical ward can be targeted more effectively. This will assist in supplying services to patients who are most likely to benefit from them, intensifying physiotherapy involvement, both for prevention of PPC and optimising function post operatively.

Key points

- Pre operative evaluation using risk scoring models may help predict post operative risk thereby improving targeting of physiotherapy services on an elective general surgery ward.
- Risk scoring models should not only aim to assess post operative pulmonary risk, but also pre operative functional ability to optimise patient outcome.
- The use of a change model can assist in guiding the stages and processes necessary to successfully implement change.
- The importance of daily, multidisciplinary two - way communication remains paramount in addition to the use of a risk scoring model.

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An evaluation of the use of feedback during respiratory In-service Training (IST)

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Summary

In-service training is an important component of any physiotherapy department education programme. In this study, a feedback process was used to evaluate respiratory in-service training with the objectives of evaluating the content of each IST session and each presenter's skill at delivering the relevant information.

■ Introduction

Continuous Professional Development (CPD) is important in the health sector to maintain practitioner competence so that patients receive safe treatment of the highest quality (European Region of the WCPT, 2008). The position statement of the World Confederation for Physical Therapy regarding standards of practice stresses the importance of education, professional development and lifelong learning (WCPT, 2007). Similarly, the rules of professional conduct set by the Irish Society of Chartered Physiotherapists state that members must deliver

treatment proficiently and in an accountable manner to the highest standards, an emphasis is also placed on staying aware of new advances and research findings (Irish Society of Chartered Physiotherapists, 2006). CPD can refer to any post-qualification education or learning and can include formal activities such as attending conferences, courses, seminars, workshops or training days, while informal CPD includes participating at journal clubs, teaching, professional endeavours such as attending committee meetings or reading current peer reviewed journal articles (French & Dowds, 2008).

Keywords

Key words- In-service training; Continuous Professional Development; evaluation

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In-service training (IST) has been identified as one of the most important forms of CPD among staff grade physiotherapists (French, 2006). IST has been defined as local training that is provided by, and for, practitioners within a department (Bogat, Sverinsson & Berggren, 1997). For staff grade physiotherapists there are increased perceived educational benefits associated with preparing and presenting the IST (French, 2006). The usefulness of IST may be increased for those presenting and attending if any learning accrued is recorded in their CPD portfolio in conjunction with a degree of reflective practice. This may facilitate the integration of any new knowledge into clinical practice (Dowds & French, 2008). Feedback is integral to any learning process and has been described as an interactive process which aims to provide learners with insight into their performance (Clynes & Rafferty, 2008). Those attending IST are ideally placed to provide objective peer review with the aim of enhancing clinical and technical competence (Paquet & Marchais, 1998).

Guidelines for the implementation of CPD for staff grade physiotherapists recommend that IST should be evaluated and that constructive feedback on presentation skills be given (DATHS Physiotherapy Departments, 2007). The

guidelines were developed after focus groups and a survey to explore support for CPD activities for staff grades within the work environment (French, 2006). The survey found that IST was a routine part of work place CPD but were poorly evaluated (French, 2006). The aim of the current study was to design an effective and acceptable process for feedback of IST incorporating the use of a previously devised IST Feedback Form (DATHS Physiotherapy Departments, 2007). The objectives of the project were to examine the content of the IST and the presenter's skill at delivering the information. The rationale behind providing feedback was to improve the presenting physiotherapist's presentation skills and to improve the educational quality of the presentations, making them more interesting and interactive with an increased emphasis on material that is evidence based and relevant to clinical practice. Further objectives were to assess the usefulness of the IST competency feedback form as a feedback process for the presenter and to determine whether there were any perceived differences in IST delivery with employment grade.

■ Methods

Ethical approval was not sought as the study was an evaluation and improvement process of current practices. IST lasting approximately thirty minutes per session was performed on a weekly rota by all physiotherapists in the clinical area of respiratory care, during the 28 week period of the study. Each IST topic was decided upon by the presenter. The IST competency feedback forms (Appendix 1) were distributed and completed anonymously by all attending physiotherapists at the end of each IST. The feedback form rates several

Table 1 Overall median results for IST for respiratory physiotherapists; range in parenthesis. The IST feedback form rates areas on a scale of 1-5 (1= Poor, 2=Fair, 3=Good, 4=Very Good and 5= Excellent).

IST Component	Median Score attained
Evidence based	4 (2-5)
Relevant to Practice	4 (2-5)
Appropriate pitch	4 (2-5)
Evidence of preparation	4 (2-5)
Logical Progression	4 (2-5)
Mastery of Subject	4 (2-5)
Visual Aids	4 (2-5)
Presence	4 (2-5)
Time Management	4 (2-5)
Overall impression	4 (3-5)

areas for assessment on a scale of 1-5 (1= Poor, 2=Fair, 3=Good, 4=Very Good and 5= Excellent). These areas are "Content" (further sub divided into "Evidence Based", "Relevant to Practice", "Appropriate Pitch" "Evidence of Preparation" and "Logical Progression", "Mastery of Subject", "Presence" "Practical Components", "Use of Visual Aids", "Time Management" and "Overall Opinion". There are also two open-ended questions which seek information regarding the strong points of each IST session, and the areas which could be improved upon. At the end of each IST session, all of the feedback forms were collected and collated by the respiratory clinical specialist (lead investigator who then gave both verbal and written one-to-one feedback to the presenter.

At the end of the study period, all physiotherapists who had taken part in the study were asked to fill out a questionnaire examining the perceived effectiveness of the feedback process. The participants were also asked what they had done with the written feedback they had received and whether they thought this feedback was fair. In addition, they were asked to

suggest any changes to the one-to-one feedback sessions that would make it a more beneficial experience.

Data was collected and collated using Microsoft Excel. There were no practical or hands on components to the IST during the study period so the section "Practical Components" was not included in analysis. Statistical tests were performed using R version 2.9.2 (Copyright (C) 2009 The R Foundation for Statistical Computing, Wilcoxon signed rank tests were performed to look for differences between staff and senior grade physiotherapists, with p-values < 0.05 considered to be statistically significant.

