EFFECTIVENESS OF ACTIVE CYCLE BREATHING TECHNIQUE OVER DIAPHRAGMATIC BREATHING EXERCISE IN PULMONARY COMPLICATION IN POST PULMONARY SURGERY

REGISTER NUMBER: 27091202

A DISSERTATION SUBMITTED TO

THE TAMILNADU Dr. M.G.R. MEDICAL UNIVERSITY

CHENNAI

IN PARTIAL FULFILLMENT FOR THE

REQUIREMENT OF THE DEGREE IN

MASTER OF PHYSIOTHERAPY

APRIL – 2011

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Head of the Institution:

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CERTIFICATE

This is to certify that the project work entitled **"EFFECTIVENESS OF ACTIVE CYCLE BREATHING TECHNIQUE OVER DIAPHRAGMATICBREATHING EXERCISE IN PULMONARY COMPLICATION IN POST PULMONARY SURGERY"** was done by **J. MARGRET VINCY SEELIA** a bonafide student of Master of Physiotherapy under **THE TAMIL NADU Dr. M.G.R. MEDICAL UNIVERSITY, CHENNAI.**

PROJECT GUIDE

Prof. B.RAMKUMAR M.P.T. (CARDIO)
TMMF, MADURAI

ACKNOWLEDGEMENT

I first thank LORD and my parents for the confidence they have given throughout my life. I humbly acknowledge all the love and care showed by my parents throughout my life in making me what I am.

I respectively thank our correspondent Prof.K.R.ARUMUGAM, for his support and guidance for the successful completion of my project. I wish to convey my sincere regards to Principal Dr.R.SHANKER,M.P.T. (O.G.).

I gracefully recognize the valuable suggestions and guidance given by my guide, Prof. B.RAMKUMAR M.P.T. (CARDIO),Vice Principal Ultra College.

I thank you from hearted to Mr. J. Sudharsan, M.P.T., (CARDIO)who was responsible for synthesizing the diverse and detailed feedback into the final cohesive document instrumental to guiding the initiative.

My project would be incomplete with the support and encouragement of my beloved parents Mr. Joseph and Mrs. J. Leela.

I am also thankful to the staffs of our physical therapy department and librarian Mr.THIRUNAVUKKARASUfor their co-operation towards the completion of this dissertation.

CONTENTS

INTRODUCTION

INTRODUCTION

Willy Meyer as forced to curtail his discussion of pulmonary surgery due to limitations of time. Yet he clearly noted the trend toward expansion of this field. In this surgery, he stressed the necessity of controlling postoperative pneumothorax and infection, and was soon to endorse underwater drainage which had been reported by another Founder (Dr.Kenyon): Although the pioneering work of Sauerbruch and others merits itscredit, the contributions of numerous Founders cannot be passed over lightly.

As control of acute postoperative pneumothorax by differential pressure became better understood and more individuals became versed in application of the various methods, particularly intratracheal insufflation, pulmonary surgery took on new life. Matas, in 1899, using a Fell – 'O' Dwyer tube with a bellows and later a pump which he built himself, reported on the management of acute traumatic pneumothorax. Using his method, Parham, an associate of Dr.Matas and later a member of the Association, soon resected a large chest wall tumor.[1] Nathan Green,. in 1906, found positive pressure methods entirely safe for experimental lobectomy in dogs.[2] Robinson and sauerbruch, in 1910, reported their technique of lung resection with a comparison of the methods of mass hilar ligation, thoracoplasty and hilar ligation, and subpleural lung transplant and subsequent excision.

Pulmonary complications occurred with seven days of surgery in 28 patients (2.9%). Thirteen patients developed respiratory failure requiring support. Nine had postoperative pneumonia, five had atelectasis requiring bronchoscopic intervention and one had a pneumothorax requiring intervention one of the pneumonia patients died. Patients with pulmonary complications remained in the hospital for 28 days versus five days for those who experienced uncomplicated recoveries.

Four variables identified as independent predictors of postoperative complications. (Odds Ratio) (OR)

1. Age older than 65 OR 5.9
2. Positive cough test OR 3.8
3. Administration of anesthesia lasting longer than 3 hours OR 3.3
4. Insertion of nasogastrictube OR 7.7

Surgery in the vicinity of the diaphragm has been shown to interfere with its contractile properties.

Diaphragmatic movement is now thought to be an important factor in prevention of post operative complication.

In recent year's new method have been adopted among which are Active cycle of Breathing Technique (ACBT) Diaphragmatic breathing exercise. (DBE).

The effect of ACBT & DBE in chest expansion at the lower costal region indicates that movement of diaphragm. Post operatively an increase in diaphragmatic movement has been observed by encouraging an increase in lung volume while using pattern of breathing control and assist greatly in prevention of post operative complication by increasing ventilation to the dependent parts of the lungs.

This study should be designed the effect of ACBT & DBE in pulmonary complication in post pulmonary surgery.

NEED FOR THE STUDY:

The understanding of the differences between ACBT & DBE will help to the physiotherapy to prescribe the correct breathing technique & prevent pulmonary complication in post operative patients.

AIM:

The aim of the study is to analyze the beneficial effects of diaphragmetic breathing exercise and active cycle breathing technique in prevention of post operative pulmonary complication in pulmonary surgery.

HYPOTHESIS:

Both ACBT & DBE in prevention of pulmonary complication in pulmonary surgery. ACBT is more effective than DBE.

NULL HYPOTHESIS:

There is no significant difference between ACBT & DBE in prevention of pulmonary complication in post pulmonary surgery.

OPERATIONAL DEFINATION:

