A retrospective analysis of the use of EZPAP positive pressure device by respiratory physiotherapists.

Sarah Elliott MA, PGCert, BSc(Hons), MCSP

Physiotherapy Practitioner

Medway Maritime Hospital, Windmill Road, Gillingham, Kent, ME7 5NY

Summary

A lack of clinical studies first led the author to conduct a small scale study investigating the effectiveness of EZPAP positive pressure device (Elliott, 2012). This suggested that EZPAP had the potential to be an adjunct to respiratory physiotherapy to aid sputum clearance, reverse atelectasis and reduce the work of breathing. This study analysed the type of patient being selected and the reasons why. It also reviewed the outcome of treatment. Results suggested the benefits of EZPAP in all clinical areas including critical care, paediatrics, in patient care and the possibility of managing long term conditions.

Correspondence Details

Sarah Elliott

Tel: 01634 830 000 Bleep 537
Email: sarah.elliott@medway.nhs.uk

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Introduction

EZPAP, see Figure 1, is a positive pressure device which amplifies an input of either air or oxygen approximately four times greater using the coanda effect. This augmentation provides a larger flow and volume with less effort than an unsupported inspiration and positive expiratory pressure is provided on expiration. It is marketed as a tool for the management of pulmonary conditions, mainly as a technique to increase lung volume and reduce atelectasis.

However, when reviewing the literature the evidence to support the use of EZPAP is predominantly based on personal testimonials (DHD Healthcare, nd; Harland, 2003) or observational studies (Kopp 2011, Daniel and Tarnow 2001, Daniel and Tarnow 2002). Though methodologically poor, these limited studies found that in clinical practice EZPAP was effective in treating atelectasis, sputum load and decreased gas exchange. Other

