



7th national
cardiothoracic special group
conference

October 18th-20th, 2001 Adelaide

The 7th National Cardiothoracic Special Group Conference was held in Adelaide from October 18th to 20th, 2001. "State of the Art" was chosen as the theme of this year's conference, as a means of reflecting upon the development of cardiothoracic physiotherapy practice, current controversies and what possibilities arise for future management. More than 150 delegates attended, representing Australia, Hong Kong, South Africa, Singapore and New Zealand.

The presenters of State of the Art papers are all nationally and internationally renowned for their work, and it is no coincidence that all are Australian. The Conference Organising Committee hoped to showcase not only the contribution that Australian researchers, academics and clinicians are making to our own country, but also how their work is influencing decision making and cardiothoracic physiotherapy practice throughout the world.

This strength and diversity of cardiothoracic physiotherapy management was reflected in 48 original papers, the peer-reviewed abstracts of which are presented over the following pages. These presentations included national and international work, with perspectives from academics, managers, clinicians and students.

Dr Marie Williams

*Chair, National Cardiothoracic Special Group
Australian Physiotherapy Association*

abstracts of conference presentations

Day 1:

STATE OF THE ART PAPER

OPERATIVE PHYSIOTHERAPY MANAGEMENT

Linda Denehy

The University of Melbourne

Physiotherapy has played a significant role in minimising the adverse effects of anaesthesia and surgery on the respiratory system for more than 50 years. This role was supported by evidence from clinical trials reported since 1947. The evidence advocated pre- and post-operative physiotherapy for all patients having major surgery to reduce the incidence of post-operative pulmonary complications (PPC) and thereby reduce patient morbidity and prolonged hospital admission.

Over the past decade, advances in surgery and peri-operative pain management have improved the process and outcomes for patients undergoing major surgical procedures. In addition, new techniques to aid lung expansion in the peri-operative period such as incentive spirometry, positive expiratory pressure masks and continuous positive airways pressure are used by physiotherapists. Results from recent research into physiotherapy management of patients following open heart surgery have challenged our traditional paradigm. Change of practice has been advocated, where prophylactic peri-operative physiotherapy treatment is no longer an expected intervention following heart surgery.

Two recent papers from Europe report randomised controlled trials where groups receiving 'routine' physiotherapy treatment are compared with no treatment control groups. The results from these studies suggest that peri-operative physiotherapy intervention reduced the incidence of PPC by approximately 20%. However, these findings are contradictory to the outcomes found for patients undergoing open heart surgery.

Advances in surgical and pain management techniques will be discussed in relation to the role of physiotherapy in the management of patients having major surgery. The past and current evidence for physiotherapy treatment will be presented, highlighting the use of specific outcome measures

and their validity and reliability. The clinical significance of findings from research, together with suggested clinical practice changes and directions for further research, will be addressed.

ORAL PRESENTATIONS

INTEGRATING EVIDENCE-BASED PRACTICE INTO CARDIOTHORACIC CLINICAL PRACTICE IN A PHYSIOTHERAPY DEPARTMENT

Pilgrim E

Royal Hobart Hospital

The use of evidence to assist and support treatments and/or recommendations for treatment is becoming more important throughout the medical and physiotherapy professions. **Aims:** To integrate the use of evidence-based practice (EBP) into physiotherapy cardiothoracic clinical practice by utilising the professional development program (PDP) of a physiotherapy department. **Methods:** A small group of clinicians revised the structure of a PDP to include an allocation of time to both EBP education as well as preparation, planning and literature searching of clinical topics. Evidence-based practice groups were established within the functional clinical teams, with a senior clinician as the team leader. All staff working in the clinical team were required to participate. The cardiothoracic team identified a need to investigate the evidence relating to the clinical use of intermittent positive pressure breathing (IPPB). The team therefore undertook a literature review using a rating scale, a national survey of IPPB clinical practice and an internal audit of IPPB use. For these purposes, survey and audit instruments were developed. **Results:** the results of the literature review, survey and audit were presented to staff within the PDP. Clinical guidelines for the use of IPPB were established. **Conclusion:** The EBP process has facilitated investigative and analytical skills by clinical staff and stimulated further areas of investigation such as the cost effectiveness of IPPB use. Other areas of further research have been highlighted, including the use of IPPB with patient groups that previously, have been excluded from research studies.

CAN AMERICAN AND AUSTRALIAN STUDENTS BENEFIT FROM WORKING COLLABORATIVELY ON A JOINT ASSIGNMENT?

Williams MT¹ and Feldman R²

¹University of South Australia ²University of the Sciences in Philadelphia, USA

Aims: To determine the feasibility and effectiveness of the use of joint assignments between international universities. **Design:** Pilot study with survey. **Subjects:** Eighty-three undergraduate physiotherapy students from the University of South Australia (n = 34) and the University of the Sciences in Philadelphia (n = 49). **Methods:** Students were allocated to small groups of two or three and provided with e-mail addresses for each member of the group. Each group was required to answer three questions for one of six client

scenarios. For each of the tasks, both Australian and American perspectives were to be included. The tasks were to (1) describe the physiotherapy management of the client; (2) provide information on the economic cost of physiotherapy services for this client depending on whether they were publicly or privately insured; and (3) discuss which country offered the 'best' health care for the client. Assessment included consideration of content, resource access and peer review. Written feedback concerning the strengths and weaknesses of the assignment were obtained. **Results:** Eighty-two students completed the assignment successfully with excellent content and evidence of resource access demonstrated. Strengths of the assignment included learning about national/international health care, improved computer skills with e-mail, communication with international students and a broader understanding of physiotherapy management. Weaknesses included difficulties accessing on-line sites and discrepancies in academic calendars between the two countries. **Conclusion:** Overwhelmingly, students provided positive feedback concerning the usefulness and innovation of this collaborative international assignment. Practical issues concerning assignment timing and electronic access can be overcome.

COURSE EVALUATION ON THE WEB: A METHOD OF ENHANCING REFLECTIVE PRACTICE ON TEACHING AND LEARNING IN PHYSIOTHERAPY

Tucker B, Straker L, Jones S, Cole J and Ots J

Curtin University of Technology, Perth

Course evaluation on the Web (CEW) is a Web-based system currently used for collecting, synthesising and reporting student and teacher perceptions on teaching and learning. This system aims to facilitate teachers, students and course manager reflection on a course. This paper will outline the "Learning Community" model on which CEW is based and the use of CEW to enhance reflective practice. The elements evaluated by CEW include the unit/subject organisation, the local environment and the broader environment. Students provide feedback by rating agreement with statements and using qualitative comments. Teaching staff prepare a summary of student comments, together with a response which covers planned changes to the unit/subject and why some suggestions will not be implemented. The summary and response are discussed with an academic colleague (year co-ordinator) to encourage reflective teaching practice and provide support for teaching staff. Following peer discussion, the summary of student ratings, summary of student comments and teaching staff response are posted onto the Web for access by all School of Physiotherapy students and staff. The individual student comments are also available. Additional activities that support reflective practice as a result of CEW will also be described.

Supported by the Learning Effectiveness Alliance Program (LEAP), Curtin University of Technology.

THE USE OF EVIDENCE-BASED PRACTICE IN THE PHYSIOTHERAPY MANAGEMENT OF THE UNCOMPLICATED CORONARY ARTERY BYPASS GRAFT PATIENT IN THE UNITED KINGDOM

Reeve J¹ and Ewan S²

¹*Auckland University of Technology, New Zealand* ²*Leeds General Infirmary, United Kingdom*

Evidence-based practice initiatives require physiotherapists to use research findings to promote best practice and optimise limited resources. **Aims:** This study investigated pre- and post-operative physiotherapy interventions in the uncomplicated coronary artery bypass graft (CABG) patient and factors influencing these interventions, ascertained research awareness and identified how this affected practice. **Methods:** A postal questionnaire was sent to senior physiotherapists in all cardiac surgical centres in the UK. **Results:** A response rate of 80% (n = 40) was obtained. Data were analysed using the statistical package for the social sciences. Factors most influencing pre-operative practice were personal experience (83%, n = 33), literature recommendations (70%, n = 28) and established practice (55%, n = 22). The basis for post-operative practice was multifactorial, mainly based on personal practice (75%, n = 30) or established practice (68%, n = 27). Only 45% (n = 18) indicated that literature recommendations affected practice. Despite evidence suggesting this level of intervention to be unnecessary, 95% (n = 38) of respondents continue to see (face to face contact) all patients post-operatively. Fifty-five per cent (n = 22) continue to treat all patients. Only one respondent had discontinued routine assessment and treatment. Ninety per cent (n = 36) of respondents had read one or more key research articles in the area. Eighteen per cent (n = 7) specifically indicated reading the literature had not affected their practice. Eight per cent (n = 3) stated they had read none of the literature. **Conclusion:** This study corroborates an earlier study demonstrating that despite research awareness, physiotherapists still appear reluctant to change practice, continuing to base interventions on personal preference. Further research should be undertaken to investigate reasons for this.

THE INCORPORATION OF DEEP BREATHING EXERCISES IN A PROGRAM OF PRE-OPERATIVE EDUCATION AND EARLY MOBILISATION POST CARDIAC SURGERY. DO THEY IMPROVE PATIENT OUTCOME?

Brasher P¹, McClelland K¹, Denehy L^{1,2} and Story I²

¹*Monash Medical Centre, Melbourne* ²*The University of Melbourne*

Aims: To establish whether incorporation of breathing exercises into a regimen of early mobilisation reduces the incidence of post-operative pulmonary complications in patients after cardiac surgery. **Design:** Prospective randomised controlled trial. **Subjects:** One hundred and ninety-eight patients undergoing open heart surgery. **Methods:** All patients received physiotherapy treatment pre-operatively and post-operatively for three days. Patients were mobilised as soon as possible following surgery. Those in the

control group completed a program of breathing exercises at each visit, consisting of a minimum of four sets of five maximal breaths incorporating a 3s breath hold. Supported cough was performed after 10 breaths and on completion of breathing exercises. Patients in the treatment group did not receive breathing exercises as part of their treatment. The incidence of post-operative pulmonary complications (PPCs), post-operative length of stay, percutaneous oxygen saturation (SpO₂) and pulmonary function were measured pre- and post-operatively. Data were analysed using *t*-tests, chi-square and repeated measures analysis of variance. **Results:** There were no significant differences between the groups in incidence of PPCs (control group 3.09% vs treatment group 2.97%, *p* = 0.96), post-operative length of stay (control group 7.06 ± 5.61 vs 6.87 ± 3.94 days, *p* = 0.79), SpO₂ (*p* = 0.32) or forced vital capacity (*p* = 0.58). **Conclusion:** Inclusion of breathing exercises in the routine post-operative physiotherapy management of open heart surgery patients did not improve outcome as measured by incidence of PPCs, SpO₂, pulmonary function tests and length of stay.

The study was supported by a grant from the Australian Physiotherapy Association Victorian Branch Research Committee.

THE ADDITIONAL VALUE OF BiPAP AND CPAP IN THE TREATMENT OF PULMONARY COMPLICATIONS FOLLOWING CARDIAC SURGERY

Reynoldson N, Morley P and Tatoulis J

Royal Melbourne Hospital

Aims: Studies show pulmonary changes occur following cardiac surgery. Techniques addressing this include oxygen therapy and non-invasive positive pressure ventilation (NIPPV). Statistically, patients who fail post-extubation on high flow oxygen and require NIPPV have an increased length of stay. **Design:** Prospective, randomised study. **Subjects:** Fifty-two cardiac surgery patients. **Methods:** A comparison of early intervention with NIPPV to high flow oxygen therapy following extubation. Time on high flow oxygen therapy and length of stay were assessed. When oxygen saturation dropped below 95% on 8L/min subjects were allocated into the BiPAP, CPAP or high flow oxygen group. All patients received standard supportive care. CPAP of 8cmH₂O was used, with BiPAP set at 8 and 15cmH₂O. Patients on NIPPV received 30 minutes of treatment three hourly, using high flow oxygen between treatments. Patients on 8L/min oxygen were checked three hourly. This was continued until saturations of above 95% were maintained. One way analysis of variance followed by Fisher's PLSD post hoc tests were used to analyse the data. **Results:** Thirty-two subjects provided complete data. Statistically significant differences were found for time on high flow oxygen (*p* = 0.003) and length of stay (*p* = 0.013). Patients on high flow oxygen spent more than three times longer on increased oxygen (mean 25.7 hours vs 7.1 and 7.9). Patients on high flow oxygen stayed in hospital longer than those on NIPPV (mean 8.8 days vs 6.3 and 7.1). **Conclusion:** The use of NIPPV reduces the requirement for long term high flow oxygen by decreasing the negative effect of pulmonary

function, and reduces the length of stay in hospital.