1. ACBT [Active cycle of Breathing Technique]

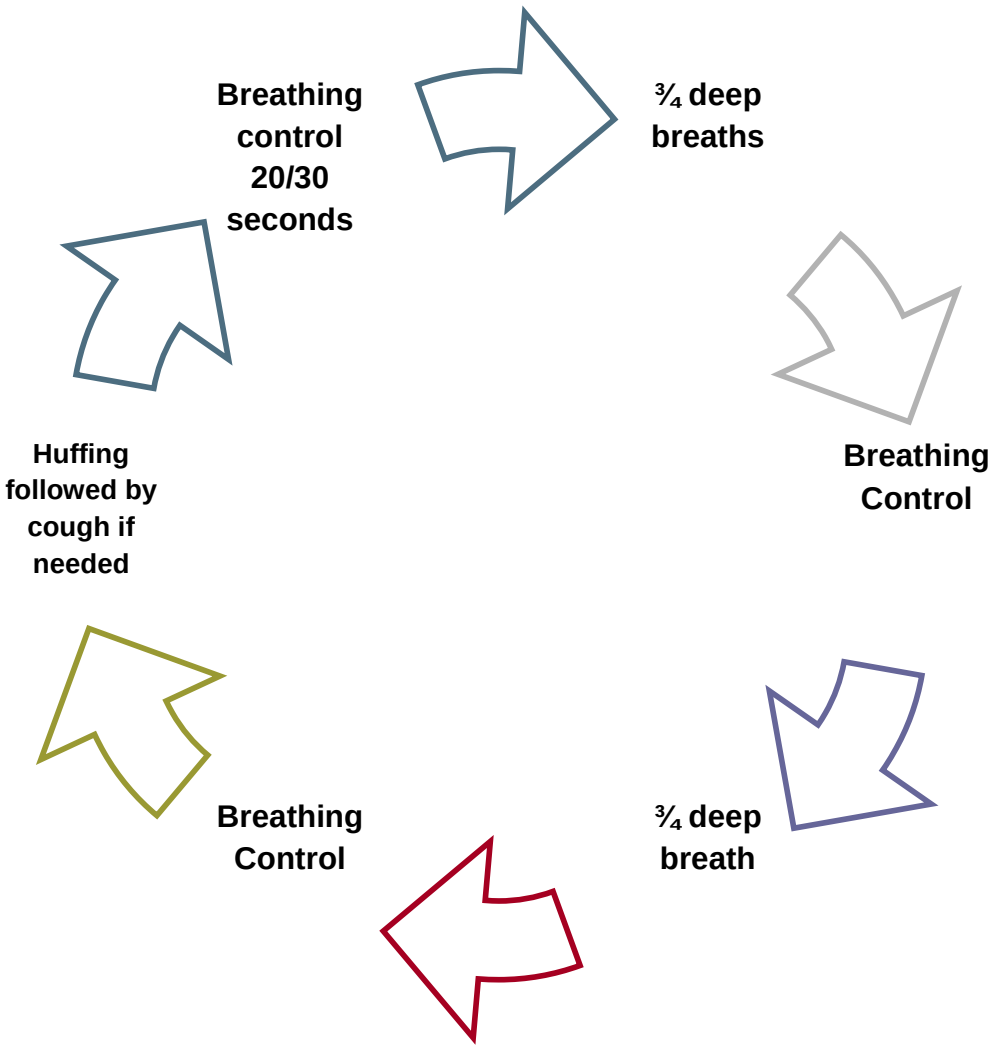
The active cycle breathing technique is used to mobilize & clear phlegm from lungs & to improve lung function.

ACBT uses alternating depth breathing to more phlegm from small airways at the bottom of your lungs to larger airway near the top where they can be cleared more easily with huffing or coughing.

Three stages will be there in ACBT

- Breathing Control
- Deep breathing exercise
- Forced Expiration technique

ACBT [Active cycle of Breathing Technique]



2. RESPIRATORY RATE:

The number of breaths (respiration including one inspiration & one expiration) per minute is known as respiratory rate.

3. PEAK EXPIRATORY FLOW RATE:

The maximum flow of expiratory air when a person expires with greater force and cannot be increased even with greatly increased additional force is conceited as peak expiratory flow rate. It is maximum when the lungs are filled with large volume of air than when they are empty.

4. DIAPHRAGMATIC BREATHING:

Diaphragmatic breathing is the art of breathing deep into lungs by flexing diaphragm rather than breathing shallowly by flexing rib cage. Diaphragmatic involves inhalation that causes the diaphragm to contract and move down, drawing air into the lungs.

KEY WORDS:

PC	:	Pulmonary complication
ACBT	:	refers to Active cycle Breathing Technique.
DBE	:	Refers to Diaphragmatic Breathing exercise
Group A	:	Refers to patients given ACBT
Group B	:	Refers to patients given Diaphragmatic breathing exercise

LIMITATION

This study is limited to the population of post operative patients in pulmonary surgery coming to the Meenakshi Mission Hospital, Madurai, between the age group of 30 to 50.

ANATOMY
&
PHYSIOLOGY

ANATOMY AND PHYSIOLOGY

LUNGS:

The two lungs are basically very similar. The right lung is made up of three lobes and the left of two lobes. Each lobe is divided into segments.

RIGHT LUNG ANTERIOR BORDER:

Start at the level of the apex 2-3 cm above the medical third of the clavicle. Trace a line behind the right sternoclavicular joint vertically down behind the right side of the sternum to the 6th chondrosternal junction.

RIGHT LUN INFERIOR BORDER:

Trace from the 6th chondrosternal junction laterally on a line which crosses the 6th costal cartilage in midclavicular line and the 8th rib in midaxillary line, then medially to the 10th rib in line with the inferior angle of the scapula to the 10th thoracic spine.

RIGHT LUNG POSTERIOR BORDER:

Trace from a point 2 cm right of 10th thoracic spine, vertically up the back to the level of the neck of the first rib, and thence to the apex.

LEFT LUNG ANTERIOR BORDER:

Trace the same as for the right lung on the left side down to the 4th chondrosternal junction. Then trace laterally along the lower border of the 4th

costal cartilage for 3.5 cm, turn down and curve slightly medially to the 6th costal cartilage 4cm from midline of sternum (this curve is the cardiac notch).

LEFT LUNG INFERIOR AND POSTERIOR BORDERS:

These are like those of the right lung.

FISSURES

OBLIQUE

This is traced from the posterior border of the right lung level with the spine of the 3rd thoracic vertebra to the 5th interspace in midaxillary line and ends anteriorly near the 6th costochondral junction at the inferior border, 7.5cm from the midline of the sternum. The oblique fissure of the left lung is equivalent on the left side.

HORIZONTAL:

This is traced from the oblique fissure of the right lung in midaxillary line horizontally forwards and medially to the sternal end of the 4th costal cartilage. There is no horizontal fissure in the left lung.

PLEURA:

The right pleura starts 3 m above the medial third of the clavicle, passes down behind the sternoclavicular joint and meets the left pleura at the sternal angle just left of midline. It passes vertically down to the level of the

4th chondrosternal junction and then obliquely to the 6th chondrosternal junction. It may then be traced laterally to the 8th costal cartilage in mid – clavicular line, the 10th rib in mid-axillary line, and the 11th rib in line with the inferior angle of the scapula to the level of the 12th thoracic angle of the scapula to the level of the 12th thoracic spine, just lateral to midline.

The left pleura is traced in the same way as the right except that from the 4th chondrosternal junction it is traced obliquely laterally to the 8th costal cartilage in midclavicular line. Thereafter it is traced like the right pleura.

MECHANICS OF RESPIRATION:

The principal effect of movements of the thorax is to alter the capacity of the thoracic cavity to enable air to be drawn in (inspiration) or expelled (expiration) and thus produce ventilation of the lungs. This capacity may be increased in three dimensions anteroposteri-orly, laterally and vertically by the muscles of respiration which are the diaphragm and the intercostals. The amount of movement depends on the depth of respiration (ventilation).

LUNG VOLUMES

The total lung capacity can be divided into various volumes:

- Tidal volume (TV) is the volume of air moved into or out of the lungs during quiet breathing at rest.
- Inspiratory reserve volume (IRV) is the volume of air additional to TV

that can be inspired during a maximum inspiration.