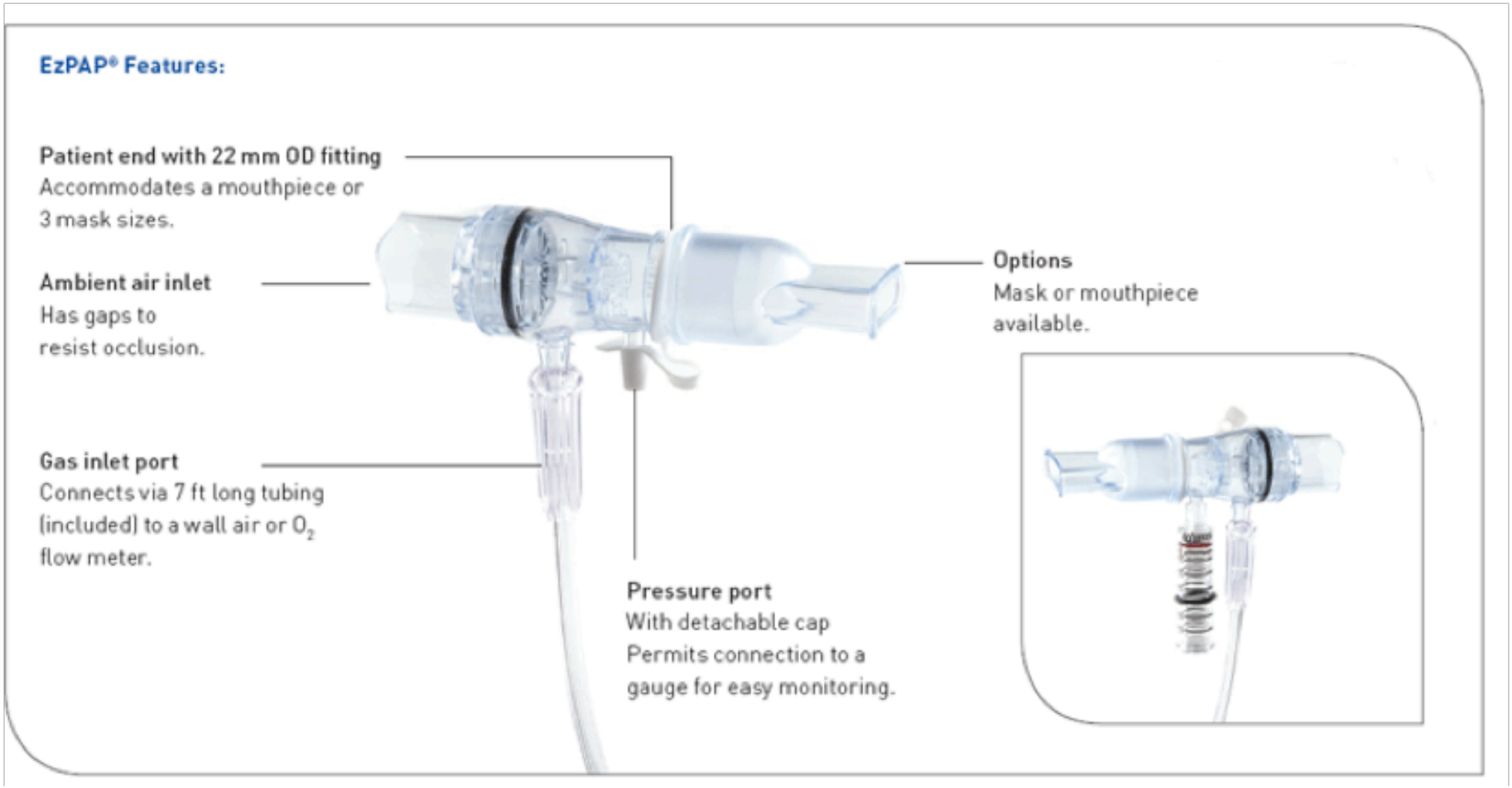

Figure 1 – The EZPAP positive pressure device (Reproduced with permission from Smiths Medical)

benefits included its ease of use and good patient compliance.

Only two clinical trials were identified during the literature search, Wiersgalla (2002) and Rieg et al (2012). Wiersgalla (2002) conducted a randomised control trial comparing EZPAP to incentive spirometry in reducing post operative atelectasis following a coronary artery bypass graft (CABG). The study concluded that EZPAP demonstrated a 100% improvement in atelectasis on radiograph compared to only a 25% improvement for incentive spirometry. The limitations of this study were the absence of a control group, small sample size (50) and the use of only one outcome measure. Rieg et al (2012) in a prospective observational study compared the effect of EZPAP compared to standard oxygen therapy delivered via a facemask in the treatment of post-operative hypoxemia by measuring SaO2. EZPAP was deemed as equally effective as oxygen delivered via a facemask and reduced the need for prolonged oxygen therapy. It was also found to be beneficial for patients deemed high risk due to obesity and pulmonary disease but identified further randomised studies were required.

Other experimental studies (Synder et al 2001, Black et al 2006) examined the inspiratory/expiratory pressures in healthy individuals on EZPAP concluding that pressures achieved are maintained consistently and are within a clinically useful range throughout the breathing cycle. This suggests that the EZPAP is reliable in delivering positive pressure.

Due to the limited available evidence, the decision to purchase EZPAP units at Medway NHS Foundation trust was preceded by a small scale, department based clinical study (Elliott 2012). The aim was to measure the outcomes of the EZPAP in relation to increasing lung volume, sputum clearance and gaseous exchange. The results demonstrated improvements in all physiological parameters and EZPAP was subsequently purchased as an additional adjunct to respiratory physiotherapy.

This aim of this study was to review the continued use of the EZPAP device, ensuring it remained a beneficial addition to respiratory physiotherapy modalities. The aim was to review the type of patient being selected for EZPAP by the physiotherapist, the reasons why it was selected and review the outcome of treatment. The data collected would allow the physiotherapy team to evaluate the continued use of EZPAP within Medway NHS Foundation Trust. The hospital, a district general, serves a population of 360,000 people and delivers acute services across all clinical specialities with 550 beds, including 25 critical care beds.

Methods

The study design was a retrospective analysis of patients who received EZPAP in a twelve month period between October 2011 and October 2012. The study collected the following data: the patients' admitting diagnosis; the patients' respiratory problem (as identified by the physiotherapist); rationale for use of EZPAP; the number of treatments; reasons for cessation of treatment; and outcome of the intervention. This information was obtained from physiotherapists who completed a log every time EZPAP was utilised, which requested the required information. The use of logs alongside retrospective analysis of medical notes ensured a complete picture of the treatment intervention was gained.