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THE RELATIONSHIP BETWEEN RESPIRATORY FLOW RATES AND DIRECTION OF SPUTUM MOVEMENT DURING ARTIFICIAL VENTILATION

Jones YMA

Hong Kong Polytechnic University

Manual lung inflation (bagging) is a technique used by physiotherapists for secretion mobilisation in mechanically ventilated patients. **Aims:** This project aimed to investigate the direction of artificial sputum movement during mechanical ventilation (MV) and bagging using a tube model. **Design:** Laboratory experiment. **Methods:** Ultrasonic gel (artificial sputum), in a range of viscosities similar to human sputum, was placed in a glass tube similar in diameter to human segmental bronchi. The tube was connected to a test lung at one end and, via a pneumotachograph, to a mechanical ventilator at the other. The ventilator was set to deliver a tidal volume of 400mL at 12 breaths per minute. The position of the 'sputum' in the tube was marked before and after delivery of 20 breaths. Inspiratory and expiratory flow rates for each breath were recorded with the pneumotachograph. The procedure was repeated using the bagging technique. The distance the artificial sputum travelled during MV and bagging was compared using independent *t*-test. **Results:** The artificial sputum moved towards the ventilating device and away from the test lung during both MV and bagging. The distance travelled by the 'sputum' during bagging was greater than that travelled during MV (*p* < 0.05). Peak expiratory flows were significantly higher than inspiratory flows (*p* < 0.0001) and presumed to account for the direction of 'sputum' movement. Peak expiratory flow during bagging was higher than that generated by mechanical breaths. **Conclusion:** The bagging technique is more effective at mobilising secretions in a tube model compared with mechanical ventilation alone.

A COMPARISON OF THE EFFECTS OF MANUAL AND VENTILATOR HYPERINFLATION ON STATIC LUNG COMPLIANCE AND SPUTUM PRODUCTION IN INTUBATED AND VENTILATED INTENSIVE CARE PATIENTS

Berney S¹, Denehy L² and Silvester W¹

¹Austin and Repatriation Medical Centre, Melbourne ²The University of Melbourne

Aims: To compare the effects of manual hyperinflation (MHI) and ventilator hyperinflation (VHI) on static pulmonary compliance (Crs) and sputum wet weight (SWW) in stable, intubated and ventilated patients. **Design:** Randomised, double cross over. **Subjects:** Twenty intubated and ventilated ICU patients at the Austin and Repatriation Medical Centre. **Methods:** Patients were randomly allocated to two treatment sequences over two days. The first sequence involved MHI followed two hours later by VHI and the order

was then reversed on the second day. In the second sequence, VHI preceded MHI. The variables of Crs, SWW and percutaneous oxygen saturation were analysed using an analysis of variance for repeated measures. Statistical significance was set at $p < 0.05$. **Results:** There was no significant difference in SWW produced between either technique (mean difference = 0.52g, 95% confidence intervals 3.74g – 8.84g, $p = 0.11$). Both hyperinflation techniques improved Crs ($p < 0.05$) but MHI improved Crs significantly more than VHI ($p = 0.048$). However, the mean magnitude of this difference in Crs was only 1.35cmH₂O and was not considered to be clinically important. **Conclusion:** Hyperinflation as part of a physiotherapy treatment appears able to be performed with equal benefit using either a manual resuscitation bag circuit or a ventilator. Both methods of hyperinflation improve Crs and clear similar amounts of pulmonary secretions. Ventilator hyperinflation provides an alternative for future research.

Supported by the Physiotherapy Research Foundation.

CARDIOTHORACIC PHYSIOTHERAPY SERVICE REVIEW: A CLINICIAN'S PERSPECTIVE

Kruger J and Andrew L

Royal Melbourne Hospital

Cardiothoracic physiotherapists make up more than half of the 40 full time staff at the Royal Melbourne and Western Hospital. Provision of a seven day a week service results in more than 73,000 interventions annually. The health environment has exerted significant pressure on clinicians through the implementation of casemix funding. The response has seen changes in clinical practices that have been externally driven and not always based on the best available evidence. This situation prompted the Manager of Physiotherapy to call for tenders to evaluate the cardiothoracic service across the two sites. **Results:** This review resulted in a document that identified the capacity for clinicians to review their service; identified blocks to implementation of evidence-based practice (EBP); proposed a model of care statement; and, finally, provided a change in management model for the implementation of EBP. The review has resulted in significant impetus to change within the cardiothoracic team. These changes have included: invigorating team members to review and challenge clinical practice through an enhanced culture of understanding and responsibility for service review; significant upskilling in the practical application of EBP; re-definition of senior roles within the team and implementation of innovative practices to recruit according to team needs; allocations of resources to secure funding, including submission writing for successful grant applications; improved data utilisation to support service change; improved organisational recognition of the value of physiotherapy beyond clinical care. **Conclusion:** This review process has comprehensively equipped clinicians to be more proactive regarding the challenges faced by physiotherapy in the current health environment.

The authors acknowledge the valuable input of Iridium Management Consulting and Clinical Epidemiology and Health Services Evaluation Unit, Melbourne Health.

A NEW SYSTEM FOR EXAMINING PATTERN OF VENTILATION

Maxwell L, Crosbie J and Ellis E

The University of Sydney

In the School of Physiotherapy Cardiopulmonary Research Laboratory at The University of Sydney, we have used the PulSys system (Clinical Engineering Solutions) to report the volume delivered and mean inspiratory and expiratory flow rates during manual hyperinflation (MHI). The limitations of this system are that it cannot identify an end inspiratory pause/hold and it does not measure peak flow rates. **Aims:** Our aim was to develop a new system that provides more comprehensive information on flow profiles during MHI. **Methods and Results:** The data acquisition system comprises a Hans Rudolph heated pneumotachograph (Model no. 3813, Hans Rudolph Inc, Kansas City) connected to the PulSys transducer that sends signals to an A-D data acquisition system (Data Translation, Type DT2801, USA). A user interface was developed using a visual programming package (Hewlett Packard HPVee Version 5). The analysis program has been specifically written and consists of calibration and test components. The calibration component requires three trials using a 3L calibration syringe. These data are used to ensure the system is stable, determine the conversion coefficient and convert the data from ATPS to BTPS. The final adjustment factor is then applied to the trial component. This component provides breath-by-breath measures of peak inspiratory and expiratory flow and, inspiratory, hold and expiratory volumes for up to 10 minutes of continuous data. The data acquisition system has been validated using a dual high and low flow rotameter ($r = 0.99$). **Conclusion:** Although this system has been designed for examining pattern of ventilation during MHI, it could also be used in spontaneously breathing subjects.

EFFECT OF CARBON DIOXIDE ON MOTOR AND PHYSIOLOGICAL RESPONSES

Leahy K, Thomas S, Warden-Flood A, Buckley J and Bidhendi I

University of South Australia

Carbon dioxide (CO₂) accumulates in motor vehicles when air conditioners recirculate air, and ensuing raised levels of CO₂ may impact driver performance. **Aims:** To investigate the effects of 15 minutes of exposure to 0.03%, 3% and 5.5% CO₂ on motor control, physiological responses and pulmonary gas exchange. **Design:** Double-blind, randomised, cross-over. **Subjects:** Ten healthy subjects (18-24 years). **Methods:** Subjects were seated throughout the protocol. Pulmonary gas exchange was determined by indirect calorimetry while subjects breathed three gas mixes of varying CO₂ concentration (0.03%, 3% and 5.5% CO₂; 21% O₂) in random order. They performed timed Purdue pegboard and choice response time tasks prior to and 12 minutes into each gas condition. Perceptions of headache, irritability and alertness were determined using visual analogue scales. A 20min interval of breathing room air was allowed between conditions. **Results:** Repeated measures analyses of variance

were used to evaluate the effects of the three gas conditions. There was no significant effect of breathing the different gas mixtures on choice response time, the Purdue pegboard task or self assessed alertness. However, significant effects were found with respect to respiration rate, tidal volume, VO_2 and heart rate. Headache and irritability significantly increased over time and there was a strong correlation ($r > 0.8$) between headache and irritability after 10 minutes of breathing the higher concentration of CO_2 . **Conclusion:** While higher levels of CO_2 stimulated respiration and heart rate, and resulted in irritability and headache, motor control and alertness were unaffected.

Supported by the University of South Australia.

THE CLINICAL AND PHYSIOTHERAPEUTIC EFFECTS OF ELEVATED CORTICOSTEROID ABSORPTION POST LUNG TRANSPLANTATION

Seale H, Scott A, Tam R, Kear L, Potter J, Williamson S and Morton J

The Prince Charles Hospital, Brisbane

Case report: A 38-year-old female underwent bilateral single sequential lung transplantation for progressive idiopathic pulmonary fibrosis. Pre-operative FEV_1 was 0.77L (25% predicted) and 6min walk test 260 metres. Her pre-transplant course was complicated by moderate proximal myopathy and intercostal muscle weakness. Mid expiratory pressure (MEP) was 58.3 cmH_2O (59% predicted). This developed on maintenance prednisolone of 10mg daily, with cyclosporin used as a steroid sparing agent. Immunosuppression was maintained on tacrolimus and prednisolone. Her subsequent course was complicated by bronchiolitis obliterans, worsening intercostal muscle weakness and bilateral lung tissue herniation (anterior rib spaces) requiring surgical correction. Cough was ineffective with poor expiratory effort due to alteration in chest wall mechanics. She was unable to tolerate non-invasive positive pressure ventilation or positive expiratory pressure devices. Rehabilitation was ineffective. Best post-transplant spirometry occurred at one month (FEV_1 1.65L). An area under the curve (AUC) analysis of her prednisolone demonstrated absorption to be three times the actual dosage of 7.5mg at 13 months post-transplant, explaining the persistent and evolving complications. Weaning prednisone to 5mg was associated with hypoadrenal crises. Finer adjustments were unsuccessful. Her clinical course deteriorated with progression from chronic chest sepsis. Death from respiratory failure occurred 17 months post-transplantation. **Discussion:** This case demonstrated the potential clinical usefulness of AUC measurements for corticosteroids, from a medical and physiotherapeutic perspective. Identifying patients pre-transplantation with supra-normal prednisolone absorption may assist in predicting poorer outcomes following surgery, and developing greater individualised exercise and rehabilitation programs. Further evaluation in this area is required.

STATE OF THE ART PAPER

ICU MANAGEMENT

Kathy Stiller

Royal Adelaide Hospital

This presentation discusses some of the major advances, current practices and controversies in ICU management over recent years, looking at general medical practice and physiotherapy practice.

As far as general medical practice is concerned, there has been an increased recognition of the impact that conditions such as nosocomial pneumonia and acute profound muscle weakness may have on the outcome of ICU patients. There has been further development in the understanding of the pathophysiology associated with the acute respiratory distress syndrome and advancements in its management. Novel nutritional and pharmaceutical approaches are also being developed, and the complex equipment that is synonymous with ICU, such as mechanical ventilators and monitoring devices, continues to evolve.

While physiotherapy is considered to be an integral part of the management of intubated, mechanically ventilated patients in most ICUs, the requirement for all those who work in ICU, including physiotherapists, to provide evidence-based practice is mandatory. The available evidence suggests that while physiotherapy may significantly improve the pulmonary function of ICU patients, it can also cause major haemodynamic and metabolic stress. Physiotherapy does appear to be effective in the treatment of acute lobar atelectasis, but its effectiveness in the management of other pulmonary conditions commonly found in ICU patients is not known.

There is insufficient evidence available to demonstrate whether physiotherapy can prevent pulmonary complications or improve the overall outcome of ICU patients. Considerable controversy remains over which (if any) components of physiotherapy are effective, predominantly because of a lack of evidence. While a lack of research does not necessarily equate to a lack of effectiveness, the role of physiotherapy in ICU will be questioned until it has been shown to improve the longer term and broader outcomes of ICU patients.