- Expiratory reserve volume (ERV) is the volume of air additional to TV that can be expired during a maximum expiration.
- Residual volume (RV) is the volume of air remaining in the lungs after a maximum expiration.

LUNG CAPACITIES

- Total lung capacity (TLC) is the total volume of air in the lungs after a maximum inspiration.
- Vital capacity (VC) is the maximum volume of air that can be expired after a maximum inspiration.
- Inspiratory capacity (IC) is the maximum volume of air that can be inspired from the endpoint of quiet expiration at rest.
- Functional residual capacity (FRC) is the volume of air remaining in the lungs at the end of quiet expiration at rest.

Values for the average male adult are: TLC 5500 ml, RV 1500 ml, VC 4000 ml, IRV 2500 mL, IC 3000 ml, TV 500 mL, FRC 2500 mL, ERV 1000 mL. Values for the average female adult are 25% less.

In exercise the tidal volume gradually increases while both the inspiratory and expiratory reserve volumes decrease.

RESPIRATORY RATE

At rest a normal adult breathes in and out between 12 and 16 times per minute. During exercise this may increase to over 30 times per minute.

Respiratory minute volume is the tidal volume multiplied by the respiratory rate; e.g. 500 mL x 14 = 7000 mL.

Anatomical dead space is the volume of air in the conducting airways from the nose and mouth to the alveoli and is 150 mL.

Forced vital capacity (FVC) is the maximum volume of air forcibly expired after a maximum inspiration. Forced expiratory volume in one second (FEV_t) is the volume of air forcibly expired after a maximum inspiration in one second and this is usually 80% FVC. Thus the ratio FEV FVC in healthy people is 80%.

Peak expiratory flow rate (PEFR) is the maximum flow rate of air from full inspiration during a forced expiration and is measured with a Wright peak flow meter. In the normal adult PEFR is over 400 L per minute.

RESPIRATORY MOREMENTS:

PRIMARY INSPIRATORY MUSCLES:

diaphragm suppled by phrenic neeve,

external intercostal muscles supplied by intercostal nerves.

ACCESSORY INSPIRATORY MUSCLES:

Sternomastoid,

Scaleni,

Antesior Serrati,

Elevators of Scapulae,

Pectorals,

PRIMARY EXPIRATORY MUSCLES:

Internal intercostal muscles.

ACCESSORY EXPIRATORY MUSCLES:

Abdominal Muscles

MOVEMENTS OF THORACIC CAGE:

In general, the change in the size of thoracic cavity occurs, because of the movements of four units of structure.

1. Thoracic lid.
2. Upper costal series.
3. Lower costal series.
4. Diaphragm

THORACIC LID:

The thoracic lid is formed by manubrium sterni and the first pair of rib. This is also called throracic operculum. Due to the contraction of scaleni

muscles the first ribs move upwards to a more horizontal position. This draws the manubrium sterni upwards and forwards increasing the anteroposterior diameter of the throacic cage.

2. UPPER COSTAL SERIES:

The upper costal series is constituted by second to sixth pairs of rib. The contraction of external intercostal muscles causes elevation of these ribs and the sternum moves upwards and forwards. This movement is called pump handle movement. The pump handle movement increases anteroposterior diameter of the thoracic cage. simultaneously, the central portions of these ribs move upwards and outwards to a more horizontal position. This movement is called bucket handle movement. The bucket handle movement increases the transverse diameter of thoracic cage.

4. DIAPHRAGM:

During inspiration, due to contraction, the muscle fibers are shortened. But the central tendinous portion is drawn downwards. The diaphragm is flattened. This increases the vertical diameter of the thoracic cage.

CLINICAL TREATMENT

CLINICAL TREATMENT

AIM OF TREATMENT:

The principal aims are

1) To relive any bronohospasm and to facilitate the removal of secretions.
2) To improve breathing control and the control of dyspnoea during attacks.
3) To teach local relaxation, improve posture and help allay fear and anxiety.
4) To increase knowledge of the longs condition and control of symptoms.
5) To improve exercise tolerance and ensure a long term commitment to exercise.
6) To give advice about self management.

PULMONARY SURGERY:

Types of thoracic Incision:

1. Posterolateral thoracotomy
2. Anterolateral thoracotomy
3. Median sternotomy
4. Left thoraco – laparotomy

Posterolateral thoracotomy:

This incision is most commonly used for operations on the long. It is a curved incision which start at the level of the third thoracic vertebra and follows the vertebral border of the scapula and the line of the rib extending forward to the anterior angle or costal margin. An incision through the bed of the fifth or sixth rib is used for pneumonectomy or lobectomy.

The muscle are trapezius, latissimus dorsi, rhomboids, serratus anterior and the corresponding intercostal. A small piece of rib approximately 1 cm, may be removed to allow easier retraction and avoid a painful fracture.

Anterotateral Thoracotomy:

This incision is used primarily for cardiac surgery but can be used to Perform Pleurectomy.

The incision starts at the level of the fifth costal cartilage. At the sternal edge it follows the rib line below the breast to the posterior axillary line. The muscles cut are pectoralis major and minor, serratus anterior, and the corresponding intercostal.

Median sternotomy:

This incision is used for lung volume reduction surgery and bilateral pleurectomy. It is a vertical incision that involves splitting the sternum.

The incision extends from just above the suprasternal notch to a point about 3 cm below the xiphisternum. No muscle is cut expect the apoheuroses of pectoralis major.

Left thoraco-Laparotomy:

This incision is used for surgery on the lower oseophagus and stomach. The thoracotomy incision follow the curve of the seventhrib and extends anrteriorly over the costal margin towards the umbilicus. The muscles involved are lattisimus dorsi, serratus anterior, the corresponding intercostals and the abdominal muscles.

CLINICAL
INDICATIONS FOR SURGERY

The commonest indication is bronchial carcinoma which account for around 90 per cent of all resections.

1. ***Malignancy****:* Primary bronchial carcinoma, bronchial carcinoic isolated secondaries arising from kidney or large intestine.
2. ***Inflammatory****:* Lung resection is occasionally required for the following conditions: lung abscess, tuberculosis, bronchiectasis aspergillosis, hydatid disease.

3. ***Trauma:*** Stab wounds, gunshot wounds.
4. ***Degenerative:*** Large lung bullae in selected patients where then is compression of normal lung.
5. ***Congenital:*** Arterio-venous fistula, sequestrated lobe, lobar emphysema.

TYPES OF PULMONARY RESECTION

PNEUMONECTOMY:

The entire lung is removed. Operative mortality in the UK is aro 7 to 10 per cent but rises to 20 per cent over the age of 70. In a radical pneumonectomy, mediastinal lymph nodes and part of the chest wall may also be removed. The resulting cavity is filled by protein-rich fluid and fibrin. The cavity size is reduced by lateral shift of the trachea and heart, upward shift of the diaphragm, and reduction of the intercostal spaces on the operated side. Occasionally, and later, a scoliosis may develop.