■ Results

A total of twenty eight IST sessions were carried out during the twenty eight week period (staff grades = 22 [78.6%]; senior staff = 6 [21.4%]). There were fourteen different IST presenters (10 staff grades, 4 seniors. IST topics varied widely but included clinical syndromes, practical techniques, the dissemination of guidelines and article reviews. In total 160 IST competency feedback forms were completed during the study period, and at each

Table 2 Comparison of median scores for IST given by different grades of physiotherapists; range in parenthesis. The IST feedback form rates areas on a scale of 1-5 (1= Poor, 2=Fair, 3=Good, 4=Very Good and 5= Excellent).

IST Component	Staff	Senior
Evidence based	4 (2-5)	4 (2-5)
Relevant to Practice	4 (2-5)	5 (3-5)
Appropriate pitch	4 (2-5)	5 (4-5)
Evidence of preparation	4 (2-5)	5 (4-5)
Logical Progression	4 (2-5)	5 (4-5)
Mastery of Subject	4 (2-5)	4 (4-5)
Visual Aids	4 (2-5)	4 (3-5)
Presence	4 (2-5)	4 (2-5)
Time Management	4 (2-5)	5 (3-5)
Overall impression	4 (3-5)	4 (4-5)

IST session individual feedback forms were completed by a median of 5 physiotherapists (range 4-7).

The median score for each of the individual areas was 4 (range 2-5 (table 1).

The median scores for senior physiotherapists appear higher but there was no statistically significant difference between senior and staff grade physiotherapists in any area (Table 2).

From the qualitative feedback obtained, a number of common themes were highlighted. The most beneficial components of IST included topics that stimulated discussion, were clinically relevant and research based. There was also a perceived increase in the clinical applicability of the IST when case studies were utilised. Some elements that could have been improved included: use of question and answer sessions, use of multimedia, organisation and structure of accompanying visual aids, and presentation skills (relating to lack of eye contact, reading from notes, lack of interaction with the audience and speaking too quickly).

From the questionnaire examining the presenters'

perceptions of the IST feedback process (n=11/14; response rate = 79% it was found that 62.5% of respondents had placed the written feedback document in their CPD portfolio. All respondents rated the three components of the feedback process (use of feedback assessment form, verbal and written feedback as "Very Good" (37.5% or "Excellent" (62.5%. All respondents reported that they perceived the feedback they had received as equitable and that they had adapted subsequent IST based on the feedback they had received. Three respondents reported that the feedback may not have been sufficiently critical, with an additional respondent suggested that the IST feedback form should include a question enquiring on any change in practice that would occur following the IST to prompt reflection.

Discussion

Thirty minute IST sessions were performed weekly during the course of this study. This scheduled delivery of IST is commonplace in public sector physiotherapy departments

(Dowds & French 2008; French, 2006).

Use of the IST feedback form indicated that the overall quality of the presentations included in this study was high, with median scores of 4 out of 5 in each category. The presentations were perceived as being well prepared, evidence-based, relevant to clinical practice and often included case studies. The use of case studies was highlighted as being a method of increasing the clinical applicability of the IST sessions. There was still room for improvement however with regard to presentation skills, the use of multimedia and visual aids. IST attendees felt that the routine inclusion of question and answer sessions should be encouraged as a method of facilitating increased discussion of the IST topic.

It must be considered that the use of a transparent feedback system may have introduced an element of bias that may have influenced the quality of presentations. As the presenters were aware that they were being assessed and in addition were made familiar with the IST competency feedback form, the high scores may not have been representative of the prior IST standards. Through the use of the feedback process, presenters would have become more aware of what constitutes a good IST session, and may have adapted their own IST content and delivery in response.

Use of a feedback tool may also have increased the presenter's awareness of the need to translate attendance at IST into learning and subsequently a change in practice. This could have resulted in an increased effort being made to make the presentations more comprehensive.

The standard of IST was high for both senior and staff grades with no significant differences in the median scores between the different grades. There was

a trend for senior physiotherapy scores to be higher in addition to a smaller range of scores in several areas (Table 2; this may be expected with increased experience in providing IST. The non significant difference could also be due to the lower numbers of IST sessions presented by senior physiotherapists. The IST rota was allocated on a rotation basis and as the usual format for IST was not altered during the study period, only 6 IST sessions were presented by senior staff (21.4% n=6. Exploration of any potential differences in IST content and delivery by grade would be an interesting area for future study

There may be an opportunity for bias with the feedback form as some staff may have been reluctant to include realistic ratings or constructive comments about peers or more senior physiotherapists, in spite of all forms being completed anonymously and gathered by the lead investigator for processing. It could also be suggested that less experienced staff would be less likely to score others negatively. However, the respiratory sub-specialty has a wide distribution of staff (4 staff grades, 2 senior staff and 1 clinical specialist, so while senior staff would have been primarily appraised by staff grades, there was usually another member of the same grade or higher also rating a senior physiotherapist's IST.

As mentioned previously, confidentiality was cited as a factor that may have influenced the scores, however the IST and the subsequent feedback should be viewed as a positive learning experience and that an environment that facilitates questioning and open discussion should be encouraged. In the current study, a clinical specialist physiotherapist, with experience providing feedback to peers and students collected, collated and communicated the feedback, and

it was perceived as a positive experience by all staff involved. It is important that feedback is provided by someone with experience in order to enhance staff confidence and encourage the transition of this process into an environment where IST feedback becomes as routine as IST itself.

From the questionnaire, it was found that many participants reported altering subsequent IST presentations based on the feedback they received, and this continually evolving practice is core to the essence of CPD (European Region WCPT, 2008; WCPT 2007; ISCP, 2007. However due to the anonymous uncoded way information from each IST feedback was stored during the study period, it is not possible to determine whether there was an objective improvement in IST delivery based on the feedback received. For future studies, this would be an interesting mechanism for evaluating the efficacy of the IST feedback process and may help in further justifying its use.

Many health professional regulatory bodies require that members participate in CPD and advocate the use of a CPD portfolio to document the process (HPC, 2009; ISCP, 2007; Irish Medical Council, 2006. This provides a tangible record of all educational activities as evidence of CPD. It is recommended within this centre that all IST presenters store written feedback received and any reflections on it, in their CPD portfolio. With only 62.5 % of the participants in this study currently engaged in this practice, the use of the CPD portfolio in this manner is not yet commonplace.