Day 2

STATE OF THE ART PAPERS

RESPIRATORY PHYSIOTHERAPY IN NEONATES

Catherine Bagley

Mater Hospital, Brisbane

The role of the respiratory physiotherapist in neonatal intensive care units has evolved since the 1970s from being poorly defined where babies were treated as small paediatric patients and, as such, programs were initiated with little

knowledge of the unique set of conditions and physiological and anatomical characteristics of the population, to being better defined with an increasing emphasis on scientific questioning and accountability in the form of peer review and informed consent.

The majority of babies requiring intensive care are either preterm, have significant congenital abnormalities or are victims of circumstances associated with adverse events occurring during pregnancy and/or delivery or shortly afterwards. Most of these babies require respiratory support in the form of mechanical ventilation or continuous positive airways pressure. Problematic secretions are common and chest physiotherapy is often indicated.

Although some significant short term benefits of active chest physiotherapy, in the form of percussion and/or vibration, such as improvement in oxygenation, reduction of post-extubation collapse and increased clearance of secretions are described, other serious short and long term effects are also noted, such as hypoxaemia, rib fractures and brain lesions. More recently, no adverse effects on intracranial dynamics, no association with brain lesions and no adverse effects on cardio-respiratory function and a protective effect on oxygenation when percussion was performed prior to suctioning have been reported.

Opinion regarding chest physiotherapy for babies in intensive care remains divided. Anecdotal evidence of benefit abounds, however ongoing neonatal audit and research is to be encouraged and supported.

PULMONARY REHABILITATION

Sue Jenkins

Curtin University of Technology and Sir Charles Gairdner Hospital, Perth

Pulmonary rehabilitation is now an accepted part of the management of patients with chronic obstructive pulmonary disease (COPD) and produces improvements in exercise capacity, symptoms and quality of life (QOL). There is evidence that some of the benefits persist well beyond the cessation of a formal program. Whilst most programs provide exercise training, education and measure outcomes, not all include psychosocial/behavioural interventions. The issue of pulmonary rehabilitation for patients with respiratory diseases other than COPD has received less attention.

Evaluation of pulmonary rehabilitation has been assisted by the availability of valid, reliable and sensitive instruments to assess exercise capacity and QOL. In recent years, research has focused on the role of peripheral muscle dysfunction as a contributor to decreased exercise capacity in COPD. Several studies have investigated the importance of precise prescription of exercise intensity to achieve physiologic benefit, however, peripheral muscle strength training has not been extensively studied and the role of respiratory muscle training requires further elucidation.

Within Australia it is estimated that fewer than 1% of

individuals with moderate to severe COPD receive rehabilitation each year. This highlights the importance of predicting individuals who are most likely to benefit from rehabilitation. It would appear that improvements in exercise capacity can be predicted from measures of muscle strength and breathing reserve. Further research is required to determine the minimum effective program in terms of both the specific components and duration.

Education for individuals with respiratory disease is beginning to focus on developing self-management skills. Many health care professionals have received little formal training in developing self-management skills and this is an area requiring attention.

Research in pulmonary rehabilitation has made a significant impact on clinical practice over the last decade, however, a large number of questions remain unanswered.

ORAL PRESENTATIONS

AN AUDIT OF THE INCIDENCE OF POST-OPERATIVE PULMONARY COMPLICATIONS AFTER MAJOR SURGERY AT THE ROYAL ADELAIDE HOSPITAL

Stiller K, Phillips A, Provis K and Wiles L

Royal Adelaide Hospital

Aims: To review the incidence of clinically significant post-operative pulmonary complications (PPCs) and duration of physiotherapy treatment for patients after major surgery. **Design:** Prospective audit. **Subjects:** Patients who underwent major cardiac, thoracic or abdominal surgery at the Royal Adelaide Hospital (RAH) over a two month period. **Methods:** The physiotherapy management of these patients at the RAH consisted of once daily post-operative assessment to detect the presence of a PPC for the first four post-operative days. All patients were, when possible, mobilised by nursing staff within the first two post-operative days. No pre-operative assessment or treatment was provided. Instruction in deep breathing and coughing was given to patients only after thoracic and upper abdominal surgery. The occurrence of PPCs was diagnosed using set clinical criteria by the attending physiotherapist and reviewed with a senior physiotherapist. In addition, the number of days on which the patient received physiotherapy was noted and, if this was more than four days, the reason for this was noted. Results were analysed in a descriptive manner. **Results:** One hundred and fifty-three patients were seen, seven (4.6%) of whom developed PPCs. The highest incidence of PPCs was seen in patients after upper abdominal surgery (7.3%). The majority of patients (64%) received physiotherapy for four or fewer days post-operatively. For virtually all patients who required more than four days treatment, this was for the progression of mobility. **Conclusion:** The current management of these patients at the RAH appears to be effective in terms of the incidence of PPCs.

CLINICAL OUTCOMES AFTER OPEN ABDOMINAL SURGERY - A COMPARISON OF TWO HOSPITALS

Mackay M and Ellis E

The University of Sydney

Aims: To compare physiotherapy outcomes in patients undergoing open abdominal surgery at two hospitals with differing physiotherapy resources. **Design:** Prospective comparative outcomes study. **Subjects:** Sixty subjects aged over 65 years who underwent open abdominal surgery involving manipulation of the viscera. **Methods:** Pre-operative morbidity, demographic measures, type of operation, length of anaesthesia and type of analgesia were recorded. Post-operative outcomes measures included incidence of post-operative pulmonary complications (PPCs), mobility indicators, length of stay, physiotherapy time, number of treatments, physiotherapy interventions and use of additional resources. Statistical analyses included student *t*-tests and Mann-Whitney tests for difference between independent means and chi-squared test for difference in frequencies. **Results:** All 60 subjects completed the study, providing data from 100% of subjects recruited. There was no difference between Hospital A and Hospital B subjects in all pre-operative measures, surgery type or length of analgesia ($p < 0.05$). Subjects at Hospital B had a significantly higher mean number of physiotherapy treatments per subject (17.77 ± 22.02 vs 8.60 ± 6.24 , $p = 0.0310$), time per patient (377.67 vs 498.26 vs 128.00 ± 106.60 min, $p = 0.0006$) and a higher ICU admission rate (40 vs 17%, $p = 0.045$). Subjects at Hospital B, despite having a 60% higher rate of PPCs, scored significantly better on two of the three mobility indicators ($p < 0.05$). **Conclusion:** Significant differences exist in the amount of staffing resources provided to post-surgical patients at these two hospitals. The ICU admission rate appears to be a major influence in resource use. This study demonstrated that caution must be used in comparing physiotherapy outcomes, even in very similar groups, due to the influence of other clinical process factors within hospitals.

THREE MONTH MORTALITY FOLLOWING LUNG VOLUME REDUCTION SURGERY

Munro P, Bailey M, Smith J and Snell G

The Alfred Hospital, Melbourne

Aims: To identify factors predicting three month mortality following lung volume reduction surgery (LVRS). **Design:** Multi-centre, retrospective case series. **Subjects:** Three hundred and thirty-four LVRS patients from 10 centres in Australia. **Methods:** Data were collected and entered onto an Access 97 database. Pre-operative demographics, pulmonary function, exercise tolerance, surgical details and post-operative information were analysed. Descriptive analysis and multivariate logistic regression were performed using SAS. **Results:** Mean age at surgery was 62.5 ± 7 years. Fifty-six-point-four per cent of patients were male. Pre-operatively,

mean FEV₁ was 0.77 ± 0.2 L, mean percentage predicted TLC was $137 \pm 22\%$, mean percentage predicted RV was $249 \pm 68\%$ and mean 6min walk (6MW) 331 ± 108 m. Three month mortality was 8.9%. Factors predicting three month mortality were major peri-operative complications (OR = 13.21; CI 3.397, 51.383; $p = 0.0002$), pre-operative percentage predicted TLC (OR = 1.04; CI 1.002, 1.068; $p = 0.0376$) and pre-operative 6MW (OR = 0.99; CI 0.989, 0.999; $p = 0.0248$). **Conclusion:** In this large series, case selection has removed traditional mortality risk factors for thoracic surgery such as age, PaO₂, PaCO₂ and FEV₁. However, analysis has highlighted the ongoing relevance of peri-operative complications, hyperinflation and 6MW to mortality. Clinical strategies to address these potentially modifiable factors need to be developed and tested.

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DEVELOPMENT OF A PHYSIOTHERAPY PRE-OPERATIVE RISK FACTOR SCREENING TOOL FOR PATIENTS IN A GENERAL SURGICAL UNIT

Scholes R¹, Denehy L², Smith B¹ and Nosworthy J³

¹*St Vincent's Hospital, Melbourne* ²*The University of Melbourne* ³*Iridium Consulting, Melbourne*

Aims: To investigate the clinical uses of a risk factor screening model for patients admitted to a general surgical unit. **Design:** Prospective audit. **Subjects:** Sixty-five patients admitted for elective surgery. **Methods:** Patients were assessed pre-operatively by the physiotherapist using a newly developed clinical assessment tool. They were asked to score patients as low, moderate or high risk for the development of post-operative pulmonary complications (PPCs) based upon the number of pre-operative risk factors present. Scores were classified as low risk (0-2 risk factors), moderate (3-5 risk factors) and high risk (6-9 risk factors). Patients rated as moderate or high risk were to receive post-operative physiotherapy treatment. **Results:** Of the 65 patients, 15 (23.1%) were classified as high, 10 (15.4%) as moderate and 40 (61.5%) as low risk for developing a PPC. The incidence of PPCs was 11.3% (seven patients), of whom 85.7% (six) were classified as high risk and 14.3% (1) as low risk pre-operatively. The length of stay was not significantly different between the three risk categories ($F_{(3,63)} = 1.50$; $p = 0.223$). However, physiotherapists did not adhere strictly to classification guidelines. As a result, the raw risk scores did not always represent the risk classification and this altered results. **Conclusion:** This risk factor model did not have sufficient sensitivity and needs modification. Development of a weighted risk score may overcome this problem and may be more useful for clinicians in identifying high risk patients pre-operatively and in justifying clinical resource allocation in a general surgical unit.

REAL PHYSIOS DON'T COUNT BEANS: AN ARGUMENT FOR MORE QUALITATIVE RESEARCH IN RESPIRATORY PHYSIOTHERAPY

Nicholls D

Auckland University of Technology, New Zealand

Aims: There is a plethora of quantitative research in respiratory physiotherapy. This paper argues that physiotherapists should engage in more qualitative research. Using data from the author's own work, the presentation explores how qualitative research can improve patient care. **Background:** While other health professionals, eg nurses, occupational therapists and psychologists, have explored the merits of qualitative research, physiotherapists have been slow to investigate the potential benefits of qualitative research. By the nature of their training, physiotherapists are encouraged to analyse the pathophysiological causes of illness. This approach to physiotherapy management could be criticised because: it assumes that a pathophysiological cause for illness always exists; it presupposes that the causes of illness can be known; it fails to address the ongoing, incurable problems of chronic illness; and it portrays suffering as an organic dysfunction rather than a human experience. This is particularly relevant for rehabilitation of people with chronic respiratory disease, whose illness is normally a mixture of social, psychological and physical phenomena. Qualitative research can be used to explain why people with similar pathophysiology present with differing clinical pictures. **Discussion:** This presentation highlights the difficulties with quantitative research methods in respiratory physiotherapy practice. A qualitative research approach (phenomenology) to chronic breathlessness will be explored, and its relevance to practice demonstrated.

ALIGNING CARDIOTHORACIC PHYSIOTHERAPY SERVICES WITH HEALTH CARE NEED: HEALTH CARE REFORM IN HONG KONG

Dean E and Jones A

The Hong Kong Polytechnic University

In 1997, a review of the health care system in Hong Kong by the School of Public Health of Harvard University resulted in recommendations to restructure the health care delivery system to better meet the needs of the population. The "Lifelong Investment in Health", the template for health care reform, outlines several priorities that are consistent with contemporary definitions of the cardiothoracic area of physiotherapy practice. Comparable with other industrialised countries, the leading causes of morbidity and mortality in Hong Kong include heart and circulatory conditions (ie heart attacks, high blood pressure and stroke), smoking-related illnesses (ie lung cancer, emphysema, bronchitis, and pneumonia), and diabetes with its life threatening complications. **Aims:** Based on the analysis of secondary data from the Department of Health, this paper presents discrepancies between current health care needs and economic trends in Hong Kong, and the number of physiotherapists in the cardiothoracic area of practice, and those in other specialties with expertise in this area of practice. Short and long-term initiatives to better serve the

people of Hong Kong, based on advances in cardiothoracic physiotherapy, are also described. **Results and Conclusion:** Compared with other industrialised countries, Hong Kong has proportionately 33% of the number of physiotherapists with fewer than 10% practising in the cardiothoracic area, which belies the prevalence of cardiovascular and pulmonary conditions. Initiatives at the level of the professional association, Department of Health and Hospital Authority, and clinician are proposed; and the impact of advances in the West, such as direct patient access are discussed.