LOBECTOMY:

Any of the five lobes may be removed; on the right side the middle and lower lobes are often removed together because of their common lymphatic drainage. If a tumour in an upper lobe protrudes into the main bronchus a cuff of main bronchus can be removed with the lobe and the remaining lung and bronchus is joined to the trachea. This is termed a sleeve lobectomy.

SEGMENTAL RESECTION:

A bronchopulmonary segment is removed with its segmental artery and bronchus. This used to be indicated for tuberculosis but is now rarely performed.

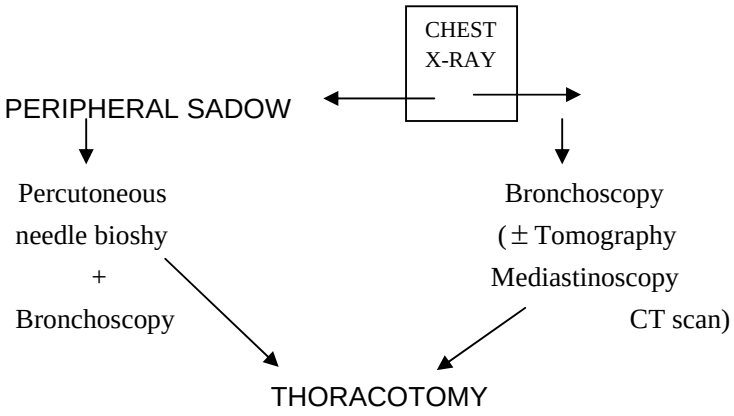
WEDGE RESECTION:

This non-anatomical resection is used for diagnosis in open lung biopsy and treatment of well-localised peripheral carcinomas in patients with reduced lung function.

PRE-OPERATIVE INVESTIGATIONS

These investigations are designed to answer two questions:

1. Can the carcinoma be removed?
2. Is the patient fit for thoracotomy?



BRONCHOSCOPY:

This is carried out by two separate techniques: via a flexible fibre-optic instrument in a conscious patient or via a rigid Instrument in a patient under a general anaesthetic. Technique allows the operator to see further into subsegmental bronchi while technique allows a better assessment of operability in central lesions. The two methods can be used together under a general, anaesthetic.

MEDIASTINOSCOPY:

A small transverse incision is made Icm above the suprasternal notch. The strap muscles are separated and the pre-tracheal fascia entered. Abnormal paratracheal and carinal nodes can then be felt. Mediastinoscope is inserted and a biopsy taken. Not all lymph node groups in the mediastinum can be reached by this technique, in particular those nodes on the left below the aortic arch Many surgeons, therefore, prefer to use an anterior mediastinotomy in which a mediastinoscope is passed through the 2nd or 3rd intercostal space and a biopsy taken.

PULMONARY COMPLICATION

PULMONARY COMPLICATION

THE MAJOR COMPLICATIONS OF PULMONARY SURGERY.

RESPIRATORY:

1. Sputum retention +/- infection.
2. Atelectasis / Lobar collapse.
3. Persistent air leak / pheumothorax
4. Bronchopleural fistula [Breakdown of the bronchus from which the lung tissue has been resected, more likely to occur following pneumonectomy and generally occurs about 8-1 days after surgery]
5. Pleural effusion.
6. Surgical Emphysema
7. Respiratory failure.

CIRCULATORY:

1. Haemorrhage
2. Cardiac arrhythmia: atrial fibrillation will occur in approximately 30% of lung resection patients.
3. Deep Vein thrombosis.
4. Pulmonary embolus.
5. Myocardial infarction.

WOUND:

1. Infection
2. Chronic wound pain
3. Failure to heal

NEUROLOGICAL:

2. Stroke
3. Recurrent Laryngeal nerve damage [the RCN supplies the vocal chords and trauma during surgery will impair the patient's ability to cough]
4. Phrenic nerve damage, resulting in paralysis of the hemi-diaphragm.

LOSS OF JOINT RANGE:

1. Loss of shoulder range on operated side
2. Postural changes

REVIEW OF LITERATURE

REVIEW OF LITERATURE

- **Anita watson and kimpollard, Jan 2001** physiotherapy, seacrift university Hospital Leeds, U.K **prefor et al (1979), Webber (1986),** this consists of combination of deep breathing exercise, thoracic expansion exercise, forced expiratory exercise, forced expiratory expiratory technique & Breathing control. The ACBT isn't a rigid treatment method and is modified to suit all ages and individual needs.

- **Abebaw M.Yohanner and Mastin J.Connolly**, Department of physiotherapy, Manchester Matropolitan University of Auckland, New Zealand, 17 October 2006. Where as ACBT was used always (or) often by 88% of responders.

- **Craig D Lapin MD, July 2002**, the science of journal of the American Associations for Respiratory care, ACBT is rely heavily on basic airway physiotherapy to enhance clearance.

- **Patterson JE, Bradley JM,** Hewitt O et al, airway clearance in bronchiactasis, a randomized cross over trail of ACBT, Respiretion 2005.

- **S.L. Hill & B. Webber, J.A. Pryor @ ERS Journals Ltd. 1999,** Technique for augmenting when necessary, the normal mucociliary and cough clearance mechanisms of the lung aren't new, but, in more recent years, technique have been developed which are effective, comfortable and can be used independent of an assistant in the majority of adolescent and adults. Postural drainage with chest clapping and chest shaking has, in most parts of the world, been replaced by the more effective technique of ACBT & Diaphragmatic breathing exercise. Many of the regimens now included forced expiratory maneuverer of a "huff" and this has probably increased the effectiveness of airway clearance.

- **Z Baster whittle, Alison (2002)** studied the Diaphragmatic breathing executive and their effectiveness as an increasing lung volumes in bronchitis patients.

- **Cherniale and youtsey (1992)** proved that polmonaey function tests help in the calculation of the mechanical function of the lungs.

- **F.Dennis MC Cool, MD, FCCP & Mark J Rosen, MD, FCCP,** department of pulmonary & Critical Care Medicine (2006) American College of Chest Physicians. Patients with COPD of any etiology may have abnormally complaint central intro thoracic airways that collapse during cough, thereby impairing the clearance of secretions, for this the FET was on introduced as on alternative to cough. FET may lead to less airway compression and better sputum clearance & improve Peak Expiratory Flow Rate & decrease dyspnea, respiratory Rate.

- **Herman HL (1998), Mullar etal (1970) Uualde (2000) Baic (1991)** found significant improve in forced expiratory volume in one second after combined use of costal and diaphragmatic breathing excercise.

- **Enright PL Hodgkin JE, (1991)** proved that pulmonary function studies are the best way to assess for the presence of lung impairment.