Conclusion

CPD is needed to ensure that health professionals stay up to date with current research and practice guidelines, in order to

transfer high standards of care to patients. IST has been shown to be a key source of CPD for staff grade physiotherapists, and a more structured method of evaluation and feedback could help identify areas for improvement (French 2006. This evaluation found that the IST competency feedback form was useful and helped participants to identify areas for development. Use of a feedback tool, may increase the educational quality and standard of presentations for IST, making them more interesting, interactive and informative.

Funding: No funding was obtained.

Conflict of Interest- Joanne Dowds was a member of DATHs CPD working group.

Key Points

- Feedback on IST is beneficial.
- Use of a feedback tool can provide valuable information to IST presenters.
- Both senior and staff grade physiotherapists can compile and deliver IST effectively.

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Appendix I DATHS Physiotherapy Departments

In-service Training Competency Feedback Form

Speaker _____

Topic _____

Type of In-service

Please tick all that apply

General In-service

Rotational In-service

Theory

Practical

Article Review

Case presentation

Please rate the in-service from 5-1. Where 5- excellent and 1 –insufficient. Please include any comments.

	Excellent 5	V Good 4	Good 3	Limited 2	Insufficient 1
1. Content (please rate all categories)					
Evidence based					
Relevant to Practice					
Appropriate Pitch					
Evidence of Preparation					
Logical progression					
2. Mastery of Subject E.g.-Confident -Spoken not read -Knowledgeable -Question + Answer session					
3. Presence E.g.-Rapport with audience -Body language + eye contact -Understandable (rhythm, intonation and accent) -Spoken loud enough to hear easily					
4. Visual Aids E.g. -Handouts -Practical Demonstrations -Use of multimedia					
5. Practical (if applicable) E.g. -Level of supervision -Balance of theory to practical					
6. Time Management					
7. Overall Impression					

What did YOU feel was good about this inservice?

What would YOU change about this presentation?

High Frequency Chest Wall Oscillation to augment airways clearance in a patient with Cystic Fibrosis: A case study.

This case study was completed as part of a 30 point post graduate module in the University of Ulster: Advanced Airways Clearance Techniques.

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Summary

The aim of this case study was to explore the effect of the addition of The Vest™ as part of airways clearance treatment during an exacerbation phase and during a 2 week follow up post discharge phase in a patient with copious secretions requiring intensive physiotherapy.

■ Introduction

The aim of this case study was to explore the effect of the addition of The Vest™ as part of airways clearance treatment during an exacerbation phase and during a 2 week follow up post discharge phase. Assessment of effectiveness focused primarily on sputum weight and secondly on patient reported outcomes.

A recent review of airways

clearance therapies in Cystic Fibrosis (CF) identified 4 randomised controlled trials or cross over studies that supported the rationale for selecting this treatment modality (Flume et al 2009). These 4 studies compared High Frequency Chest Wall Oscillation (HFCWO) with another Airways Clearance Technique (ACT) using sputum weight as the primary measure of efficacy. However, in the study by Osman et al (2010), 24 hour sputum

Keywords

High Frequency Chest Wall Oscillation, Cystic Fibrosis, exacerbation, airways clearance.

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weight and patient preference measures favoured the other ACT in comparison to HFCWO during an exacerbation in 29 patients with CF (Osman et al 2010). The BTS/ACPRC 2009 Guidelines recommend that HFCWO should be considered in patients with CF when stable (Grade A, level of evidence 1++) however it is currently not recommended during an exacerbation (Grade B, level of evidence 1+) based on the results of the study by Osman et al (2010) (Osman et al 2010, Bott et al 2009). This evidence, along with the physiological aims of treatment and the patient's holistic considerations supported a trial of this technique as an adjunct for treatment, (as opposed to replacing the usual regime) during an exacerbation of CF and during a follow up phase. As this patient's usual physiotherapy regime was labour intensive in terms of time and resource, literature showing that HFCWO could be more cost effective with good compliance and patient preference, further supported the selection of this treatment on a trial basis (Ohnsorg 1994, Klous et al 1993, Arens et al 1994, Anbar 1998, Oermann et al 1997).

■ Summary of patient problems and clinical course of illness

A 53 year old male with CF required daily intensive physiotherapy for copious secretions. Usual daily

treatment while stable (1 hour x 1-2 daily) required assistance from a carer and included postural drainage with percussion & vibration with BiPAP (PD&P&V with BiPAP). This treatment was carried out by the community CF team x 3 weekly. He was admitted in October 2009 to the adult CF centre with an exacerbation. A case study approach was used to ascertain if the use of HFCWO (The Vest™) could reduce the burden of airways clearance treatment during an exacerbation phase and during a 2 week follow up post discharge phase.

On admission, the patient met the criteria for an exacerbation (Fuchs et al 1994). The patient's main problems were increased 24 hour sputum weight (140g versus usual 60-80g per day) and a drop in FEV₁ (12%). The patient's 'usual treatment' during an exacerbation consisted of 1½ hours of PD&P&V with BiPAP carried out by a CF physiotherapist.

The aim of this case study was to explore the effect of the addition of The Vest™ as part of airways clearance treatment during an exacerbation phase and during a 2 week follow

up post discharge phase in this patient with copious secretions requiring intensive physiotherapy.

Course of treatment

From day 1 - day 4 the patient received his 'usual treatment' during an exacerbation. At day 5 until day 13 (end of IV antibiotics) the patient received 'Vest treatment' (37 mins HFCWO; Pressure 6; Freq 6,8,10,16,18,20 Hz. 6 mins each & 37 mins PD&P&V with BiPAP) once daily and 'usual treatment' once daily. The treatment was carried out by a CF physiotherapist.

The Vest™ model was used on a ramping mode, as evidence suggests the highest airflows were achieved between 13-20Hz (Milla et al 2006). 'Vest treatment' was alternated between morning and afternoon to control for variations in sputum volumes expectorated throughout the day. In line with normal clinical practice, patients received one daily treatment at the weekends.