MANUAL HYPERINFLATION: THE EFFECTS OF VARYING THE FRACTION OF DELIVERED OXYGEN

Patman S¹, Winship P¹, Goard L¹ and Blackmore M²

¹Royal Perth Hospital ²Curtin University, Perth

Aims: To examine the effect of varying the fraction of delivered oxygen (FDO₂) during manual hyperinflation (MH) on lung compliance (C_L) and arterial oxygenation (PaO₂). **Design:** Randomised, within subjects repeated measures, single factor. **Subjects:** Thirty-two intubated, mechanically ventilated subjects making no spontaneous respiratory effort. **Methods:** Subjects were studied twice, at an interval of four hours. Subjects were randomised to firstly receive MH with either an FDO₂ of 1.0 (Group 1) or as per their current ventilator setting (Group 2). Baseline measures of C_L and arterial blood gases (ABGs) were taken prior to MH. An experienced physiotherapist, using a Mapleson-B manual resuscitation circuit with an Irwin valve, delivered MH for four minutes. Repeated measures of C_L and ABGs were recorded for one hour post-MH. At the second testing period, subjects received MH with the alternate level of FDO₂. Repeated measures ANOVAs were performed. **Results:** No significant difference in C_L post MH was found. Mean increases in PaO₂ of up to 100mmHg (86%) were recorded post-MH ($p < 0.001$) for both groups. A difference in PaO₂ between groups for up to 20 minutes post-MH ($p = 0.029$) was noted. No differences in heart rate, mean blood pressure or arterial carbon dioxide pressure were recorded following MH. **Conclusion:** The use of MH does not adversely affect haemodynamic status or arterial carbon dioxide pressure in stable, mechanically ventilated subjects. Significant improvements in PaO₂ occurred with MH. The magnitude and duration of improvements was significantly greater with an FDO₂ of 1.0. The clinical implication of this improvement is unclear.

CLOSED VERSUS PARTIALLY VENTILATED ENDOTRACHEAL SUCTION IN PRETERM NEONATES UNDER BIRTH WEIGHT OF 1000 GRAMS: PHYSIOLOGIC CONSEQUENCES

Tan A¹, Gomez J¹, Rajadurai V¹, Lin R¹, Mathews J¹, Williams M² and Paratz J³

¹KK Women's and Children's Hospital, Singapore ²University of South Australia ³Royal Brisbane Hospital

Aims: Endotracheal suction is a necessary but potentially hazardous procedure to maintain patent airways in intubated patients. Suction-induced hypoxia and bradycardia are risk

factors associated with haemodynamic disturbance in high risk preterm neonates with immature vasculature and impaired autoregulation. The aim of the study was to compare two endotracheal suction protocols: the partially ventilated (through porthole adaptor) method and closed (Ballard TrachCare) method. **Subjects:** Fifteen intubated and ventilated extremely low birth weight (ELBW) preterm infants < 1000grams. **Design:** Randomised cross-over. **Methods:** Each infant randomly underwent both the partially ventilated and closed method of endotracheal suction within a 24h period. Three sets of partially ventilated and closed method readings were taken on three different days. Outcome measures included the degree of oxygen saturation (SpO₂) drop using pulse oximetry and heart rate (HR) changes using electrocardiogram. All measures were recorded, using a Hewlett Packard monitor and related trending software, during the whole suction procedure and three minutes post-suction or until recovery to baseline. The mean of each measurement's variation from baseline was obtained using SPSS descriptive statistics and analysed using SPSS repeated measures ANOVA. **Results:** Fifteen ELBW subjects completed the study (mean birth weight 689g). Preliminary analysis suggests that there was significantly less reduction in SpO₂ and HR ($p < 0.001$) from baseline associated with the closed method of endotracheal compared with the partially ventilated method. **Conclusion:** Preservation of oxygenation and HR during endotracheal suction in low birth weight neonates appears to favour the closed method of suction.

This study was carried out with research grant from KK Women's and Children's Hospital Research Unit.

CAN EARLY EXTUBATION AND INTENSIVE PHYSIOTHERAPY DECREASE LENGTH OF STAY OF ACUTE QUADRIPLÉGIC PATIENTS IN INTENSIVE CARE? A RETROSPECTIVE CASE CONTROL STUDY

Berney S¹, Stockton K¹, Denehy L² and Berlowitz D¹

¹Austin and Repatriation Medical Centre, Melbourne ²The University of Melbourne

Aims: To determine if early extubation and intensive physiotherapy treatment in quadriplegic patients resulted in a difference in length of stay in an intensive care unit (ICU) compared with matched patients receiving a tracheostomy. To determine if an overnight on-call physiotherapy service for quadriplegic patients was cost effective. **Design:** Retrospective case control study. **Subjects:** Fourteen acute quadriplegic patients admitted to ICU at the Austin and Repatriation Medical Centre. **Methods:** Seven patients who did not require a tracheostomy were identified. Case controls were matched for severity with seven patients who did receive a tracheostomy. Length of stay in ICU, days from injury to fixation and the number of overall respiratory and night physiotherapy treatments were recorded. A night physiotherapy treatment occurred between 2100-0800 hours. Data were compared using independent *t*-tests and the Mann Whitney U statistic. The level of significance for both tests was set at $p = 0.05$. **Results:** In the extubation group, five of the seven patients received overnight physiotherapy treatment for the first three days following extubation. The length of

stay of this group in ICU was significantly less than the patients who were tracheotomised ($p = 0.02$). The reduction in cost from the reduced length of stay was greater than the cost of the overnight physiotherapy service. **Conclusion:** The results suggest that if extubation is undertaken for suitable patients the length of stay in ICU can be significantly reduced. This represents a considerable cost saving for ICU and more than covers the added cost of providing an after hours on-call physiotherapy service.

HAEMODYNAMIC EFFECTS OF MANUAL HYPERINFLATION

Paratz J^{1,2}, Lipman J², McAuliffe M² and Rickard C²

¹The University of Queensland ²Royal Brisbane Hospital

Aims: This study aimed to measure haemodynamics, respiratory mechanics and catecholamines during manual hyperinflation (MHI). **Design:** A pre/post design. **Subjects:** Part I – 16 ventilated subjects (mean SD age 65.9 ± 13.9 years). Part II – seven ventilated subjects (67.5 ± 5.2 years). **Methods:** In Part I, MHI was performed with a Mapleson 'C' circuit, 2L reservoir bag, with peak inspiratory pressure standardised to 30mmHg and positive end expiratory pressure to 5cmH₂O. Measurements of arterial and pulmonary artery pressure were recorded every minute. Pulmonary artery occlusion pressure (PAOP), cardiac output (CO) and arterial blood gases were recorded immediately before and after MHI. From this, systemic vascular resistance index (SVRI), oxygen delivery (DO₂) and PaO₂/FIO₂ ratio were calculated. Tidal volume, mean airway pressure and dynamic compliance (C_{dyn}) were recorded on a Ventrak™ respiratory mechanics monitor. In Part II, in addition to the above measurements, continuous cardiac output measurement (CCO) (Vigilance™) were taken and an assay of noradrenaline and adrenaline performed pre- and post-MHI. **Results:** All subjects completed the study providing data from 100% of measure outcomes. An ANOVA demonstrated no significant changes in PAOP or CO in Part I. There were significant increases in DO₂ ($p < 0.01$), SVRI ($p < 0.01$), diastolic arterial pressure (DAP) ($p < 0.05$) and C_{dyn} ($p < 0.01$). Part II demonstrated a trend towards a decrease in CCO during MHI and an increase in DO₂ ($p < 0.01$), SVRI ($p < 0.02$), DAP ($p < 0.05$) and C_{dyn} ($p < 0.05$). There was a significant increase in plasma noradrenaline post-MHI ($p < 0.005$). **Conclusion:** Increases in DAP, SVRI and plasma noradrenaline suggest a sympathetic vasoconstrictive response during the application of increased positive pressure.

Supported by the Physiotherapy Research Foundation.

PATIENT SATISFACTION WITH THE PHYSIOTHERAPY SERVICE IN THE INTENSIVE CARE UNIT

Stiller K

Royal Adelaide Hospital

Aims: To investigate patients' satisfaction with the physiotherapy service provided to them while in the intensive care unit (ICU). **Design:** Retrospective survey. **Subjects:**

Twenty-eight patients who spent at least two weeks in the Royal Adelaide Hospital ICU, and who were conscious and orientated for at least two weeks of this time, participated in the study. **Methods:** Within a few days of transfer from ICU, each eligible patient was given a questionnaire which he/she completed independently or with their relatives' assistance if necessary. If patients received treatment from more than one physiotherapist they were asked to make comments relevant to the physiotherapist seen most frequently or else to tick more than one box. Areas addressed included whether the physiotherapist explained the reasons for assessment/treatment and the physiotherapist's manner (eg degree of friendliness, courtesy, thoroughness, respectfulness). Patients were also asked to provide up to three things they liked and disliked about the physiotherapy service in ICU. Patient confidentiality was assured. Results were analysed in a descriptive manner. **Results:** Twenty-five of the 28 patients surveyed over approximately a two year period clearly remembered their physiotherapist during their ICU stay. An overwhelming majority were satisfied with the physiotherapy service, with positive comments received in all areas of the questionnaire. **Conclusion:** A proportion of ICU patients are able to provide information in the important and often neglected area of patient satisfaction. A high level of satisfaction with the physiotherapy service in ICU was seen in this patient sample.

A SURVEY OF NASOPHARYNGEAL AND OROPHARYNGEAL SUCTION USE BY PHYSIOTHERAPISTS

Smith M

Charles Sturt University, Albury

Aims: Evidence supporting the efficacy of nasopharyngeal and oropharyngeal suction in adult patients has not been established. This study aimed to examine current Australian practice and to establish a base for future research. **Methods:** A written questionnaire was posted to 36 Australian hospitals. Physiotherapists with experience in the use of nasopharyngeal and oropharyngeal suction in adult patients were invited to complete the questionnaire. The data collected were analysed descriptively and the researcher was blinded to both the physiotherapist and the hospital. **Results:** One hundred and fifteen physiotherapists from 27 hospitals returned the questionnaire. There were similarities in technique and perceived indications for suction throughout Australia. Respondents rated nasopharyngeal suction and oropharyngeal suction to be equally effective. The most common adverse effects observed have been minor mucosal trauma (88% of respondents) and patient resistance (95%). Serious adverse effects observed included arrhythmias (31%) and death (11%). The respondents expressed more negative than positive feelings towards suction, but indicated that they would perform the technique if necessary. Ninety-seven per cent of respondents indicated that they would suction an unconscious patient, without informed consent, if deemed clinically necessary; 90% would suction if the patient was confused and 28% would suction if the patient was capable of giving consent but refused suction. Learning the technique most commonly occurred when the respondents were students

(52%). Sixty-eight per cent of respondents were assisted/observed twice by an experienced physiotherapist before having to perform the technique independently. **Conclusion:** This survey provides a foundation for future research and raises issues concerning informed consent, teaching and assessment of competency.

This study was funded through a Charles Sturt University Faculty of Health Studies seed grant.

STATE OF THE ART PAPER

CO-ORDINATION OF THE POSTURAL AND RESPIRATORY FUNCTIONS OF THE DIAPHRAGM

Paul Hodges

The University of Queensland and Prince of Wales Medical Research Institute, Sydney

The diaphragm is the principal muscle of inspiration. In addition, the diaphragm also contracts during postural tasks and is thought to provide a critical contribution to spinal stability. This raises a number of important issues. For instance: how are the postural and respiratory functions co-ordinated by the nervous system; how does the diaphragm mechanically contribute to spinal control; and can these functions be co-ordinated when respiratory demand is increased?