- **L.J. Faling, Pulmonary rehabilitation, December 1989**, the review focuses on deep breathing, autogenic drainage (postural drainage, chest percussion, vibration and control cough as techniques of chest PT. These modalities may be effect in patients with COPD.

MATERIALS & METHODOLOGY

MATERIALS & METHODOLOGY

STUDY SETTING:

The study is conducted in Meenakshi Mission Hospital, Madurai-20.

STUDY SAMPLE:

20 individuals who underwent pulmonary surgery, aged between 30-50 years are going to be selected based on the randomly selection criteria for the study.

CRITERIA:

INCLUSION CRITERIA:

1. patients who will undergo pulmonary surgery.
2. Patients without any other systemic and cardiac conditions preoperatively.
3. Age group from 30 to 50 years.
4. Both Males & females.
5. Patient stable, Co-Operative.

EXCLUSION CRITERIA:

1. Acute Rib fracture
2. Chest and spinal deformities
3. Age less than 30 and more than 50
4. Patients with other systemic and cardiac conditions preoperatively
5. Patients with neurological disorder.

DESIGN OF THE STUDY:

The study is an experimental design involving the effective analysis of two groups were randomly selected in pulmonary surgery.

Group I - ACBT

Group II - DBE

DURATION OF THE STUDY:

The Study is carried out for period of Six Months.

PARA METER

PEAK EXPIRATORY FLOW METER:

PEF Rate was calculated by asking the subjects to blow three times and the best of the three readings were taken in to considerations. It is measure with Wright peak flow meter care is taken that the exhaust holes aren't occluded and the pointer is checked to at zero.

RESPIRATORY RATE:

Measure manually by placing the palmar aspect of right palm on the subjects abdomen, fingers adducted & the tip of the thumb just below the xiphisternum the diaphragmatic movements were counted for one minute.

PRACTICE SESSIONS:

1. ACBT
2. DBE
3. PEAK FLOW METER

THE ACTIVE CYCLE OF BREATHING TECHNIQUES:

The active cycle of breathing techniques is used to mobilize and clear excess bronchial secretions. It has been shown to be effective in the clearance of bronchial secretions, to improve lung function and it does not increase airflow obstruction. It is a flexible method of treatment which can be adapted for use in any patients young or old, medical or surgical, where there is a problem of excess bronchial secretions. It can be used with or without an assistant.

It is a cycle of breathing control, thoracic expansion exercises and the forced expiration technique.

THORACIC EXPANSION EXERCISES:

Thoracic expansion exercises are deep-breathing exercises emphasizing inspiration. Inspiration is active and may be combined with a 3 second hold before the passive relaxed expiration. The postoperative manoeuvre of a 3 second hold at full inspiration has been said to decrease collapse of lung tissue. This ‘hold’ may also be of value in some patients

with medical chest conditions, but it is probably unnecessary in the presence of hyperinflation, and cannot be achieved in the very breathless patient.

In the normal lung the resistance to airflow via the collateral ventilatory system is high, but with increasing lung volume and in the presence of lung pathology the resistance decreases, allowing air to flow via the collateral channels the pores of Kohn, canals of Lambert and channels of Martin. When air can move behind secretions it cab assist in mobilizing them.

The effectiveness of thoracic expansion exercises in re-expanding lung tissue and in mobilizing and clearing excess bronchial secretions can also be explained by the phenomenon of interdependence. This is the effect of expanding forces exerted between adjacent alveoli. At high lung volume the expanding forces between alveoli are greater than at tidal volume and assist in re-expansion of lung tissue.

Three or four expansion exercises are usually appropriate before pausing for a few seconds for a period of breathing control. Any more deep breaths could produce the effects of hyperventilation or could tire the patient.

Thoracic expansion exercises can be encouraged with proprioceptive stimulation by placing a hand, either the patient’s or the physiotherapist’s, over the part of the chest wall where movement of the chest is to be

encouraged. There is no evidence to support an increase in ventilation to the lung underlying the hand, but there is an increase in chest wall movement and an increase in lung volume.

who need further motivation to increase their lung volume it can be a useful technique.

Thoracic expansion exercises may be combined with chest shaking, vibrations, and/or chest clapping. These techniques may further assist in t he clearance of secretions.

THE FORCED EXPIRATION TECHNIQUE:

The forced expiration technique is a combination of one or two forced expirations (huffs) and periods of breathing control. A huff to low lung volume will move the more peripherally situated secretions and a huff from a high lung volume will clear secretions that have reached the more proximal airways.

With any forced expiratory manoeuvre there is dynamic compression and collapse of the airways downstream (towards the mouth) of the equal pressure point. This is an important part of the clearance mechanism of either a huff or a cough.

As lung volume decreases during a forced expiratory manoeurve the equal pressure points move more peripherality, and below functional residual

capacity they move towards the alveoli. At lung volumes above functional residual capacity the equal pressure points are located in series of coughs without intervening inspirations to clear bronchial secretions, but clinically a single continuous huff down to the same lung volume is as effective and less exhausting.

The mean transpulmonary pressure during voluntary coughing is greater than during a forced expiration. This results in greater compression and narrowing of the airways which limits airflow and reduced the efficiency of bronchial clearance. In 1989, Freitag et al demonstrated an oscillatory movement of the airway walls in addition to the squeezing action produced by the forced expiratory manoeuvre.

When mobilizing and clearing peripheral secretions it is an unnecessary expenditure of energy to start the huff from a high lung volume. A huff from mid-lung volume is more efficient and probably more effective. To huff from mid-lung volume a medium – sized breath should be taken in, and with the mouth and glottis open, the air is squeezed out using the chest wall and abdominal muscles. It should be long enough to loosen secretions from the more peripherally situated airways and should not just be a clearing noise in the back of the throat. However, if the huff is continued for too long it may lead to unnecessary paroxysmal coughing. Too short a huff may be

ineffective, but when the secretions have reached the upper airways, a shorter huff or a cough from a high lung volume is used to clear them.

The huff is a forced but not violent manoeuvre. The length of the huff and force of contraction of the expiratory muscles can be altered to maximize airflow from the periphery and to minimize airway collapse.

A peak flow mouthpiece, or similar piece of tubing, may improve the effectiveness of the huff as it helps to keep the glottis open. In some people huffing through a tube at a tissue or cotton – wool balls may help to perfect the technique.

The huff can be introduced to children as blowing games and from about the age of 2 years they are usually able to copy others doing a huff.

An essential part of the forced expiration technique is the pause for breathing control after one or two huffs which prevents any increase in air flow obstruction. The length of the pause will air flow obstruction. The length of the pause will vary from patient to patient. In a patient with bronchospasm or unstable airways, or in one who is debilitated and fatigues easily, longer pauses (perhiaps 10-20 seconds) may be appropriate. In patients with no bronchospasm the periods of breathing control may be condierably shorter (perhaps two or three breaths or 5-10 seconds).