In the 2 week follow up post discharge phase the patient used the 'Vest treatment' once daily for week 1 and 'usual

treatment' once daily for week 2 (treatment duration 45-75 minutes). Treatment using The Vest™ was carried out independently, while the percussions and vibrations were carried out by the patient's wife or by a physiotherapist in the out patient setting (the patient received 3 sessions of out patient physiotherapy during week 1 and 2 of the follow up phase).

Outcome measures

During the exacerbation phase, wet weight sputum post treatment, number of coughs during treatment, patient reported ease of sputum clearance and fatigue were measured. Safety measures of FEV₁ and SpO₂ were collected. During the 2 week follow up post discharge phase, daily 24 hour wet weight sputum was measured. Ease of use and satisfaction with both ACT's were measured at end of the each phase.

Results

Sputum weight: During the exacerbation phase, 'usual treatment' resulted in more sputum expectorated after

Figure 1: Exacerbation phase: Wet weight sputum post treatment session

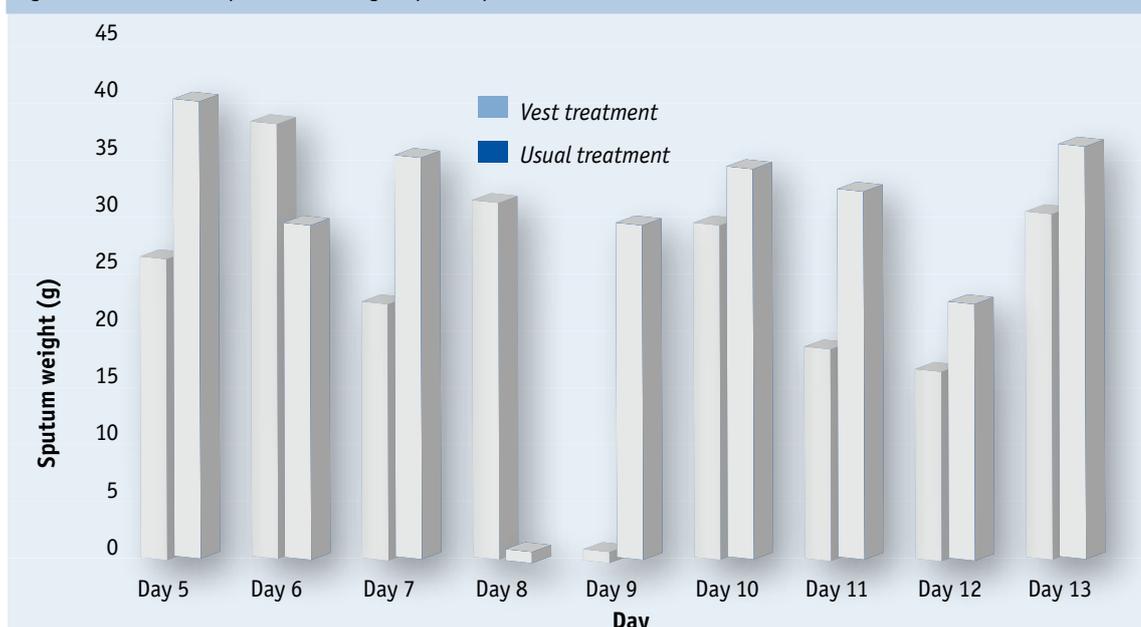
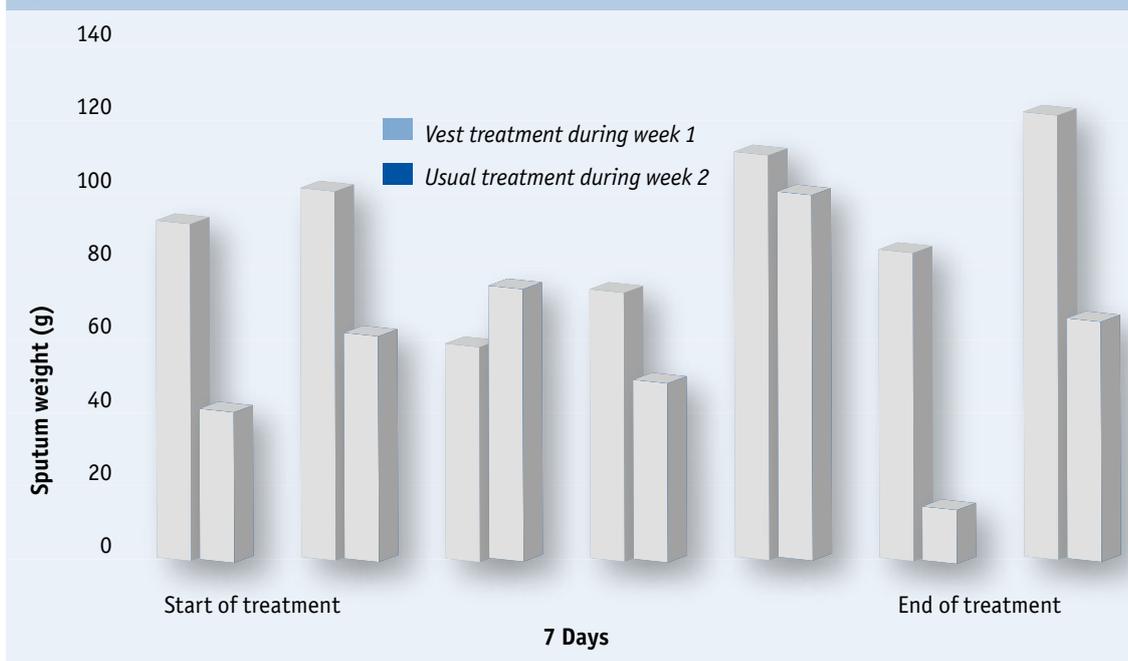


Figure 2: 2 week follow up phase: 24 hour sputum weight



treatment compared with the 'Vest treatment' (SD 33.8g compared with 28.1g) (Figure 1). During the 2 week follow up phase, 24 hour sputum weights were greater in week 1 using the 'Vest treatment' compared with week 2 using 'usual treatment' (an average of 96g per day compared with 61g per day) (Figure 2).

Patient reported outcomes:

During the exacerbation phase, the patient reported less fatigue with the 'Vest treatment' compared with 'usual treatment'. Slightly greater ease of clearance was reported with 'usual treatment' however the scores were very similar (Table 1).