We have undertaken a series of neurophysiological and biomechanical studies to investigate these questions. These studies involve recordings from the costal diaphragm in humans using fine-wire intramuscular electrodes inserted into the 7th or 8th intercostals space. In this series of experiments subjects performed single or repetitive shoulder movements to challenge the stability of the spine. Electromyographic (EMG) recordings were also made from a selection of limb, abdominal and paraspinal muscles and recordings were made of gastric and oesophageal pressures. In some trials, end-tidal CO₂ was increased by breathing with an increased dead space and additional studies were undertaken using patients with severe chronic airways limitation. A final study involved electrical stimulation of the diaphragm to measure the affect of contraction on spinal stability. The results confirm that diaphragm EMG activity occurs as a component of the postural response associated with limb movements and provides evidence for how these activities are organised.

An important finding has been that the co-ordination of postural and respiratory activities is compromised when respiratory demand is increased by exercise or disease. Recent studies indicate that the entrainment of respiration and locomotion may simplify this control. These studies have also highlighted the mechanisms for diaphragm contraction to augment spinal stability and have confirmed this in biomechanical studies. This complex interaction between postural and respiratory activity of the diaphragm has important implications for patients with spinal pain and respiratory disease.

ORAL PRESENTATIONS

AN EVALUATION OF THE EFFECTIVENESS OF CARDIAC REHABILITATION IN THE MANAGEMENT OF PATIENTS WITH HEART FAILURE

Bray C, Sindone A, Baker V, Partridge J, Smith M, Colley S, Webber D, Cohen P, Thompson C, Keogh A and Sammel N (Tallis M)

St Vincent's Hospital, Sydney

Aims: Having previously demonstrated that patients awaiting lung transplantation can improve exercise capacity and muscle strength, we developed an exercise program to improve the physical condition of patients awaiting heart transplantation. Clinical application of this program suggested outcomes would be consistent with published studies in heart failure. This study was developed to assess the effect of a randomised, controlled trial of cardiac rehabilitation on heart failure patients. **Subjects:** The study assessed the effects of a structured exercise program on patients with moderate to severe left ventricular failure (ejection fraction of less than or equal to 30%). Seventy-nine patients were recruited from the outpatient cardiac clinic and randomised to one of three groups: control ('standard' medical management); exercise; or exercise and psychological intervention. **Methods:** Maximal stress test (including VO_2 max), according to the Naughton Protocol, and 6min walk test, right heart catheterisation, serum lactate levels and quality of life questionnaires were performed and applied. Exercise training involved weekly supervised, gymnasium-based exercise and a daily home program. Each session consisted of four components: education, endurance training, weight training and prescription of an individualised home program. **Results:** Training resulted in a significant increase in time exercised on the Naughton Protocol ($p < 0.0001$) and 6min walk distance ($p < 0.009$). We further found clinical trends such as decreased trunk girth measurements, increased girth of upper leg and upper arm and increased exercise tolerance on gymnasium equipment. **Conclusion:** Appropriately prescribed exercise training in heart failure patients is safe, well tolerated and improves exercise capacity.

This research was funded by the National Heart Foundation.

IS THERE A RELATIONSHIP BETWEEN UPPER LIMB STRENGTH AND UPPER WORK CAPACITY IN PATIENTS WITH CHRONIC AIRFLOW LIMITATION?

Isedale M¹ and Alison J^{1,2}

¹The University of Sydney ²Royal Prince Alfred Hospital, Sydney

Aims: The aim of the study was to determine whether there was a relationship between upper limb strength and upper limb work capacity in patients with chronic airflow limitation (CAL). **Methods:** Subjects with mild to severe CAL were

recruited for this single group design study. All subjects had measurements of spirometry, lung volumes and upper limb strength (hand-held dynamometer). Subjects performed incremental arm cranking to peak work capacity (supported arm exercise [SAE]) and incremental unsupported arm exercise (UAE), randomly assigned. The VO_2 , VCO_2 , V_E , V_T and frequency of breathing were recorded throughout the tests. Data were analysed using correlation, multiple regression and paired sample *t*-tests. **Results:** Fourteen patients with CAL completed the study. The mean (SD) $FEV_1 = 1.2 \pm 0.5L$, $FEV_1/FVC = 48 \pm 9\%$, $FRC = 142 \pm 27\%$ predicted, $RV = 175 \pm 51\%$ predicted. There was a significant correlation between upper limb strength and peak oxygen consumption (VO_{2peak}) ($r = 0.803$, $p < 0.001$) and between FEV_1 and VO_{2peak} ($r = 0.775$, $p < 0.001$) for SAE. Upper limb strength combined with FEV_1 was able to predict 82% of the variance seen in VO_{2peak} for SAE. Data from UAE showed a significant correlation between upper limb strength and VO_{2peak} ($r = 0.79$, $p < 0.001$) and between FEV_1 and VO_{2peak} ($r = 0.56$, $p < 0.039$). Upper limb strength was only predictive of 25% of the variance in VO_{2peak} for UAE. **Conclusion:** Strength is an important contributor to upper limb work capacity, especially SAE. Further research is needed to determine whether an upper limb strengthening program would improve upper limb work capacity in CAL.

DEVELOPMENT OF AN OUTCOME MEASURE FOR UPPER LIMB FUNCTION IN PATIENTS WITH CHRONIC OBSTRUCTIVE PULMONARY DISEASE

Hill C, Denehy L, Nosworthy J and McDonald C

The University of Melbourne

Aims: To establish the reliability and validity of an outcome measure (grocery shelving task – GST) of upper limb function in chronic obstructive pulmonary disease (COPD). **Design:** Test retest reliability and correlation. **Subjects:** Twelve patients with moderate to severe COPD (FEV_1 median 0.74L, range 0.47-1.65) from the pulmonary rehabilitation waiting list at a tertiary teaching hospital. **Methods:** All patients completed a modified version of the Chronic Respiratory Questionnaire (CRQ), which included an upper limb dyspnoea section. Patients performed the standardised GST, placing the contents of two bags, each containing 10 items weighing 410g, on a shelf 15cm above shoulder height. Patients repeated the test three times after practice testing; the average time taken was used in data analysis. Testing for the GST and modified CRQ was repeated after six weeks without intervening exercise. Data for the GST and CRQ from the first and repeat test times were analysed for test retest reliability using the intraclass correlation coefficient (ICC) and Spearman's rho. Time taken for the GST was correlated with the modified CRQ at baseline and after six weeks using Spearman's rho. **Results:** Test retest reliability of the GST was high (ICC = 0.98). Correlation with the CRQ was moderate to poor at Time 1 and Time 2 (rho = -0.51, -0.29). Reliability of the modified CRQ was high (rho = 0.78). **Conclusion:** Results suggest the GST is a reproducible outcome measure for upper limb function in patients with COPD. Further investigation is required to establish validity.

USE OF THE INCREMENTAL SHUTTLE WALK TEST FOR EXERCISE PRESCRIPTION IN PATIENTS WITH CHRONIC OBSTRUCTIVE PULMONARY DISEASE

Cecins N¹ and Jenkins S^{1,2}

¹Sir Charles Gairdner Hospital ²Curtin University of Technology², Perth

Training patients with chronic obstructive pulmonary disease (COPD) at high intensities (> 60% peak oxygen consumption [VO_{2peak}]) has been shown to improve exercise capacity and reduce ventilation and lactate levels at identical sub-maximal work rates. The incremental shuttle walk test (ISWT) can be used to estimate VO_{2peak} in COPD patients. Exercise intensity can be prescribed as a walking speed at a given percentage estimated VO_{2peak} . **Aims:** To describe the method of prescribing exercise intensity using the ISWT and measure the effect of training at this intensity on exercise capacity in patients with COPD. **Subjects:** Twenty-two patients (12 males) with COPD. Mean (SD) age and FEV_1 were 65.5 (8.4) years and 1.03 (0.43), 40.2 (13.7) percentage predicted. **Methods:** The ISWT was conducted using a standard protocol prior to and following an eight week out-patient exercise program. Exercise intensity was prescribed by setting a walking speed equivalent to 70% estimated VO_{2peak} calculated from the ISWT. Patients were given a target distance to walk in 20 minutes to achieve this walking speed. The program was supervised at least once per week and patients were advised to exercise three times per week. **Results:** The distance walked on the ISWT increased significantly following the eight week program, mean (SD) distances pre- and post-program were 350 (125.6)m and 405 (125.2)m respectively ($p < 0.001$). The walking speed achieved by the patients at the end of the program was equivalent to 80% estimated VO_{2peak} obtained from the post-rehabilitation ISWT. **Conclusion:** The ISWT can be used to prescribe exercise intensity in patients with COPD. Further research is required to establish the intensity required for maximum benefit.

PULMONARY REHABILITATION: APPLICATION OF VIDEO-CONFERENCE – A PILOT PROGRAM

Rowe S¹, Cafarella P² and Johns J¹

¹Noarlunga Health Services, South Australia ²Repatriation General Hospital, Adelaide

Aims: To assess the viability of video-conferenced pulmonary rehabilitation education sessions. **Design:** Observational. **Subjects:** Eight patients with varying severity of chronic obstructive pulmonary disease (COPD) and three carers. **Methods:** The Repatriation General Hospital (RGH) conducted video-conferenced lectures at Noarlunga Health Services (NHS), 25 kilometres away. The program at NHS consisted of an introductory session, followed by eight weekly video-conferenced education sessions and an on-site exercise program. A NHS employee supervised the video-conferenced sessions. Evaluation of the video-conference approach included a NHS staff evaluation (written

questionnaire) and subject evaluation (written questionnaire and focus group). **Results:** Five subjects reported video-conferencing as a good learning environment. Subjects reported that the service was convenient, accessible and reduced fatigue level, as it was closer to their residence, thus reducing travel time to RGH. Four subjects found it essential to have staff support at NHS for technical issues. Challenges with using the video-conferencing equipment included successful connection (80% of the sessions), poor sound quality and average picture quality. Initial set-up costs at NHS were \$3508 and projected maintenance costs for future programs is \$855 per program. Additional costs at RGH were \$200 for line usage. Comparatively, it is estimated that there is a minimum 11% cost saving using video-conferencing compared with a traditional face-to-face presentation. **Conclusion:** Preliminary results suggest that video-conferenced pulmonary education sessions are a viable means of service delivery in terms of feasibility and cost effectiveness. The cost effectiveness may be further demonstrated when the video-conference is provided to rural and remote areas.

Acknowledgment to Allied Health team at NHS and the Respiratory Unit at RGH.

LEFT VENTRICULAR ASSIST DEVICE AND PHYSIOTHERAPY

Tallis M, Colley S and Bray C

St Vincent's Hospital, Sydney

Aims: The left ventricular assist device (LVAD) has become accepted as an option for appropriate candidates as a successful bridge to cardiac transplantation (CTx). Physiotherapy intervention is directed towards achieving maximal physical condition and a return to daily activities. This presentation details exercise prescription for a patient with an intra-aortic balloon pump (IABP) and LVAD. **Design:** Case study. **Subject:** A thirty-seven-year-old year old male with a LVAD and a history of congestive cardiac failure (NYHA IV) which became stable on IABP and inotropes but resistant to weaning. **Procedure:** Physiotherapy commenced with the patient on an IABP. Due to the bed restriction, a muscle-strengthening program consisting of upper limb free weights and lower limb exercises and thoracic mobility and muscle stretching exercises was established. The subject was sitting out of bed day one post-LVAD and was mobilising 520 metres within one week. At 12 days, the patient was exercising in the gym with a program including treadmill, stationary bike and lower and upper limb weights. Arm endurance was highlighted due to the need to manually hand pump the LVAD for lengthy periods at a time if there is a malfunction. On discharge, the patient was given a home exercise program and is reviewed by the physiotherapy team monthly. **Conclusion:** Our experience has shown that it is safe and profitable to exercise LVAD patients early and aggressively. In comparison with medically managed heart failure patients, LVAD and exercise conditioning appears to result in improved musculoskeletal condition and the ability to return to work and most daily activities.