Results

There were 25 patients who received EZPAP as part of their physiotherapy treatment during the study period, 60% were males and 40% females. The age range was 9 – 91 years. Two patients were under 16 (nine years old and thirteen years old), eight patients in the age range 16-65 and the remaining fifteen patients were over 65 years old. Table 1 shows the collated audit results for the patients.

Patient No.	Patient's Admitting Diagnosis	Medical Speciality	Physiotherapy Respiratory Goal/s	Rationale for Use	Number of Treatments	Reason for Treatment Cessation	Outcome of Treatment	Other
1	Road traffic collision, spinal shock	Orthopaedics	Prevent atelectasis	Patient on bed rest, unable to mobilise	7	Patient began to mobilise	Maintained good lung volumes	Easy to set up. Patient used independently
2	Laparotomy x 3	Surgery	Increase lung volumes	Numberous general anaesthetics, poor basal expansion	7	Patient became independently mobile	Improved breath sounds on auscultation	Patient found it easy to use, but fatiguing at times
3	Advanced Parkinson's disease with chest infection	Elderly care	Clear secretions	Unable to coordinate with intermittent positive pressure breathing	5	Problem resolved	Stronger cough generated and patient able to clear secretions	Unable to use mouth piece, but worked well with face mask
4	Femoral hernia repair	Surgery	Improve gas exchange	Required positive pressure	4	Patient began to mobilise	Weaned from vapotherm after 24 hours and oxygen after 48 hous	
5	Fractured neck of femur	Orthopaedics	Increase lung volume	Unable to mobilise due to cardiovascular instability and oxygen demand (100%)	4	Patient began to mobilise	Increased lung expansion	Patient tended to hold breath
6	Anterior resection	Surgery	Increase lung volume and improve gas exchange	Required positive pressure	2	Problem resolved	Patient weaned off oxygen	Easy to use
7	Bilateral pneumonia	Medical	Improve gas exchange	Ease of use compared to IPPB	3	Problem resolved	Patient weaned off oxygen	Decreased respiratory rate
8	Post-partum haemorrhage, hysterectomy and post extubation	Gynaecolory	Increase lung volume	Patient too tired to use incentive spirometry	3	Patient began to mobilise and able to use incentive spirometry	Improved air entry on ausculation	

Table 1 – Audit date for patients receiving EZPAP

Patient No.	Patient's Admitting Diagnosis	Medical Speciality	Physiotherapy Respiratory Goal/s	Rationale for Use	Number of Treatments	Reason for Treatment Cessation	Outcome of Treatment	Other
9	Pneumonia	Medical	Sputum retention	Ineffective cough	2	Problem resolved, patient self clearing secretions	Improved cough, patient able to clear secretions	Used manual techniques at the same time
10	Subtotal colectomy	Surgery	Increase lung volumes	Unable to mobilise patient due to cardiovascular instability	3	Patient began to mobilise	Improved air entry on auscultation	
11	Guillain-Barre syndrome	Neurology	Prevent atelectasis	To prevent respiratory complications	14	Improved physical function	Maintained respiratory status	Patient found easy to use and good compliance
12	Pneumonia	Medical	Sputum retention	Patient unable to expectorate secretions	1	Patient confused, unable to tolerate	No change in respiratory status	Unable to use mouthpiece or face mask due to confusion
13	Laparotomy	Surgical	Increase lung volume	Poor inspiratory effort	3	Improved strength, able to do deep breathing exercises and mobility	Improved air entry on auscultation	
14	Pneumonia	Medical	Increase lung volume and improve gas exchange	Patient drowsy	5	Patient less drowsy, participated in active treatment	Decreased oxygen demand	Managed well with face mask
15	Pneumonia	Elderly	Clear secretions	Other techniques not successful	4	Problem resolved	Good cough stimulated and secretions cleared	
16	Ischaemic lower limb	Vascular	Increase lung volume	Too drowsy to use incentive spirometry	2	Patient deteriorated and commenced Liverpool Care Pathway	Expansion visibly increased	