During the 2 week follow up phase, the patient reported less fatigue and greater ease of clearance with the 'Vest treatment' compared with 'usual treatment'. This correlated with the greater weights expectorated during the 'Vest treatment' week.

Even though the patient felt that the 'Vest treatment' was easier in both phases he was still more satisfied with his 'usual treatment' (Table 2).

Coughing: During the exacerbation phase, the number of coughs during each treatment

session was counted manually. An average of 9% less coughs were recorded during 'Vest treatment' compared with 'usual treatment'.

Safety measures: No significant difference in lung function or oxygen saturations were recorded after either treatment during the exacerbation phase. (FEV_1 post 'Vest treatment' mean difference = -0.19L compared with -0.06L with 'usual treatment'). There was no change in SpO_2 after either treatment.

Other novel outcome measures: On assessing the therapist's perception of ease of clearance (during the exacerbation phase) using the VAS scale, the results concurred with the patient reported VAS i.e. the 'Vest treatment' and 'usual treatment' had similar scores.

Discussion

Exacerbation phase

During the exacerbation phase 'usual treatment' resulted in more sputum expectorated after treatment compared with the 'Vest treatment'. 'Vest treatment' was perceived to

be equally effective in terms of ease of expectoration and resulted in less fatigue. However the patient stated that they still preferred their 'usual treatment'.

In the review by Flume et al (2009) all 4 studies found HFCWO to be superior to or at least as effective as, other ACT including PD& percussion in terms of sputum weight expectorated. However only 2 of these studies assessed CF patients during an exacerbation (Kluft et al 2006; Varekojjs et al 2003). The sputum weights recorded during 'Vest treatment' in this case study may have been influenced by the outcome of cough counting. The patient was only encouraged to cough in between frequency changes, however during 'usual treatment' the patient coughed at will. In terms of sputum weight expectorated during treatment and patient preference, this case study concurs with the results of the recent comparative study by Osman et al (2010). However ease of expectoration was similar between treatments, fatigue demonstrated an improvement and the technique was safe, with no significant changes in FEV_1 or SpO_2 after treatment. The

Table 1: Patient reported outcomes during the exacerbation phase

Patient reported outcome	Visual Analogue Score (cm)	
	Usual treatment	Vest treatment
Ease of clearance (0=easiest 10= hardest) (SD)	5.8	6.3
Change in fatigue (post-pre treatment) (SD)	+1.0	+0.04
Ease of use (0= not easy 10= extremely easy)	6.3	8.2
Satisfaction (0= extremely dissatisfied 10= extremely satisfied)	9.1	5.2

Table 2: Patient reported outcomes during the 2 week follow up phase

Patient reported outcome	Visual Analogue Score (cm)	
	Usual treatment	Vest treatment
Ease of clearance (0=easiest 10= hardest)	5.3	1.5
Fatigue (0= no fatigue 10= worst fatigue)	7.6	2.1
Ease of use (0= not easy 10= extremely easy)	4.7	9.9
Satisfaction (0= extremely dissatisfied 10= extremely satisfied)	9.7	5.4

patient felt the 'Vest treatment' was easier to carry out and it could, in part, be carried out independently, it was a more time efficient technique and encouraged independent treatment. Therefore HFCWO to augment another ACT could be offered for certain patients during an exacerbation phase.

This patient's individual circumstances (copious secretions, labour intensive physiotherapy routine) justified the inclusion of HFCWO for treatment during the exacerbation phase and may benefit other patients with similar clinical pictures. There may be other circumstances in the hospital environment when The Vest™ could be useful e.g. to facilitate an additional ACT in the evening and/or at weekends.

2 week follow up post discharge phase

In the 2 week follow up post discharge phase the 'Vest treatment' was more effective than 'usual treatment' in increasing the 24 hour sputum weight expectorated and was associated with more ease

of expectoration and less fatigue. With treatment at home the patient exercised greater autonomy over the timing and duration of treatment including the choice of PD position and this key difference may have influenced results.

Improvements in the ease of clearance and fatigue were associated with the use of the 'Vest treatment' however consistent with results from the exacerbation phase, he was more satisfied with his 'usual treatment' despite reporting that the 'Vest treatment' was easier to use. This particular patient highly valued contact with the health care team including 'hands on' therapy (receiving 3 physiotherapy out patient appointments per week) and did not want a device to completely replace this service.

Research implications

The most appropriate measures to assess the outcome of a particular ACT in both the clinical and research setting are still to be determined. Controversy exists over the

clinimetric properties of outcome measures chosen for this case study, such as sputum weight, where there is little data about what defines a minimal clinically important difference. The use of sputum as an outcome measure in assessing the efficacy of ACT's requires more study to determine which parameter to measure (i.e. 24 hour weight, weight post treatment, wet weight, dry weight) and standardisation is needed to allow for inter study comparison. Consensus over this issue would facilitate future clinical trials and inform best practice. This case study also highlights the importance of patient reported outcomes for use in future airways clearance trials. Patient reported outcomes capture important patient perceptions which influence adherence.

■ Conclusion

HFCWO to augment usual airways clearance was explored with a patient during an exacerbation phase and post discharge phase. During the exacerbation phase treatment 'usual treatment' resulted in more sputum

expectorated and the patient preferred this technique. However other patient reported outcomes favoured the 'Vest treatment'.

In the 2 week follow up post discharge phase the 'Vest treatment' was more effective than 'usual treatment' in increasing the 24 hour sputum weight expectorated and was associated with more ease of expectoration and less fatigue. However the patient was still more satisfied with 'usual treatment'. This study demonstrates the usefulness of single patient case study design in verifying and individualising an ACT regimen in patients with CF.

Key points

- HFCWO to augment another ACT could be offered for certain patients during an exacerbation phase and post discharge phase.
- Single patient case study design can be useful in verifying and individualising an ACT regimen in CF patients.

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Airway clearance in bronchomalacia with chronic cough suppression.

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Summary

A patient previously diagnosed with brittle asthma required admission to the Intensive Care Unit for intubation and ventilation following an acute episode of secretion retention, shortness of breath and pain. She was found to have a complex and unusual diagnosis of bronchomalacia on a background of chronic cough suppression, and was successfully treated with oscillatory positive expiratory pressure, forced expiration technique, hypertonic saline and continuous positive airway pressure.