THE EFFECTS OF STANDARD (WITH HEAD DOWN TILT) AND MODIFIED (WITHOUT HEAD DOWN TILT) POSTURAL DRAINAGE POSITIONS ON OXYGEN SATURATION AND HEART RATE IN NEWLY DIAGNOSED INFANTS WITH CYSTIC FIBROSIS

Button B^{1,2,3}, Heine R², Catto-Smith A³, Olinsky A², Phelan P² and Story I¹

¹The University of Melbourne ²Royal Children's Hospital, Melbourne ³The Alfred Hospital, Melbourne

Normal infants less than six months old experience intermittent oxygen desaturations. Some studies have recorded oxygen desaturations during postural drainage in older patients with cystic fibrosis (CF). Newborn screening results in infants with CF commencing physiotherapy at around two months. **Aims:** To measure the effects of four standard postural drainage positions including head down tilt (SPT) compared with four modified postural drainage positions excluding tilt (MPT) on oxygen saturation (SpO₂) and heart rate (HR) in newborn infants with CF. **Methods:** SpO₂ (%) and HR (bpm) were measured during two sessions of MPT and two sessions of SPT in 20 infants with CF on consecutive days using oximetry (Nellcor Symphony N-3000 Pulse Oximeter). Measurements were made before each MPT and SPT session (resting measurements) and after each of the four 8min cycles of percussion and vibration comprising each session (treatment measurements) during 2min pauses between each change in position. The SPT consisted of supine horizontal, prone, left and right side lying each with 30 degree head down tilt. MPT consisted of supine 30 degree head up tilted, prone left and right side lying horizontal. **Results:** The mean age of the 20 infants was 2.1 months. The mean SpO₂ ± SD for MPT sessions were: resting 97.65 ± 1.49 and treatment 98.75 ± 1.07 (range 94-100) and for SPT 98.28 ± 1.40 and 98.54 ± 1.60 (93-100) respectively. The mean resting vs treatment HR measurements for MPT sessions were: 140.65 ± 15.62 and 139.19 ± 8.61 (103-164) vs SPT 140.70 ± 8.93 and 141.97 ± 11.48 (114- 171). **Conclusion:** Asymptomatic infants with CF tolerated SPT and MPT relatively well. There were no significant differences between SPT and MPT regimens, nor were adverse events recorded.

Funded by research grants from the Physiotherapy Research Foundation and the Royal Children's Hospital Research Foundation.

THE EFFECTS OF EIGHT DIFFERENT WIDELY USED STANDARD AND MODIFIED POSTURAL DRAINAGE POSITIONS AND STATES OF AROUSAL INCLUDING NON-NUTRITIVE SUCKING, CRYING AND SLEEP ON GASTRO-OESOPHAGEAL REFLUX IN NEWBORN INFANTS WITH CYSTIC FIBROSIS

Button B^{1,2,3}, Heine R², Catto-Smith A³, Olinsky A², Phelan P² and Story I¹

¹The University of Melbourne ²Royal Children's Hospital, Melbourne ³The Alfred Hospital, Melbourne

Gastro-oesophageal reflux (GOR) occurs in cystic fibrosis (CF) and is sometimes associated with postural drainage.

Non-nutritive sucking (NNS), crying (C) and falling asleep (FA) are common during infant chest physiotherapy (CPT). **Aims:** To determine which standard (SPT) and modified physiotherapy (MPT) positions are associated with increased episodes of GOR; and whether NNS, crying or falling asleep increase GOR. **Methods:** Twenty newborn infants with CF undertook two sessions each of SPT and MPT on consecutive days during oesophageal pH monitoring. The SPT consisted of supine horizontal [S-], prone [P-30 degrees], left [LSL-30 degrees] and right side lying [RSL-30 degrees] each with 30 degrees head down tilt. MPT consisted of supine 30 degree head up tilt [S+30 degrees], prone [P-], left [LSL-] and right side lying [RSL-] all horizontal. The number of reflux episodes (NRE) and state of arousal (SOA) was recorded during each different position including: asleep; asleep+NNS; awake; awake+NNS; crying. The proportion of reflux or reflux ratio (RR) was calculated for each SOA. **Results:** The NRE for SPT was significantly higher than MPT; $p = 0.029$. The NRE during MPT positions vs SPT were: [S+30 degrees] = 12 episodes vs [S-] = 20 episodes, $p = 0.067$; [P-] = 9 vs [P-30 degrees] = 18, $p = 0.03$; [RSL-] = 9 vs [RSL-30 degrees] = 13, $p = 0.45$; [LSL-] = 11 vs [LSL-30 degrees] = 7, $p = 0.59$. The RR for MPT vs SPT were: asleep = 1.00 vs 1.20; asleep+NNS = 0.60 vs 0.41; awake = 1.31 vs 1.59; awake+NNS = 1.28 vs 0.88; crying = 0.64 vs 1.15. The higher the value, the greater the proportion of reflux. **Conclusion:** There was significantly more reflux during SPT than MPT positions. Sleep and NNS were not associated with an increased GOR during CPT.

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BUBBLE PEP – THEORY AND PRACTICE

Thomas P¹ and Thomas N²

¹Royal Brisbane and Royal Women's Hospital, Brisbane ²Royal Children's Hospital, Brisbane

Aims: To determine the levels of positive expiratory pressure (PEP) generated from various constructs of bubble PEP and produce guidelines that will allow standardisation in its use. **Design:** Randomised trial. **Methods:** Tubes of four different diameters were cut at lengths of 30, 40 and 50 centimetres. Constant gas flow rates of five, 10, 15 and 20 L/min were directed individually through these tubes, which were placed in water of depth five, 10 and 15 centimetres. A Ventrak respiratory mechanics monitor recorded the positive pressure generated from each circuit. Flow rates were then adjusted to attain positive pressure levels of 5, 10, 15 and 20cmH₂O. These results allowed selection of circuits that might be useful and practical in the clinical situation. Five normal adult subjects then completed two minutes of normal tidal volume breathing and two minutes of PEP therapy with a pressure range of 15-20cmH₂O, using selected bubble PEP circuits and an Astra PEP circuit, randomly. The Ventrak monitor recorded tidal volume, respiratory rate, inspiratory:expiratory ratio, expiratory and mean airway pressure. Analysis of variance was used to compare bubble PEP with tidal volume breathing

and Astra PEP application. **Results:** Standardised bubble PEP circuits can be used to generate ranges of PEP between five, 10, 15 and 20cmH₂O. Further data analysis on the comparison of normal tidal volume breathing, bubble PEP and Astra PEP is currently being analysed. **Conclusion:** Therapists can construct bubble PEP circuits from readily obtained, inexpensive materials that will allow them to generate a predetermined range of PEP.

INTERMITTENT POSITIVE PRESSURE BREATHING: A SURVEY OF CLINICAL PRACTICE

Lewis D and Pilgrim E

Royal Hobart Hospital

Aims: To determine clinical practice in the use of intermittent positive pressure breathing (IPPB) throughout Australia as part of an evidence-based practice project within a physiotherapy department. **Methods:** A national telephone survey was conducted of 31 hospitals. The survey investigated: the utilisation of IPPB, the reasons for use or non-use of IPPB, evidence for utilisation or non-utilisation of IPPB, mode of delivery, gases delivered, referral source, criteria for ceasing treatment and outcome measures used. **Results:** Fifty-five per cent of hospitals utilised IPPB. Of those which did not use IPPB, 64% did have the equipment available and 64% stated that staff lacked knowledge about how to use IPPB. Other reasons cited for non-use were 'other adjunct preferred' and perceived 'lack of clinical efficacy'. Of those who used IPPB, 29% had reviewed their clinical practice and 35% had undertaken a review of the literature. The most frequently cited criteria for intervention were atelectasis/consolidation, poor breathing pattern, reduced air entry and spinal cord injury. The most frequently cited patient groups that required IPPB were HDU, ICU and general surgery. Fifty-three per cent of hospitals which utilised IPPB measured outcomes that included vital capacity, oxygen saturation, auscultation, chest x-ray, arterial blood gases, peak flows/spirometry and effective cough. **Conclusion:** While IPPB appears to be a commonly used form of intervention by clinicians, there is little evidence available to support or negate the continued use of this type of treatment. Further research needs to be focused on the most suited patient groups, the parameters of delivery and the length of treatment required.

THE EFFECT OF BODY POSITION ON MAXIMUM EXPIRATORY PRESSURES AND PEAK EXPIRATORY FLOW RATES

Badr C¹, Ellis E¹ and Elkins M²

¹The University of Sydney ²Royal Prince Alfred Hospital, Sydney

Maximum expiratory pressure (MEP) and peak expiratory flow rate (PEFR) have been used as surrogate measures of cough and huff strength. Positioning affects lung volumes and muscle-length tension relationships, which are major

determinants of MEPs and PEFRs. **Aims:** To investigate the effect of body positions on MEPs and PEFRs. **Design:** Repeated measures. **Subjects:** Twenty-five subjects with normal respiratory function (NRF) and 11 subjects with chronic airflow limitation (CAL). **Methods:** Repeated measures of MEP and PEFR were taken across seven randomised positions. The positions were standing, chair sitting, upright sitting in bed with the legs straight, 45 degree sitting in bed with the legs straight, supine, left side lying and 20 degree head down tilt in left side lying. After a 5min rest in each position, three MEP and three PEFR recordings were made. **Results:** Data were analysed using ANOVA. In both the NRF and CAL groups, standing MEP and PEFR were significantly higher than in all other positions, while the head down position led to significantly lower results. Chair sitting led to significantly higher MEPs than all other positions (except standing) in both groups. Other significant differences were also seen between positions. The MEPs were not significantly different between the two groups, but PEFRs were significantly higher in the NRF group. **Conclusion:** It is recommended that patients be placed in less recumbent positions in order to improve their MEPs and PEFRs. This may subsequently lead to the production of stronger coughs and huffs.

PREVALENCE OF LOW BACK PAIN IN SUBJECTS WITH CHRONIC AIRFLOW LIMITATION – A PRELIMINARY STUDY

Synnot A and Williams M

University of South Australia

Aims: People with chronic airflow limitation (CAL) have a number of risk factors which may increase the risk of low back pain (LBP). To date, there have been no prospective studies of the prevalence of LBP in people with CAL. The aim of this study was to determine the prevalence of low back pain in people with CAL. **Design:** Cross-sectional observational survey. **Subjects:** People with CAL attending South Australian metropolitan Lung Support groups and their partners. **Methods:** Subjects were surveyed during attendance of a single meeting. Three reliable and validated questionnaires (SF-36, St George's Respiratory Questionnaire and the Nordic Low Back Pain Questionnaire) collected ratio and categorical data on general health and wellbeing, respiratory health and prevalence of LBP, respectively. Odds ratios were used to examine the relative risk of LBP in the CAL and carer samples, using EpiInfo Version 6.0. **Results:** Sixty subjects completed this study (41 CAL subjects, 19 carers). Lifetime, 12 month and seven day prevalence of LBP in the CAL sample was 69%, 58% and 31% respectively. The carers were found to have a higher prevalence of LBP. No other differences were evident between CAL and carers. A number of significant relationships were demonstrated between indices of perceived general health and respiratory health and the impact of LBP. **Conclusion:** The prevalence of LBP in both the CAL subjects and their carers was higher than the older general population. The unexpected finding of higher prevalence for carers suggests that this group warrants closer investigation.

Day 3:

STATE OF THE ART PAPERS

CARDIAC REHABILITATION

Helen McBurney

La Trobe University, Melbourne

Cardiovascular disease continues to be the leading cause of morbidity and mortality in Australia. Whilst death rates due to cardiac disease have declined, improved treatments have ensured that numbers of patients with cardiac disease and survivors of cardiac events have increased.

Comprehensive cardiac rehabilitation (CR) services have recently been shown to be reducing cardiac mortality by 31%. Outpatient CR services in Australia are provided by more than 260 programs. The provision of supervised exercise programs and education in relation to physical activity are perceived as the areas of specific expertise of the physiotherapist. Challenges for physiotherapists in the provision of CR services are many. Current services provide only for those who are willing and able to attend. This means that more than 60% of patients currently receive no services. Alternative models of CR program delivery are urgently needed. There has been an expansion of the need for CR services. The elderly and those with heart failure can improve their fitness with an exercise program. Resistance exercise can be used to improve muscular strength in cardiac patients without compromising safety.

Current low cost CR programs have been very successful, but are limited by their lack of funding to provision of baseline rather than best practice services. A lack of outcome data is inhibiting any demonstration of effect and without this, it is unlikely CR services will be funded for growth. What and how to measure, the timing, interpretation and utilisation of measures are current challenges. The provision of exercise services within CR by physiotherapists is being challenged by exercise physiologists. If such services are perceived as minimal, this may be our downfall and must be rectified for physiotherapy to retain input in this expanding area of health service provision.