17	Open abdomen	Surgery	Clear secretions	Accidental decannulation of tracheostomy, trying to avoid re-intubation, patient weak and fatigued	6	Improved strength and cough, able to participate in active rehabilitaion	Maintained self ventilation	Used overnight regularly by ITU nursing sraff after teaching, avoiding physiotherapy on call visits
18	Cystic fibrosis	Paediatrics	Clear secretions	Daily routine of physiotherapy not effective	8	Once acute episode resolved, patient reverted to daily routine of physiotherapy	Effective cough and increased sputum cleared	Good compliance, patient keen to use at home if air suppy can be achieved
19	Guillain-Barre syndrome	Neurology	Prevent atelectasis	Maintain respiratory status post extubation	16	Improved strength and mobility	Maintained respiratory status	Patient used device independently
20	Fractured pelvis	Orthopaedics	Prevent atelectasis	Patient on bed rest	8	Patient transferred to speciality hospital	Maintained respiratory status	Patient used device independently
21	Pneumonia	Paediatrics	Improve gas exchange	Patient unable to use IPPB	4	Patient discharged home	Weaned off oxygen	Good compliance
22	Caesarean section	Gynaecology	Clear secretions	Asthmatic, poor cough	2	Improved cough, patient mobile	Patient able to self manage secretions	Required pain relief prior to treatment
23	PEA Arrest, fractured sternum	Medical	Clear secretions, improve lung volume	Aspiration, unable to achieve good lung expansion independently after extubation	9	Patient opted to do active treatments / attend gym	Re-intubation avoided, good expansion and cough achieved	Painful at times, used with saline nebuliser
24	Road traffic collision, multiple trauma	Orthopaedics	Prevent atelectasis	Patient on bed rest, smoker	2	Patient non-compliant	Patient self managed chest and did not deteriorate despite non-compliance with physiotherapy	Patient non-compliant
25	Multiple sclerosis with chest infection	Medical	Clear secretions, improve lung volume	Weak cough, poor expansion	6	Discharged home	Stimulated effective cough and avoided fatigue	Patient would like to use long term to maintain respiratory status

Discussion

Clinical speciality and medical diagnosis

EZPAP was utilised across all clinical specialities within the hospital with the highest usage in surgery (24%) and medical directorates (28%). When the patient's medical diagnosis is grouped into themes, 36% of EZPAP interventions were with patients who were admitted with a respiratory condition; 32% post abdominal / gynaecological surgery and 16% orthopaedic surgery which concur with the work of Wiersgella (2002) who suggested it as a viable treatment option in pulmonary management. On two occasions it was used to manage acute exacerbations of long term conditions such as cystic fibrosis (CF) and multiple sclerosis (MS). The CF patient expressed a wish to continue with EZPAP as a long term therapy to manage sputum clearance, if an air supply could be sourced for use at home.

Analysis identified significant use of EZPAP to prevent atelectasis in patients who were on bed rest (five patients) or had neuromuscular disorders such as Guillain-Barre Syndrome (GBS) (two patients). On another two occasions EZPAP was the treatment of choice to prevent re-intubation in ITU patients. In all of these EZPAP interactions there may have been the possibility of avoiding more invasive and costly treatments or reducing length of stay in critical care by avoiding re-intubation. Daniel and Tarnow, (2002), in a small scale study utilising EZPAP as a lung expansion therapy found that four out of five patients in their study avoided intubation and ventilation and McEdwards cited by DHD Healthcare (nd) proposed that EZPAP may reduce care costs by avoiding intubation. However, at this time there is currently limited clinical evidence to demonstrate or measure these aspects adequately. Further research with appropriate robust methodology is required to support these theories.

The EZPAP has also been successfully introduced to paediatrics patients as young as nine years of age. To date there are no other investigations, testimonials or case studies that have considered the use of EZPAP as a treatment choice with children, so EZPAP in this area of practice requires more research. An important aspect of this analysis is that the children were compliant with the treatment and were also empowered to carry out the EZPAP intervention independently throughout the day. A child with cystic fibrosis felt it would be a treatment that could be easily utilised at home, thus encouraging self management of their conditions. The Health Foundation (2011) proactively supports self management and by focusing on behaviour change at a young age it can impact on clinical outcomes and emergency service use throughout life.