Zach et al (1985) have expressed concern that airway instability in patients with cystic fibrosis may be increased by bronchodilator drugs, and this airway instability could lead to an increase in airflow obstruction during

a forced expiratory manoeuvre. However, there is no evidence to support this concern with the use of the forced expiration technique in patients with cystic fibrosis.

In the tetraplegic patient, clearance of secretions from the upper airways is difficult because maximum lung volume cannot be achieved and the equal pressure points will therefore never reach t he largest airways (Morgan et al 1986), Secretions can be cleared from the smaller airways, but accumulate in the larger upper airways.

APPLICATION OF THE ACTIVE CYCLE OF BREATHING TECHNIQUES :

The cycle of breathing control, thoracic expansion exercises and the forced expiration technique is adapted for each patient. Sometimes one set of thoracic expansion exercises will be followed by the forced expiration technique, but if secretions loosen slowly it may be more appropriate to use two sets of thoracic expansion exercises. The surgical patient will probably benefit from the 3 second hold with the thoracic expansion exercises, but there is probably no indication for the use of chest clapping, and wound support may be more suitable than chest compression during huffing and coughing.

In many patients the active cycle of breathing techniques will effectively clear secretions in the sitting position, but in others gravity-assisted positions will be required.

For patients with a moderate amount of bronchial secretions, for example with bronchiectasis of cystic fibrosis, a minimum of 10 minutes in any productive position is usually necessary. For patients with minimal secretions, for example some asthmatics, some chronic bronhities or following surgery, less time is required. The ‘endpoint’ of a treatment session can be recognized, either by the physiotherapist or the patient treating himjself, when an effective huff to low lung volume in two consecutive cycles has been dry sounding and non-productive. The sicker patient may not reach this end-point before tiring and should stop when fatigue is recognized.

It is important to introduce the concept of self-treatment at an early stage. Patients in hospital should be encouraged to take some responsibility for their treatment. Surgical patients should continue with their breathing exercises in between the treatment sessions with the physiotherapist. Medical patients can perhaps start by doing their own evening treatment before discharge home, both the patient and physiotherapist will have the confidence that treatment will be continued effectively at home.

Revision of techniques at appropriate intervals is necessary to assess the effectiveness of the treatment regimen, and to correct and update techniques as necessary, Currie et al (1986) recognized the importance of reassessment to maintain patient compliance.

HOW TO PERFORM ACBT

- try to maintain a good breathing pattern with relaxed shoulders and neck (avoid to use accessory muscle during the ACBT)
- breath through your nose and out through your mouth

THE CYCLE IS:

- Breathing control (also called abdominal breathing)
- Rest one hand on your abdomen, keeping shoulders and upper chest relaxed and allow your hand to rise gently as you breathe in. (if you imagine air filling the abdomen like a balloon this may help)
- Sigh out gently
- Ensure shoulders remain relaxed
- Over a few seconds, gradually increase depth of breathing while maintaining relaxation breathing control is an essential part of the cycle to allow rest.

DEEP BREATHING EXERCISE:

- take 3-4 deep breaths in, allowing the lower chest to expand
- try to ensure neck and shoulders remain relaxed
- at the end of the breath in, hold the air in for 3 seconds
- let the air out gently

FORCED EXPIRATION TECHNIQUE:

i.e 1 or 2 “huffs” combined with breathing control

- take a half breath in and blow air our steadily through an open mouth
- Follow this with breathing control
- Repeat
- As phlegm moves into larger airways take a deep breath in and blow air out again through an open mouth.
- Breathing control
- Repeat the Cycle your chest is clear.

ACTIVE CYCLE BREATHING EXERCISE

DEEP BREATHING EXERCISE

BREATHING CONTROL

DIAPHRAGMATIC BREATHING

The diaphragm is the most efficient muscle of breathing. It is a large, dome-shaped muscle located at the base of the lungs. Your abdominal muscles help move the diaphragm and give you more power to empty your lungs.

When you have pulmonary disease, air often becomes trapped in the lungs, pushing down on the diaphragm. The neck and chest muscles must then assume an increased share of the work of breathing. This can leave the diaphragm weakened and flattened, causing it to work less efficiently.

POSITION OF THEE PATIENT:

Diaphragmatic breathing is usually taught in a relaxed half-lying or sitting position. The patient should be sitting straight and upright with the head and bark fully supported, and the abdominal wall realaxed. If he is in bed relaxation of the abdominal wall is helped by slightly flexing the knees. When teaching breathing exercise out of bed, a high – backed chair without arms is preferable.

There are two schools of thought concerning the teaching of diaphragmatic breathing; the first concentrates on epigastric and lower rib

movement. The second concentrates on allowing the whole abdomen to swell as the diaphragm descends.

The physiotherapist places her hands on the anterior costal margins and upper abdomen to feel the movement occurring. At a later stage the patient can feel this movement himself. He starts by gently breathing out, while relaxing the shoulders and upper chest, and feeling the lower ribs sink down shoulders and upper chest, and feeling the lower ribs sink down and in towards the mid-line. When the patient is ready to breathe in, he is told to breathe in gently and to 'feel' the air coming in around the waist'. If done correctly, the upper abdomen will bulge forward slightly and the anterior costal margins will move up and out.

The physiotherapist places both hands over the abdomen. The patient starts by gently breathing in and concentrating on allowing the abdominal wall to swell, gently not forcibly, under the slight pressure of the physiotherapist's hands. On breathing out he feels his abdomen slowly sinking back to rest. The patient can practice by resting both hands over the abdomen to feel the gentle movement which occurs as a result of diaphragmatic movement not abdominal muscle contraction. The upper chest and shoulders should remain relaxed throughout. The emphasis should be on gentle breathing with the minimum of effort. If the patient takes too deep a breath he will expand the apical areas of his chest. The patient should

breathe at his own rate and no attempt should be made to slow this until a more controlled pattern of breathing is achieved. It is vital to remember that the expiratory phase is completely passive; any forced or prolonged expiration may increase airways obstruction. In normal expiration the airways shorten and become narrower, so if the airways are already partly obstructed and the patient forces expiration the flow of air will be further reduced. Forced expiration (huffing) must not be used when teaching breathing control.

After careful instruction emphasis needs to be placed on the importance of regular practice. Sufficient progress will not be made if the patient only does his exercises during his physiotherapy sessions.

DIAPHRAGMATIC BREATHING IS INTENDED TO HELP YOU USE THE DIAPHRAGM CORRECTLY WHILE BREATHING TO:

- Strengthen the diaphragm
- Decrease the work of breathing by slowing your breathing rate
- Decrease oxygen demand
- Use less effort and energy to breathe

DIAPHRAGMATIC BREATHING TECHNIQUE:

1. Lie on your back on a flat surface or in bed, with your knees bent and your head supported. You can use a pillow under your knees to support your legs. Place one hand on your upper chest and the other just below your rib cage. This will allow you to feel your diaphragm move as your breathe.