THE PHYSIOTHERAPIST AND MASK VENTILATION

Amanda Piper

Royal Prince Alfred Hospital, Sydney

Non-invasive mask ventilation is becoming an increasingly used therapy in patients with both acute and chronic respiratory failure. Used initially in the home setting to control nocturnal respiratory failure in patients with neuromuscular and chest wall disorders, mask ventilation is now frequently used in managing patients with acute respiratory failure in the hospital setting. A number of randomised controlled trials have demonstrated the effectiveness of non-invasive ventilation in avoiding the need

for intubation, reducing the work of breathing and reducing the length of hospital stay.

Whether in the acute or chronic setting, the success of the technique depends greatly on the skill and experience of the staff in assessing the ventilation needs of the patients, setting the equipment appropriately and training the patient in its use. Cardiothoracic physiotherapists, with their skills and knowledge base, are well positioned to be involved in the initiation and ongoing management of mask ventilation. Many physiotherapists are already familiar with the use of positive pressure therapy in the form of intermittent positive pressure breathing and continuous positive airway pressure. However, non-invasive mask ventilation offers advantages over either of these techniques, and therapists need to be familiar with both the theory and practicalities of this technique in order to be an effective part of the global management of patients with respiratory disease. In this presentation, the findings from recent studies will be used to illustrate key issues pertinent to physiotherapists and their role in caring for patients requiring mask ventilatory support.

ORAL PRESENTATIONS

ECONOMIC EVALUATION IN PULMONARY REHABILITATION – IS IT AS DIFFICULT AS WE THINK?

McCann K¹, Denehy L², Hawthorne G², Campbell D³ and Nosworthy J⁴

¹Western Hospital ²The University of Melbourne ³Royal Melbourne Hospital ⁴Iridium Consulting, Melbourne

Chronic obstructive pulmonary disease (COPD) affects 9.7% of the population over the age of 45 years. Within Victoria alone, there are approximately 10,000 hospital admissions per annum related to the management of this disease. Although there is good evidence to demonstrate that a period of pulmonary rehabilitation improves exercise tolerance and health related quality of life in patients with COPD, there is little evidence investigating the impact that pulmonary rehabilitation has on health care utilisation. **Aims:** To demonstrate the value of economic evaluation in assessing the financial and health benefits of pulmonary rehabilitation. **Design:** Randomised controlled trial. **Subjects:** Thirty patients with COPD undertaking a community-based pulmonary rehabilitation program. **Methods:** Subjects were asked to complete a weekly diary specifically designed to record information on medical and pharmaceutical costs, patient and family costs and community services costs associated with their chronic condition. In addition to data on pharmaceutical use and medical payments provided by the Health Insurance Commission, an economic evaluation will be conducted using the information obtained from these diaries. **Results:** This paper will introduce and explain the principles of economic evaluation using data from this study as examples. In particular, areas to be considered include describing the cost of the burden of illness and treatment, the measurement of service outcomes and the type of economic analysis which may be undertaken.

EVALUATION OF AN EDUCATION PROGRAM FOR PATIENTS WITH CHRONIC OBSTRUCTIVE PULMONARY DISEASE

Cecins N¹ and Jenkins S^{1,2}

¹Sir Charles Gairdner Hospital, Perth ²Curtin University of Technology, Perth

Pulmonary rehabilitation aims to reduce symptoms, decrease disability and improve the quality of life of individuals with chronic lung disease. To achieve these goals a multi-disciplinary program that includes exercise training, education, behavioural and psychosocial intervention, and outcome assessment is recommended. The benefits directly attributable to the education component are unclear and the topics covered vary. **Aims:** A pilot study was conducted to determine suitable components of a multi-disciplinary education program for individuals with chronic obstructive pulmonary disease (COPD) and their partners, and trial evaluation methods. **Subjects:** Fourteen patients currently enrolled, or who had recently completed, an exercise program and five partners were recruited. **Methods:** Participants were invited to attend nine one-hour sessions. Process, impact and outcome evaluations were undertaken. Process evaluation considered take-up rate, attendance and participant satisfaction. Impact evaluation was measured using the COPD Self-Efficacy Scale (CSES) and the Hospital Anxiety and Depression (HAD) scale. Outcome evaluation focused on health care utilisation. **Results:** Twelve patients (mean[SD] age (67.6[8.6] years and FEV₁ 48.2[23.8] percentage predicted) and five partners attended a mean of 7.2 (range 4-9) sessions. Following the program there was no difference in any of the domains on the CSES. There was a significant decrease in depression ($p = 0.04$) but no difference in anxiety, mean difference (95% confidence intervals) was 2.2(0.1-4.3) and 0.3(-1.9-2.5) respectively. **Conclusion:** Further evaluation is required to determine the sensitivity of the CSES and HAD scale to change following a multi-disciplinary education program and to determine the effect of such a program on health-care utilisation.

EXERCISE PRESCRIPTION FOR A PATIENT WITH A LEFT VENTRICULAR ASSIST DEVICE

Munro P¹, Ntoumenopoulos G¹ and Bradley S^{1,2}

¹The Alfred Hospital, Melbourne ²Monash University, Melbourne

Aims: To assess maximal exercise performance, functional walking capacity and isokinetic lower limb strength in a patient with a LVAD pre- and post- a rehabilitation program, and after heart transplantation, to assist exercise prescription. **Design:** Single case study, repeated measures. **Subject:** A 60-year-old man who had a LVAD (Novacor®) implanted two weeks following myocardial infarction and who was listed for cardiac transplantation. The patient commenced pre-transplantation exercise conditioning classes eight weeks following LVAD insertion. **Methods:** Cardio-pulmonary exercise testing, isokinetic strength testing of quadriceps and hamstrings and 6min walk test were performed two months after LVAD insertion, after rehabilitation and after heart

transplantation. **Results:** Maximum oxygen consumption (VO₂max) and peak and average torque of hamstrings and quadriceps improved with rehabilitation and again following heart transplant. Maximum oxygen consumption improved from a baseline of 15.1ml/kg/min to 15.5 ml/kg/min after rehabilitation and then to 16.8 ml/kg/min post-heart transplant. With the LVAD, the patient demonstrated a respiratory limitation to exercise. This may be due to the space occupied by the LVAD in the thoraco-abdominal cavity. The 6min walk improved from 465m pre-rehabilitation to 617m post-heart transplant. Post-rehabilitation peak and average torque of quadriceps and hamstrings improved from 83% to 210%. Post-heart transplant peak and average torque of quadriceps and hamstrings improved from 4% to 67%. **Conclusion:** Testing facilitated accurate monitoring of cardiopulmonary performance and functional status and assisted in the prescription of exercise in a patient with a LVAD pre-transplantation and then post-heart transplantation.

IMPROVING PHYSICAL FUNCTION AND QUALITY OF LIFE BY ATTENDANCE AT A MULTIDISCIPLINARY REHABILITATION PROGRAM FOR PEOPLE WITH CHRONIC OBSTRUCTIVE PULMONARY DISEASE LIVING IN RURAL COMMUNITIES

Brydon V¹, Cahill E¹, Coffey T¹, Francis J², Miller C¹, Russell J¹ and Simmons V¹

¹Stewart Cowen Community Rehabilitation Centre, Bendigo, Victoria ²La Trobe University, Bendigo

Aims: To determine the effects of a rural pulmonary rehabilitation program over a period of two years. **Subjects:** 149 participants with chronic obstructive pulmonary disease (COPD) with an average age of 69 years. **Methods:** Assessments were carried out prior to and on completion of a 12 week outpatient program. Reassessments were carried out at three monthly intervals thereafter. Assessments included the Chronic Respiratory Disease Questionnaire (CRDQ), 12min walking test, SF 36 Health Status, Mini-nutritional Questionnaire and patient satisfaction surveys. **Results:** A mean improvement in the performance of a standardised field walking test of 26% was recorded upon completion of the program. An improvement of 12% was found two years post-program. Seventy per cent of participants reported a noticeable improvement in their level of general physical activity on completion of the program. After attendance at the program, an average improvement of 22.5% in ease of breathing was measured using the CRDQ, with improvement maintained at two years post-program. Preliminary results suggest a reduction in the number and duration of inpatient hospital admissions post-program. **Conclusion:** The multi-disciplinary model presented is comprehensive and flexible, addressing the issues of both rural communities and health providers. The program does not require specific equipment or facilities and has been shown to be effective in both outpatient rehabilitation and community based settings. Reduction in hospital inpatient admissions observed post-program make this model a cost effective mechanism for the long term management of patients with COPD.

CARDIORESPIRATORY RESPONSES TO FIELD WALKING TESTS AND AN INCREMENTAL CYCLE ERGOMETRY TEST IN PATIENTS WITH MODERATE TO SEVERE CHRONIC OBSTRUCTIVE PULMONARY DISEASE

Jenkins S^{1,2}, Cecins N¹, Allen-Williams S², Eastwood P¹ and Hillman D¹

¹Sir Charles Gairdner Hospital, Perth ²Curtin University of Technology, Perth

The incremental shuttle walking test (ISWT) and the six minute walking test (6MWT) are commonly used as simple alternatives to a laboratory based exercise test in patients undergoing pulmonary rehabilitation. Previous research has shown lower heart rate (HR) and dyspnoea levels with the 6MWT compared with the ISWT, and there are few data comparing responses to field walking tests and a laboratory based incremental cycle ergometry test (CET). **Aims:** A within-subject study design was used to compare HR, oxygen saturation (SpO₂) and dyspnoea responses to the ISWT, 6MWT and CET. **Methods:** Twenty-two patients (17 male) with chronic obstructive pulmonary disease (COPD), mean (SD) age 63.9 (7.2) years and FEV₁ 0.80 (0.30)L, (30.3 [8.9] percentage predicted) were studied. Tests were performed in random order with strong encouragement to maximise performance. Heart rate (Polar monitor) and dyspnoea (Borg 0-10 scale) were measured at one minute intervals during each test. Oxygen saturation was recorded before and immediately following exercise. **Results:** There were no significant differences in peak HR or dyspnoea with the three tests. Peak values for HR (bpm) and dyspnoea were: ISWT - 123.9 (15.0) and 6.0 (2.0), 6MWT - 126.9 (14.0) and 6.2 (2.2), and CET - 124.5 (12.6) and 6.8 (1.8). Oxygen desaturation was more profound following the walking tests. Post-exercise SpO₂ (%) was: ISWT - 86.2 (4.9), 6MWT - 86.5 (5.6) and CET - 91.7 (3.3) ($p < 0.001$). **Conclusion:** With strong encouragement, the 6MWT can provide a degree of cardiorespiratory stress equivalent to that achieved with the ISWT or CET. However, the ISWT and CET have the advantage of enabling within and between subject comparisons at equivalent workloads and exercise prescription based on workload.

THE EFFECT OF RELAXED BREATHING EXERCISE PATTERNS ON RESTING ENERGY EXPENDITURE IN PATIENTS WITH CHRONIC OBSTRUCTIVE PULMONARY DISEASE

Chow CSC¹ and Jones YMA²

¹Caritas Medical Centre, Hong Kong ²Hong Kong Polytechnic University

Patients with chronic obstructive pulmonary disease (COPD) are taught relaxed breathing exercises in an attempt to reduce their work of breathing, which in turn should lower resting energy expenditure (REE). **Aims:** This study investigated the effect of different patterns of relaxed breathing exercises on the REE in patients with stable COPD. **Subjects:** Thirty patients with stable COPD who had completed a pulmonary rehabilitation program. **Methods:** Baseline REE and respiratory rate (RR) during natural breathing pattern were

recorded for 10 minutes by an indirect calorimetric method using breath by breath oxygen and carbon dioxide data, with the patient in the supine position. Subjects were then asked to use, in random order, three previously learned patterns of relaxed breathing exercises (diaphragmatic breathing [DB], pursed-lip breathing [PLB] and a combination of both patterns [CB]) for 10 minutes during which REE and RR were recorded. **Results:** REE during all 'learnt' breathing patterns was lower than the patient's natural breathing pattern, with PLB producing the lowest REE. **Conclusion:** This study showed that PLB, DB or a combination of these two breathing patterns resulted in a lower REE level compared with a natural breathing pattern. Pursed-lip breathing appeared to be the most energy efficient pattern. The lower REE measured during PLB may be as a result of a lower RR and possibly a decreased dynamic hyperinflation ventilatory pattern. Pursed-lip breathing appeared to be the most appropriate technique employed for dyspnoea management in patients with COPD.