■ Introduction

This case study presents and discusses the treatment course of an acutely unwell 27-year old female referred for investigation

and management of frequent infective exacerbations, not consistent with her diagnosis of brittle asthma. With a complex presentation, not seen before at our unit, she was rehabilitated

Keywords

**Bronchiectasis
Bronchomalacia
Oscillatory Positive
Expiratory Pressure
Hypertonic saline**

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with an unusual airway clearance strategy, the success of which has implications for the physiotherapeutic management of patients with bronchomalacia and cough suppression.

The patient's past medical history included middle ear, chest and sinus infections since infancy, atopy, and gastrooesophageal reflux. Reporting frequent exacerbations characterised by chest pain, breathlessness, wheeze and purulent sputum, she had required intubation and ventilation five times in the last eight months. On bronchoscopy her trachea had been reported as 'floppy' and a CT had demonstrated no structural lung disease but debris within the trachea.

Prior to inpatient admission she had a panel of diagnostic tests demonstrating no immunological abnormality, and excluding cystic fibrosis (CF) and primary ciliary dyskinesia.

■ Summary of patient problems and clinical course of illness

On admission the patient was self ventilating on 3L O₂/min with satisfactory capillary blood gases (pH 7.44kPa, pCO₂ 5.43kPa, pO₂ 9.1kPa, SaO₂ 94%). Her respiratory medications on admission are outlined in Figure 1.

On day one, physiotherapy assessment identified retained

Fig. 1 Respiratory medications on admission

Nebulisers: Salbutamol 5mg x 6 daily, Ipratropium Bromide 500mcg x 6 daily and 6% sodium chloride b.d.

Inhalers: Beclomethasone, Salmeterol and Tiotropium

Tablets: Prednisolone, Montelukast, Carbocysteine, Azithromycin

secretions with palpable fremitus on relaxed expiration and marked upper respiratory tract noise on auscultation. Despite this the patient declined treatment and although coughing with enough strength to mobilise secretions proximally, she suppressed effective expectoration. Inspiring through her nose and partially open mouth, she appeared to mobilise the secretions back distally again. On one occasion we were able to persuade the patient to use the forced expiration technique (FET), following which an excellent cough was triggered and she expectorated.

On day two, the patient continued to decline physiotherapy intervention. Clinically her chest was deteriorating and so she was commenced on intravenous antibiotics and aminophylline. Despite this, she required intubation and ventilation. Copious secretions were suctioned from her chest, following which she was ventilated with low pressures. She self-extubated 12 hours later.

On days three and four the patient complained of feeling breathless, but clinically she was stable. As she continued to refuse all active physiotherapy intervention, an unusual regimen of four times a day nebulised hypertonic saline (HS) (4mls, 6% NaCl) was commenced, following which she started to expectorate thick secretions.

A CT pulmonary angiogram was performed at this time and showed mild bilateral lower lobe and right middle lobe

bronchiectasis. As on previous scans, significant debris was noted in the trachea.

On days five and six, the patient declined intermittent positive pressure breathing and manual techniques, which we believed to be the most appropriate interventions, but took HS and agreed to try an oscillating positive expiratory pressure device (OPEP), the Acapella, in sitting and after HS. Wearing nose clips while performing FET and cough manoeuvres, she cleared over 100g of extremely thick secretions on both days. Sputum cytology was unremarkable other than for acute inflammatory cells. She was mobilised while self ventilating on room air and did not desaturate.

This airway clearance regimen was continued until discharge on day twelve of her admission. Her medications were rationalised to exclude all nebulised bronchodilators and her oral steroids were weaned. Expectored sputum weights fell steadily, plateauing at 15g per day.

As she was unable to perform the respiratory manoeuvres required for an expiratory CT scan or flow-volume loop, the patient was admitted for a rigid bronchoscopy to visualise her upper airways. Copious, very tenacious secretions were seen in the distal trachea and main bronchi. Collapse of her main bronchi (but not her trachea) was observed on expiration. As a consequence of these findings she was commenced on overnight continuous positive airway pressure (CPAP) therapy.

Discussion

Bronchomalacia is characterised by isolated weakness and easy collapsibility of the bronchi, and may develop as a result of chronic inflammation and exposure to irritants, high-dose steroids and repeated or lengthy intubations (Carden *et al* 2005).

This structural abnormality reduces expiratory flow, and reduces FET and cough efficacy, preventing secretions from being mobilised proximally. This leads to their retention and encourages the cycle of infection and inflammation which can cause bronchiectasis. Therefore, the bronchomalacia identified at her rigid bronchoscopy helps to explain this patient's presentation. Certainly, the ease with which the patient was ventilated and extubated, the lack of response to bronchodilators and the ease with which medications were withdrawn are not consistent with her previous diagnosis of brittle asthma. Similar cases have been reported by Weinberger and Abu-Hasan (2007) where adults initially diagnosed with asthma were subsequently found to have malacic airways.

Suprasedullary influences on cough are well described (Widdicombe *et al* 2006) and the ability to voluntarily suppress cough is thought to involve the cerebral cortex's ability to affect central cough generation in the brainstem. Patients may voluntarily suppress an ineffective cough in order to reduce cough frequency or tiring coughing bouts and this is common behaviour in those with recurrent exacerbations. Bronchiectasis secondary to cough suppression has been reported (Dhillon and Watanakunakorn 2000) and the development of dilated airways over successive CT scans has been demonstrated in this patient.

We are unable to establish the precise cause of this patient's bronchomalacia and whether it is a result of, or cause for, recurrent intubation as a result of sputum retention. However, it seems unlikely that the airway changes seen are entirely iatrogenic as the trachea is not involved and her history of infections is life-long. As the structural changes diagnosed are irreversible and cough suppression is habitual, the establishment of an effective airway clearance regimen was paramount in order to treat both the acute exacerbation and to try to reduce the rate of their occurrence in the future.