EZPAP as a physiotherapy intervention

Physiotherapists identified that the most common problems they used EZPAP for were to clear secretions (28%), improve lung volume (24%), to prevent atelectasis (20%) and improve gas exchange (12%). On four occasions physiotherapists selected EZPAP to treat multiple problems including to increase lung volume and improve gas exchange simultaneously and also to clear secretions and improve lung volume. There has been no consideration in the literature to date that EZPAP could be used to treat multiple physiotherapy respiratory problems as a combined therapy. No physiotherapists selected EZPAP as a technique to reduce the work of breathing - but it was noted that one patient with pneumonia had a reduced respiratory rate post treatment which may suggest that reducing the work of breathing is an additional outcome measure, but not a determining factor in treatment choice.

EZPAP to improve lung volume

Interestingly, the majority (71%) of patients who received EZPAP to improve lung volume had undergone abdominal surgery. Wiersgella, (2002), also identified the benefit of EZPAP post-surgery (Coronary Artery Bypass Graft) as an effective method to reverse atelectasis

and Kopp (2011) found good compliance with post operative patients using EZPAP. The physiotherapist's rationale for selecting EZPAP as the treatment of choice for reduced lung volume was mainly poor lung expansion or reduced inspiratory effort and the patient being too weak or tired to manage incentive spirometry (IS). Boykin (2007), identified that if a patient cannot achieve a minimum of 15ml/kg of predicted inspiratory capacity then IS would not be effective. EZPAP was frequently selected over IPPB due to ease of use or patient being unable to trigger the IPPB. Kopp (2011), also found that therapists chose EZPAP as a therapy in respiratory care due to ease of use. In all cases the physiotherapist documented either improved lung expansion or increased air entry on chest auscultation. Unfortunately one patient's general condition deteriorated and they were placed on the Liverpool Care Pathway so EZPAP was ceased. However, in all other cases improvements were made and in time physiotherapy progressed to active rehabilitation and mobility for respiratory therapy as Hough (2001), advocates that exercise is the optimum treatment for increasing lung volume.

EZPAP to clear secretions

In this sample, 78% of patients who had EZPAP for sputum clearance were within the medical or elderly care speciality, and had weak or ineffective coughs on assessment or were unable to trigger the IPPB. All patients receiving EZPAP for sputum retention, except one case where therapy was ceased due to confusion, demonstrated either a stronger more effective cough, or a cough was stimulated during therapy. EZPAP was discontinued because either the patient was able to self clear their own secretions, used mobility and exercise as treatment or the problem completely resolved. The experience of physiotherapists at Medway Maritime Hospital of EZPAP for sputum clearance matches case studies by Cox and McEdwards, cited by DHD Healthcare (nd) who also reported improved cough and effective expectoration of secretions following EZPAP.

EZPAP to prevent atelectasis

Physiotherapists selected EZPAP as a preventative treatment modality to maintain respiratory function and prevent respiratory complications in patients who were either on bed rest due to orthopaedic conditions or who had GBS. One patient was non compliant with EZPAP treatment and physiotherapy as a whole, so treatment was discontinued, all other patients maintained good lung volumes and maintained their respiratory status. EZPAP was only stopped when physical function improved so mobility and exercise became the treatment of choice by the physiotherapists. None of the patients demonstrated any decline in their respiratory condition. One patient was transferred to another hospital so no further data was collected, but until transfer they were maintaining their respiratory status. Harland, (2003), advocates that EZPAP is the treatment of choice for preventing atelectasis and Mitchell, cited by DHD Healthcare (nd) proposes that EZPAP is a cost effective investment as they too reported on a neurovascular patient who did not require intubation due to the regular use of EZPAP. However, further randomised controlled trials would need to be utilised to determine if EZPAP was the key aspect of therapy in such situations.

EZPAP to improve gas exchange

The physiotherapists' rationale for choosing EZPAP to improve gas exchange was the need for positive pressure interventions in all but one case. In the remaining patient EZPAP with a face mask was selected due to the patient being too drowsy to co-operate with other treatment interventions. Physiotherapists chose the EZPAP device as it was easier for both the therapist and patient to use compared to IPPB, which Kopp, (2011) also found. All patients were successfully weaned from oxygen. However, it is impossible to draw firm conclusion that the improvement in gas exchange and the weaning of the oxygen was due to the EZPAP intervention or the result of the resolving respiratory condition and further

randomised controlled trials would need to be conducted to prove this.