MANDIBULAR ADVANCEMENT SPLINT: IMPACT ON OBSTRUCTIVE SLEEP APNOEA AND DAYTIME FUNCTION

Skinner M¹, Robertson C¹, Jones D² and Taylor R¹

¹University of Otago, New Zealand ²Dunedin Hospital, New Zealand

Aims: To evaluate the efficacy of a titratable mandibular advancement splint (MAS) on sleep and daytime function in subjects with obstructive sleep apnoea (OSA). **Design:** Before-after clinical trial. **Subjects:** Adults (n = 14) with mild to moderate OSA diagnosed on the basis of full-night 16-channel polysomnography (PSG) data, at the Tom McKendrick Sleep Laboratory. **Methods:** Initial screening included a standard health questionnaire, anthropometric measures, Epworth Sleepiness Scale (ESS) and lateral cephalometry in the natural head position. Subjects were instructed on how to fit and titrate the MAS prior to sleep during the six to eight week trial. Subjects kept a self-report diary of sleep habits. Polysomnography and cephalometry were repeated when each subject had reached their endpoint - maximal MAS titration and reported improvements in function. **Results:** Polysomnography variables with the MAS in situ significantly improved compared with baseline. Mean number of arousals decreased (37.2-18.5/hour slept, SD 15.4, $p < 0.001$); Apnoea-Hypopnoea Index (AHI) decreased (34.0-9.7/hour slept, SD 20.3, $p < 0.001$); and ESS score also decreased (11.6-5.9, SD 3.8, $p < 0.0001$). There were no correlations between anthropometric measures and severity of AHI. Subject reported compliance with wearing the MAS averaged six hours per night. At review, all subjects reported improvements in their sleep pattern and snore frequency and in freshness on waking and daytime hypersomnolence. **Conclusion:** Conservative management of OSA using a titratable MAS significantly improved OSA and daytime function in the subject group. Physiotherapists should consider asking questions on sleep habits and daytime hypersomnolence when patients report a decline in daytime function and exercise capacity.

Support from the Otago Respiratory Research Trust is acknowledged for assistance with funding for the research.

THE INCIDENCE OF SLEEP DISORDERED BREATHING IS INCREASED FOLLOWING CERVICAL SPINAL CORD INJURY

Berlowitz DJ, Brown DJ, Campbell DA and Pierce RJ

Austin and Repatriation Medical Centre, Melbourne

In previous cross-sectional studies, the prevalence of sleep disordered breathing (SDB) in quadriplegics has been found to be two to five times higher than the general population. The reasons for this increased prevalence are unknown. **Aims:** This study aimed to investigate the evolution of SDB during the first year following acute quadriplegia. **Design:** Prospective cohort. **Methods:** Assessments comprised serial polysomnography (Compumedics™ PS2, Australia) and respiratory function testing (flow-volume loops, maximal inspiratory and expiratory pressures) performed at two weeks, one, three, six and 12 months post-injury. The rate of undiagnosed SDB that may have existed prior to the spinal cord injury was quantified using the Maislin multivariate apnoea prediction equation. Sleep was staged and scored using standard criteria and the presence of SDB was defined as a respiratory disturbance index (RDI) of ≥ 10 events/hour. **Results:** Fifty-nine quadriplegics were admitted to the VSCS during the 18 months of recruitment. Thirty subjects (25 men, median age 30.5, range 17-66 years) fulfilled the inclusion criteria. Three subjects (10%) had a 75% likelihood of undiagnosed SDB prior to the injury. At two weeks, 60% of the quadriplegic subjects had a RDI > 10 , 60% at one month, 82% at three months, 68% at six months and 55% at one year. **Conclusion:** Sleep disordered breathing is present early after cervical spinal cord injury. The incidence peaks at three months following injury at 82%. This is significantly higher than the prevalence in both the general population and in previously described quadriplegic cohorts.

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CHANGES TO REGIONAL VENTILATION AND DIAPHRAGM MOVEMENT WITH TWO DIFFERENT BREATHING MANOEUVRES

Blaney F¹, Chatterton B², Greville H², Sawyer T¹ and Warden-Flood A¹

¹University of South Australia ²Royal Adelaide Hospital

Previous studies investigating the use of breathing exercises to influence the distribution of lung ventilation have often been confounded by poor control of variables such as inspired flow rate and inspiratory volume. **Aims:** The aims of this study were to compare the distribution of regional ventilation and determine the relationship between diaphragmatic movement and regional ventilation during two different breathing manoeuvres in normal subjects. **Design:** Prospective, randomised, cross-over design. **Methods:** Regional ventilation was measured using Technegas and a gamma camera, and diaphragm movement was measured with sonography. Ten naïve subjects were tested twice, one month apart. Subjects were instructed to use an upper chest or an abdominal pattern of breathing while maintaining a flow rate of 0.5L/s at 20% of their vital capacity. Regional ventilation for three lung zones (upper, middle and lower) was expressed as a percentage of the total radiation count. **Results:** There was less ventilation to the midzone ($p = 0.03$) and greater ventilation to the lower zone ($p = 0.005$) when

subjects used an abdominal pattern of breathing. However, there was no significant difference in diaphragmatic movement between the two breathing manoeuvres and no relationship between diaphragmatic movement and regional ventilation. **Conclusion:** In a group of normal subjects, an abdominal pattern of breathing resulted in less ventilation to the midzone and greater ventilation to the lower zone compared with upper chest breathing. This shift in ventilation did not correlate with diaphragm movement.

Supported by the Physiotherapy Research Foundation.

RESPIRATORY FUNCTION AND KINETICS OF THE DIAPHRAGM AND PELVIC FLOOR DURING LOW-LOAD ACTIVITIES IN SUBJECTS WITH SACROILIAC JOINT PAIN SYNDROME

Tucker B, O'Sullivan P, Beales D, Beetham J, Cripps J, Graf F and Lin I

Curtin University of Technology, Perth

Clinically, patients with sacroiliac joint (SIJ) pain syndrome are reported to have alterations in respiratory patterns when performing low-load tasks. **Aims:** To examine the stabilising strategies adopted by subjects with a clinical diagnosis of SIJ pain syndrome during low-load activities, and the resultant effect of these strategies on respiratory patterns. **Design:** Observational study. **Subjects:** Thirteen subjects (11 female) with a clinical diagnosis of SIJ pain syndrome and an equal number of matched controls. **Methods:** Subjects were studied using spirometry and real time ultrasound of the diaphragm and pelvic floor during three stages of the active straight leg raise test, a valid procedure used for the assessment of SIJ stability. Visual analysis and analysis of variance was performed on ultrasound and spirometry data using a critical alpha value of 0.05 to determine statistical significance. **Results:** Minute ventilation and pelvic floor and diaphragm movement were significantly different between the two groups and these differences were eliminated when the SIJ pain syndrome group had stability of the pelvis enhanced with manual compression to the innominates. **Conclusion:** Sub-optimal muscle recruitment strategies and alterations in respiratory function do occur in subjects with impaired SIJ stability. The changes observed appear to represent a compensatory strategy of the neuromuscular system to provide increased stability to the pelvis.

NEONATAL CHEST PERCUSSION – DOES A SINGLE SESSION OF EDUCATION ALTER PERCUSSIVE FORCE AND TECHNIQUE?

Hassam M and Williams M

University of South Australia

Aims: Neonatal chest percussion is a technique used to assist secretion removal. This technique, when performed incorrectly, has been associated with brain damage in low birth weight pre-term infants. This study investigated the forces and technique demonstrated by novice practitioners performing neonatal chest percussion on a model with and without education. **Design:** Same subjects test retest. **Subjects:** Forty final year physiotherapy students from the University of South Australia. **Methods:** Subjects percussed a model for one minute on two separate occasions with an education session given between testing. The education session was based on the Inquiry into the

Provision of Chest Physiotherapy Treatment Provided to Pre-Term Babies at the National Womens Hospital (NWH) between April 1993 and December 1994. The model consisted of a pressure sensor, positioned on a neonatal mannekin connected to Fscan software. The model was reliably calibrated ($r^2 = 0.98$) and a repeatable four component technique scoring system (head holding, wrist, elbow and shoulder movement) was developed. Force (g/cm^2) and acceptable technique (yes/no) were recorded throughout each testing session. Forces between pre- and post-education trials were analysed using a related t -test and acceptable technique using chi square. **Results:** One subject demonstrated overall acceptable technique prior to the education session whereas 34 subjects fulfilled the criteria for acceptable technique following education. There was a significant reduction ($p = 0.04$, 83% reduction) in the mean force generated following the education session. **Conclusion:** Naïve physiotherapy students demonstrated unacceptable neonatal percussive technique, which was significantly improved by a single education session.

THE FIVE YEAR FOLLOW-UP OF TWO GROUPS OF INFANTS WITH CYSTIC FIBROSIS RANDOMISED TO STANDARD VS MODIFIED POSTURAL DRAINAGE DURING INFANCY

Button B^{1,2,3}, Heine R², Catto-Smith A², Olinsky A², Phelan P², Ditchfield M² and Story I¹

¹The University of Melbourne ²Royal Children's Hospital, Melbourne ³The Alfred Hospital, Melbourne

We previously found that standard physiotherapy (SPT) [with 30 degree head down tilt] resulted in significantly more episodes of gastro-oesophageal reflux than modified physiotherapy (MPT) [without 30 degree head down] ($p = 0.007$) in 20 newly diagnosed infants with cystic fibrosis (CF). **Aims:** (1) To compare the effects of SPT vs MPT on respiratory symptoms and antibiotic use one year after diagnosis; (2) to study radiological changes from birth to six years; and (3) to compare lung function at six years. **Methods:** The newborn infants were randomized to daily SPT or MPT for 12 months. Parents kept a daily diary of symptoms and antibiotic use. A blinded radiologist determined each infant's radiological Brasfield score from diagnosis to six years. Pulmonary function tests were measured by a blinded accredited laboratory technician at six years. **Results:** The SPT group had significantly more annual days with upper respiratory symptoms ($p = 0.03$) and overall, more days with lower respiratory tract symptoms requiring antibiotics than the MPT group. On reviewing patient records at six years, overall treatment and adherence in the two groups appeared equal. The mean Brasfield scores for the SPT vs MPT groups respectively were: at diagnosis 24.57 vs 24.50; at one year after diagnosis 24.28 vs 24.71; at two-three years of age 23.71 vs 24.86 ($p = 0.028$); and at five-six years 22.4 vs 24.25. The MPT group had a significantly higher $FEV_1 - 121.8 \pm 15.9\%$ vs $102.9 \pm 11.1\%$ for the SPT group ($p = 0.012$); with FVC $116 \pm 14.6\%$ vs $99.7 \pm 16.1\%$ ($p = 0.036$); and $FEF_{25-75} - 102.3 \pm 34.4\%$ vs $82.6 \pm 22.4\%$ ($p = 0.12$) respectively. **Conclusion:** Modified physiotherapy should be considered the most appropriate regimen for infants with CF.

Funded by research grants from the Physiotherapy Research Foundation and the Royal Children's Hospital Research Foundation.



Physiotherapy Research Foundation Oration

The Inaugural Physiotherapy Research Foundation Oration was presented by Mark Elkins, recipient of a PRF Seeding Grant in 2001. This grant supported a project to advance the measurement of mucociliary clearance.

Conventional measurement of mucociliary clearance (MCC) involves the delivery of a radioaerosol to the airways. A gamma camera is then used to record the distribution of radiolabelled secretions within the lung. By measuring the distribution as a function of time, clearance rates can be calculated. By controlling the breathing pattern during delivery, the deposition pattern in the lung can be reproduced on repeat occasions. This system therefore allows the comparison of the effect of different interventions on MCC rates. To date, MCC has only been measured using a two-dimensional gamma camera, which does not allow analysis of MCC from the central region independently from the peripheral region.

The PRF Seeding Grant was used to establish a method of quantifying MCC in three-dimensions using single photon emission computer tomography. Ten subjects with no history of respiratory disease and normal respiratory function attended for two testing sessions each. On each occasion, the radioaerosol was delivered while the target breathing pattern was maintained. Subjects were then scanned with a triple-headed gamma camera for 90 minutes, during which the distribution of radioactivity within the right lung was recorded. The amount of radioactivity cleared from the whole right lung at 90 minutes was calculated. Similar calculations were made for two concentric regions of interest: peripheral and central. Repeatability between the two study days was excellent, with negligible differences between days for the whole lung, central and peripheral regions.

The PRF supports projects such as this which impact positively on physiotherapy research for improved health. All donations to the PRF are tax deductible. Applications for seeding grants close mid-year.