Hypertonic saline is established as a safe and effective adjunct to airway clearance in patients with CF (Elkins et al 2006). Although recommended for use in non-CF related bronchiectasis (Bott et al 2009), the exact mode of action and its long term tolerability and efficacy are yet to be defined in these patients. Evidence exists supporting the use of HS in transplant patients with stented airways (Fernandez-Bussy et al 2009) and neonates with pharyngomalacia (Chan et al 2007). To date, there is no established evidence base for its use or mechanism of action in adults with bronchomalacia. It seems probable that it acts as an irritant, stimulating a strong cough reflex that aids expectoration, but it may be possible that in airways with thick, chronically adhered secretions, as in this patient, where airway surface liquid may be reduced, the hyperosmolar effect of HS may help to assist sputum clearance by rehydrating this layer.

OPEP devices are recommended (Bott et al 2009) and have an established evidence base in patients with non-CF bronchiectasis. Their use has not been described in bronchomalacia, although clearly there is a logical rationale

for using positive expiratory pressure (PEP) in this condition, as the splinting of floppy airways should help maintain their patency and promote secretion clearance. As this patient had very thick tenacious secretions, and oscillations in expiratory flow are postulated (Newbold 2005) to mechanically reduce the viscoelasticity of sputum, an OPEP as opposed to constant PEP device was selected.

This device was effective in mobilising secretions and acceptable to the patient but nose clips were necessary to achieve expectoration through an effective FET.

Nose clips are commonly used to aid cough strength in those with neuromuscular disorders and during the assessment of maximal cough. There is, however, no report of their therapeutic use in cough suppression. The habitual way in which this patient suppressed expectoration is not possible if the nasal passages are occluded. It should be noted that the patient found their use unpleasant at first but did find them tolerable and effective with successive treatments.

■ Conclusion

We have described and discussed the effective rehabilitation of a complex patient with bronchiectasis and bronchomalacia. Secretion retention with a multifactorial origin was successfully treated using nebulised hypertonic saline to stimulate cough and secretion movement, OPEP to splint malacic airways and reduce sputum viscosity, and nose clips to optimise FET and cough efficacy. The patient has avoided intubation for nine months.

Key Points

- Hypertonic saline and positive expiratory pressure devices should be considered in patients with bronchomalacia who retain secretions.
- Nose clips worn during airway clearance, and hypertonic saline may facilitate successful expectoration in patients who suppress their cough.

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ACPRC Conference 16th & 17th April 2010

Head-up tilt-table rehabilitation in intensive care

Is it better than sitting in a chair for ventilated adults in terms of improving lung function?

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■ Background:

Physiotherapists use the upright posture to elicit improvements in lung function. Sitting in a chair and standing with a tilt-table are commonly used interventions but there are no published reports comparing the efficacy of these interventions in ventilated subjects.

Subjects acted as their own controls undergoing sitting in a trauma chair and standing on a tilt table at 70 degrees in random order. Respiratory rate (RR), tidal volume (V_T), ventilation (V_E) and oxygen consumption (VO_2) were measured at minute intervals during rest and intervention. Functional residual capacity (FRC) was measured once at rest and following each intervention.

■ Methodology:

Convenience sampling of ventilated subjects meeting the inclusion criteria was employed.

■ Statistics:

Raw data was analysed for normal distribution using SPSS. Normally distributed data was

analysed with paired t-test's, Wilcoxon-Mann-Whitney U tests were employed as the non-parametric equivalent.

■ Results

10 subjects were recruited. No adverse events occurred during interventions. Significant increases in RR ($p < 0.0001$), V_E ($p < 0.0001$) and VO_2 ($p = 0.009$) over baseline occurred during the tilt table intervention. There was an increase in FRC during tilting of 600ml which failed to reach significance. Significant increases in RR ($p < 0.0001$), VO_2 ($p = 0.024$) and a decrease in V_T ($p = 0.015$) from baseline occurred with the chair intervention.

■ Conclusions

Increased muscular activity associated with these upright interventions elicited expected elevations in VO_2 . The tilt-table produced an increase in V_E driven by an increased RR at the expense of V_T . V_E was not elevated during chair sitting despite an increased VO_2 and was accompanied by an unexpected decrease in V_T .

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Effect of Body Position on Peak Cough Flow

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■ Background

The maximal expiratory flow recorded immediately following the opening of the glottis during a cough manoeuvre is Peak Cough Flow (PCF). There is lack of an effective protocol with regard to standardisation of body position while testing PCF. This study aimed to investigate whether body position has an effect on cough strength expressed by PCF.

■ Methodology

Quasi-experimental, random order, repeated measures design was employed. 29 healthy females aged 19-25 years were recruited through convenience sampling. Using a Mini-Wright Peak Flow meter, PCF was measured randomly in supine, three-quarter sitting (TQS) and upright long sitting (ULS) positions in all the subjects. Three attempts were made in each position and maximum value was used for analysis.

■ Statistics

One-Way Repeated Measures ANOVA was used to determine positional effect ($P < 0.05$). Post-Hoc Tukey's was used to determine differences between individual positions.

■ Results

Mean PCF was highest in TQS (442.8 litres/min) followed by ULS (437.4 litres/min) and supine positions (419.5 litres/min). One-way ANOVA showed a highly significant effect ($P < 0.001$). Tukey's post-hoc revealed significant difference between TQS and supine ($P < 0.001$) and between ULS and supine ($P < 0.05$) with no differences between TQS and ULS ($P > 0.05$).

■ Conclusions

Body position has a significant effect upon PCF. Since PCF is higher in upright than in recumbent positions it is important to perform forced expiratory manoeuvres in erect positions e.g. for effective airway clearance or to measure PCF to accurately predict extubation outcomes in ICUs. Positions such as TQS and ULS may not need to be stringently standardised.

Maintaining an active lifestyle following pulmonary rehabilitation: patients' perspectives.

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physical ability, confidence and understanding. Regular exercise following PR was seen as essential for maintaining an active lifestyle. Many participants expressed a desire for ongoing exercise sessions with peers, and access to knowledgeable staff, to sustain an exercise routine and thus an active lifestyle. Exercise venue and COPD symptoms were viewed as potential barriers. Self-efficacy for physical activity was an important sub-theme underpinning facilitators and barriers.

■ Conclusions

These views suggest that ongoing exercise opportunities with peer and staff support, in a suitable venue, may assist some COPD patients to sustain a physically active lifestyle. Long-term support may prevent a decline in patients' confidence in their own abilities.