Additional Information

Both physiotherapists and patients agreed that the EZPAP is easy to use, comfortable and so afforded a good compliance rate (92%). Only two patients did not comply with EZPAP intervention. One patient was confused and unable to correctly use the device. The other patient declined all physiotherapy input. It was noted that one patient complained of fatigue and another patient tended to hold their breath, so it is imperative that the technique is taught effectively and the patient observed carefully. Physiotherapists utilised the facemask as well as the mouthpiece and included nebulisation and manual techniques as indicated which may have increased the positive treatment outcomes that were recorded.

Number of Treatments

The average number of physiotherapy led sessions that a patient received EZPAP was 5.2, with the range from 1 to 16. Unfortunately treatment sessions supervised by nursing staff or independently carried out by the patient were not documented accurately and this will need to be addressed in any future study. If documented, it would allow physiotherapy department to analyse if expensive on call visits were being avoided if nursing staff and patients were taught how to carry out on going treatment, the initial set up and effectiveness being assessed by the physiotherapist.

The mean number of treatments has increased to 5.2 from 2.8 compared to the previous study by Elliott (2012), but in comparison the EZPAP is being utilised more to manage long term conditions, as a preventative treatment for both patients on bed rest and those with neurovascular disorders. If these patients are excluded, in order to compare with the results of the previous study, the mean number of treatment sessions a patient receives is 4. Additionally it has been implemented successfully in ITU and paediatrics - clinical areas where it previously had not been utilised. On one occasion EZPAP was only used once as the patient was unable to co-operate due to confusion and another occasion where EZPAP was trialled twice then discontinued due to poor compliance. Further monitoring is needed to ensure physiotherapists continue to use clear clinical reasoning for their treatment options rather than 'just trying' EZPAP as it was a new modality. With the remaining patients, EZPAP was ceased because the problem resolved, patient was discharged home, patient progressed to incentive spirometry or physiotherapy utilised mobilisation and exercise as their treatment choice for respiratory care.

Conclusions

This retrospective analysis suggests that EZPAP positive airway device can be a useful adjunct to respiratory physiotherapy in aiding clinical improvements in lung expansion especially with post operative patients with poor inspiratory effort, preventing atelectasis in bed bound patients and neurovascular disorders such as GBS and MS. It appears to aid clearance of secretions with patients who have a weak, ineffective cough and may be a tool to prevent intubation / re-intubation within a critical care unit when patients are demonstrating signs of fatigue. Physiotherapists identified that it was easier to use than IPPB when delivering a positive pressure treatment to improve gas exchange. EZPAP is not selected as a treatment to reduce work of breathing but may reduce respiratory rate and patient's perceived breathlessness in some cases. Both physiotherapists and patients find the device easy to use which leads to a high compliance rate. It is possible to teach nursing staff or the patient to carry out this treatment after initial set up which may reduce physiotherapy on call costs, but this requires further investigation.

Overall, this study at Medway NHS Foundation Trust found that EZPAP was used in a variety of different patient groups for a range of respiratory problems and so justifies the

ongoing purchase and feasibility as a respiratory physiotherapy modality at our hospital.

Limitations and Recommendations

- It is acknowledged that a limitation of this study was a lack of objective outcome measures to determine the effectiveness of EZPAP, further research such as prospective studies and case studies with clearly defined outcomes should be considered.
- In order to identify cost effectiveness for avoiding physiotherapy on call visits, the number of EZPAP sessions completed by nursing staff or the patient need to be analysed, not just in terms in numbers but effectiveness of technique.
- Although this study demonstrated clinically positive outcomes as assessed by physiotherapist it is limited to physiotherapy intervention only and more information could have be gained by considering other multidisciplinary involvement.

Key points

- EZPAP is effective in aiding clinical improvements of lung expansion in post abdominal surgery patients
- EZPAP can be used in the prevention of atelectasis in bed bound patients and those with neuromuscular disorders
- EZPAP aids sputum clearance in patients with ineffective cough
- EZPAP provides positive pressure to improve gas exchange
- EZPAP is easy to set up and has a good compliance rate
- EZPAP can be used for all ages in acute and long term care

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