2. Breathe in slowly through your nose so that your stomach moves out against your hand. The hand on your chest should remain as still as possible.

3. Tighten your stomach muscles, letting them fail inward as you exhale through pursed lips the hand on your upper chest must remain as still as possible.

TO PERFORM THIS EXERCISE WHILE SITTING IN A CHAIR:

1. Sit comfortably, with your knees bent and your shoulders, head and neck relaxed.

2. Place one hand on your upper chest and the other just below your rip cage. This will allow you to feel your diaphragm move as you breathe.

3. Tighten your stomach muscles, letting them fall inward as you exhale through pursed lips. The hand on your upper chest must remain as still as possible.

DIAPHRAGMATIC BREATHING TECHNIQUE

USING THE FINGERTIPS OF BOTH HANDS

RESTING THE HANDS OVER THE ABDOMEN

PEAK EXPIRATORY FLOW RATE (PEFR)

Peak Expiratory Flow Rate (PEFR) is the easiest and most commonly performed.

It is the fastest rate which air can move through the airways during a forced expiration starting with fully inflated lungs.

Ideally, peak flow should be measured thrice a day at home, but since this is practically difficult, twice a day monitoring should suffice: once in the morning and once at right.

Peak flow can be measured with the help of a peak flow meter which is a small, portable, and inexpensive device.

Basic steps for using a peak flow meter

- Move the indicator to the bottom of the numbered scale
- Stand up
- Take a deep breath, filling your lungs completely
- Place the mouthpiece on your tongue and close your lips around it. Do not put your tongue inside the hole
- Blow out as hard and fast as you can in a single blow.

- ❖ Write down the number you get

- ❖ Repeat the above steps twice. Note the best of the three values for your record

Note: If you cough while blowing out, disregard that reading.

The peak flow varies according to age, sex and height.

PEAK EXPIRATORY FLOW RATE (PEFR)

PATIENT PERFORMING PEAK EXPIRATORY FLOW METER

DATA ALALYSIS
&
INTERPRETATION

DATA ANALYSIS & INTERPRETATION

Descriptive statistics including mean & standard deviation for dependent variables namely, respiratory rate, Peal Expiratory Flow rate was calculated before & after administering ACBT & DBE for the two groups.

Inferential statistics was done with Independent T-Test to analyze significant differences between the values.

$$t = \frac{[\overline{x_2} - \overline{x_2}]}{\sqrt{\frac{(n_1 - 1)s_1^{\,2} + (n2 - 1)s_2^{\,2}\{1/n1 + 1/n2\}}{n_1 + n_2 - 2}}}$$

Where

$[\overline{x_1} - \overline{x_2}]$	=	difference in mean
N	=	Number of patients
S	=	Standard deviation
df	=	degree of freedom = n_1+n_2-2

The ‘t’ calculated value of paired ‘t’ test for respiratory rate is 4.86

The ‘t’ calculated value of paired ‘t’ test for Peak Expiratory Flow Rate is 11.62

The ‘t’ table for $(n_1 + n_2 -2)$ degrees of freedom at 5% level of significance is 2.101

The ‘t’ calculated value is greater than ‘t’ table value.

DIAGRAMMATIC REPRESENTATION RELATED TO MEAN

(Respiratory Rate)

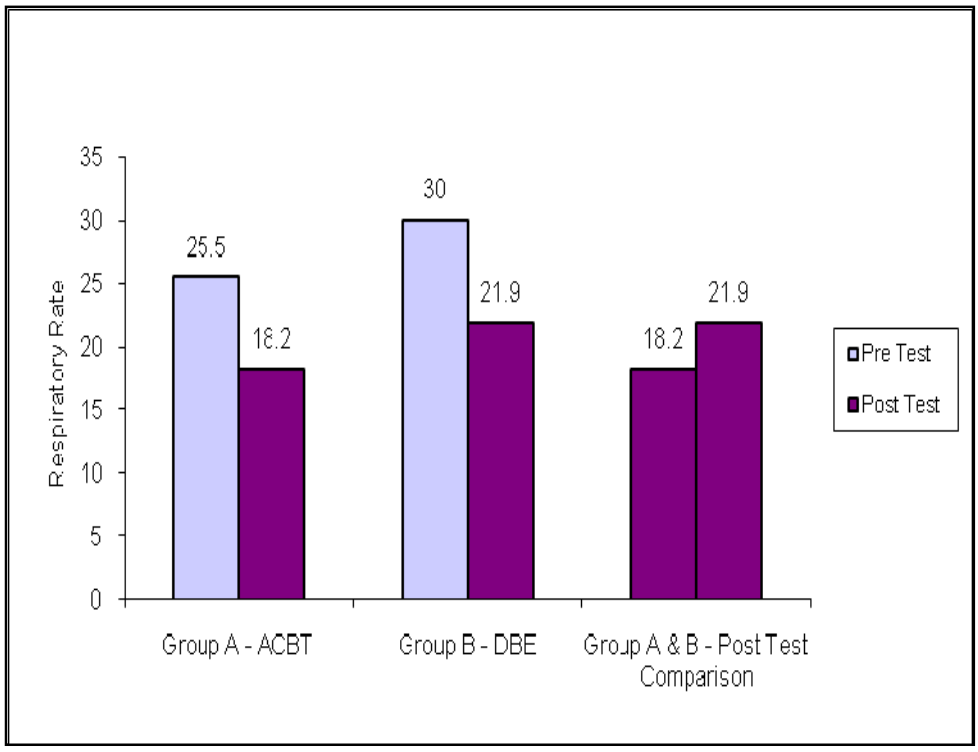


TABLE – I [GROUP A]

RESPIRATORY RATE:

Treatment Status	Mean	S.D.	Calculated 't' Value
Pre – test	25.5	2.87	9.12
Post – test	18.2	2.18	

Table I shows mean & SD value of respiratory rate calculated pre & post administration of ACBT & calculated 't' value statistically significant at 5%.

TABLE – II [GROUP B]

RESPIRATORY RATE:

Treatment Status	Mean	S.D.	Calculated 't' Value
Pre – test	30	3.37	8.52
Post – test	21.9	2.62	

Table II shows mean & SD value of respiratory rate calculated pre & post administration of DBE & calculated 't' value statistically significant at 5%.

Table – III [Group A and Group B] Post test comparison Respiratory Rate

Treatment Status	Mean	S.D.	Calculated 't' Value
Post – A	18.2	2.18	4.86
Post – B	21.9	2.62	

Table III shows mean & SD of respiratory rate calculated post adminstrations of ACBT & DBE then calculated 't' value statistically.