■ Background

Physical activity has been shown to have prognostic value in COPD. Pulmonary rehabilitation (PR) aims to increase activity in daily life by improving exercise capacity and confidence. The positive effects of PR diminish once the course is complete. Patients' views of continuing with an active lifestyle after PR are presently unheard.

■ Aim

To gain an understanding of COPD patients' attitudes towards maintaining a physically active lifestyle following PR.

■ Method

Inductive, interpretive inquiry. Two focus groups were conducted with PR graduates. One group (n=4M/5F, mean (range) MRC 2(2-3), 67(47-91) %predicted FEV1) had experienced ongoing exercise support from PR staff. The other group (n=5M/2F, MRC 2(2-3), 59(28-78) %predicted FEV1) had not. Thematic analysis was applied.

■ Results

Facilitators and barriers to physical activity were identified as main themes. The PR course itself was perceived to be a facilitator, through improved

Time to activity within a general/trauma Intensive Care Unit

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activities occurred earlier in our general/trauma ITU population compared to patients with respiratory failure in America. Different approaches to the initiation of mobilisation may account for the reduced time to activity in our population.

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■ Background

Time taken from ICU admission to first activity has been reported in studies examining Physician referred physiotherapy, with mobility protocols commenced within 24hours of admission^{1,2}. This investigation examines "time to activity" in our ITU where early physiotherapy is standard practice.

■ Methodology

All admissions to an 18 bed ICU over 2-months were included. Demographics, diagnosis, APACHE score, airway/ventilation mode, oxygenation, passive and active rehabilitation interventions were recorded for each physiotherapy episode.

■ Statistics

Patients with < 48hours of ICU stay or death within 48hours of admission were excluded. Data was analysed descriptively for the remaining sample. Mean

time to activity intervention from ICU admission was calculated.

■ Results

77 patients completed 622 physiotherapy episodes. 367 (59.0%) episodes did not include rehabilitation while 255 (41%) included at least one activity. SOEOb and transfers to sit in chair occurred with the highest frequency and a mean time to activity from ICU admission of 8.9 ± 6.3 days and 5.6 ± 4.8 days respectively. Walking occurred within 8.8 ± 6.7 days from ICU admission. Active and active assisted exercises occurred within 8.7 ± 8.9 days and 8.8 ± 7.5 days respectively.

■ Conclusions

Our data compares favourably with published studies of respiratory failure patients who report time to activity from ITU admission of 8.8 ± 7.6 days to sit in chair and 11.3 ± 10.1 days to walk¹. These specific

Book reviews

■ Roses RE, Paulson EC, Kanchwala SK, Morris JB (2009)

Gowned and Gloved Surgery: Introduction to Common Procedures; Philadelphia; Saunders Elsevier.

Gowned and Gloved Surgery is a useful text written predominantly for medical students to enhance their knowledge of surgical procedures, however it may also be a useful resource for physiotherapists working in general surgery and also critical care.

Chapter by chapter the authors address a different aspect of surgical intervention or a specific procedure, and whilst some of the operations included in this book no longer commonly require post-operative physiotherapy intervention there are many that still do including oesophagectomy, gastrectomy, gastric bypass and pancreatic resection.

Chapter one introduces the reader to perioperative and interoperative care and provides a basic level of information that might be useful to the student physiotherapist or rotational band 5 therapists. Topics covered include when and why catheter or NG tube insertion may be required, types of sedation and risk factors for surgery.

Chapters three and ten discuss central venous catheterisation and enteral access procedures and give a good overview of these techniques. The reasons why these interventions may be required are covered along with different types of access,

description of the technique and helpful anatomical diagrams. There is also a helpful overview of common complications associated with these procedures which would help the novice clinician to know what to look out for.

Each chapter, addressing a range of surgical procedures, follows a similar format. There is a case study followed by an outline of the anatomy of the affected part, common pathologies that lead to the surgical intervention and helpful diagnostic information. Each chapter contains a description of the surgical procedure, and whilst there may be more information than a physiotherapist needs it does provide good insight into the complexities of the procedure. Again, common complications are outlined and these often relate well to the multidisciplinary rehabilitation of the patient post-operatively, and would be a useful resource for the new band 6 physiotherapist or those wanting to know a little bit more.

Although aimed at medical students this book could be a useful addition to a physiotherapy team's learning resources, having application to students, junior and more experienced staff working with acute surgical patients.

Journal of the Association of Chartered Physiotherapists in Respiratory Care

INSTRUCTIONS FOR AUTHORS

Submissions may take the form of review papers, research reports, audit reports, case studies, editorials, conference reports, equipment reports and reviews of books, CDs or DVDs. Student contributions are welcomed.

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Articles should normally be no longer than 2000 words (editorials, case studies 1000 words and book reviews 250 words). They should be emailed to leigh.mansfield@plymouth.ac.uk and Catherine.baker@nuth.nhs.uk with the files named as follows

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This is typeset in bold at the beginning of the article, and should be between 50 and 60 words in length. It should be designed to develop the readers' interest in the article.

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The introduction should have a clear rationale and purpose/aim or state the question that the paper sets out to answer.

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This should outline the methodology used to complete the respiratory project or literature review. A summary of the statistical process should be provided, for research projects a statement of ethical approval should be included.

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Results should include a detailed summary of your findings.

DISCUSSION

Interpretation of the results obtained in the study should be offered here. The findings must be considered in relation to previous work and in terms of whether the aim specified in the INTRODUCTION has been achieved. Suggestions should also be included for the improvement of the study. Furthermore recommendations for future research should be offered.

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Your conclusions should be succinct and logically ordered. Identify gaps in present knowledge and suggest future initiatives.

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Samuels B (1979) Pulmonary complications of AIDS. In: Rand A, Long B, eds. *Management of AIDS*. Butterworths, London: 387-95

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Author/editor Year Title [online]. Place of publication: Publisher (if available). Available from: Site [Accessed date].

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Papers that have been submitted for publication but not yet accepted are not acceptable as references. Papers that have been accepted for publication but not yet published may be included in the reference list e.g. Abel HL (1988) Endometriosis. *Br J Hosp Med* (in press)

The total number of references should not exceed 20.