DIAGRAMMATIC REPRESENTATIONS RELATED TO MEAN

(Peak Expiratory Rate)

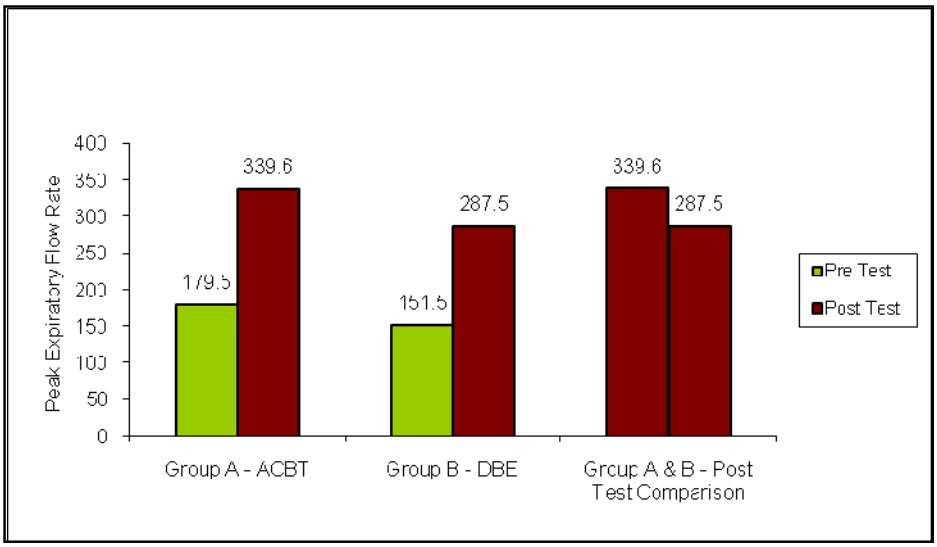


TABLE – IV [GROUP A]

PEAK EXPIRATORY FLOW RATE:

Treatment Status	Mean	S.D.	Calculated 't' Value
Pre test	179.5	8.31	38.48
Post test	339.6	16.65	

Table IV shows mean & SD of Peak Expiratory Flow rate calculated pre & post administrations of ACBT & calculated 't' value statistically significant at 5%.

TABLE – V [GROUP B]

PEAK EXPIRATORY FLOW RATE:

Treatment Status	Mean	S.D.	Calculated 't' Value
Pre test	151.5	13.04	35.41
Post test	287.5	11.23	

Table V shows mean & SD of Peak Expiratory Flow rate calculated pre & post administrations of DBE & calculated 't' value statistically statistically significant at 5%.

TABLE – VI [GROUP A & GROUP B] POST TEST COMPARISON

PEAK EXPIRATORY FLOW RATE:

Treatment Status	Mean	S.D.	Calculated 't' Value
Pre test	339.6	16.65	11.62
Post test	287.5	11.23	

Table VI shows mean & SD of Peak Expiratory Flow rate calculated post administrations of ACBT & DBE then 't' value statistically.

DEMOGRAPHIC REPRESENTATION

S. No	Parameter	Table's	MEAN		S.D		Calculated 'T' value
			Pre	**Post**	**Pre**	**Post**	
1	Respiratory	Table I Show	25.5	18.2	2.87	2.18	9.12
	Rate	Table II Show	30	21.9	3.37	2.62	8.52
			Post A	**Post B**	**Post A**	**Post B**	**'T' value**
		Table III Show	18.2	21.9	2.18	2.62	4.86
2.	Peak Expiratory	Table IV Show	179.5	339.5	8.31	16.65	38.48
	Flow Rate	Table V Show	151.5	287.5	13.04	11.23	35.41
			Post A	**Post B**	**Post A**	**Post B**	**'T' value**
		Table VI Show	339.6	287.5	16.65	11.23	11.62

KEY WORDS:

Table I, IV shows (Group A) – Treatment given **ACBT**

Table II, V shows (Group B) – Treatment give **DBE**

Table III, VI shows (Group A and Group B) – **Both post test**

RESULTS

RESULTS

Respiratory Rate

The means & SD of the two groups A & B have been shown in table.

Group A (ACBT) showed a significance of 5% [9.12] & Group B (DBE) showed a significance of 5% [8.52]. In the comparison between the two groups a significance of 5% [4.86] was achieved.

The results suggest that there is a significant decrease in respiratory rate in pulmonary surgery in post operative patients after the giving ACBT & DBE. ACBT is more effective than DBE.

PEAK EXPIRATORY FLOW RATE

The means & SD of the two groups A & B have been shown in table.

Group A [ACBT] showed a significance of 5% [38.48] & Group B (DBE) showed a significance of 5% [35.41]. In the comparison between the two groups a significance of 5% [11.62] was achieved.

The results suggest that there is a significant Increase in Peak Expiratory Flow Rate in Pulmonary Surgery in Post operative patients after the giving ACBT & DBE But ACBT is more than DBE.

DISCUSSION

DISCUSSION

This study was designed to compare the effectiveness of two airway clearance techniques in pulmonary surgery in post operative patients. It was a simple random study. The result clearly demonstrated that there were ACBT is more effective than DBE.

In airway clearance techniques Peak Expiratory Flow Rate is a most useful and reproducible change in airway obstruction following short term intervention and so Peak Expiratory Flow Meter are most widely used instrument.

Both the treatment showed there is a small but significant decrease in respiratory rate 30 minutes after treatment. Breathlessness significantly decreased in both the treatments after removal of secretion. However, this decrease was more in ACBT than in DBE.

We see the effectiveness in the Treatment protocols and further study is made to improve this in a best possible way.

CONCLUSION

CONCLUSION

The results of this study indicates greater effectiveness in ACBT, less effectiveness in DBE in acutely clearing secretions, prevent the pulmonary complications & increase PEF Rate & also decrease respiratory rate, post operative in patients with pulmonary surgery.

These techniques can be used in post operative patients in pulmonary surgery and the physiotherapist's preferences.

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APPENDIX - 1

Name :

Age :

Sex :

Address :

Occupation :

Chief Complaints :

History :

Past Medical History : Any Medications : Any Physiotherapy

Yes / No (If yes Details)

Present Medical History : Any Medications : Any Physiotherapy

Yes / No (If yes Details)

Personal History : Smoking : Alcoholic

Yes / No (If yes Details)

Family History : Type of house

No of persons

Socio - Economic History

Class - Lower, Middle, Upper

Job - Salaried, Daily Wages

Dyspnea	:	Yes / No
		Types of Dyspnea – orthopnea,
		Paroxysmal Nocturanal dyspnea
Grade	:	Borg Scale
Cough	:	Dry, Productive
Sputum	:	Quantity
		Colour
		Consistency
		Smell
Chest pain	:	Yes / No (if yes details)
Fever	:	Yes / No (if yes details)

On observation
General Appearance

Face	:	Pallor	:	Yes/No
		Flaring of nostrils	:	Yes /No
		Pursed lip breathing	:	Yes/No
		Central cynosis	:	Yes / No
Neck	:	Acting of accessory Muscles	:	Yes/No
Extremities	:	Oedema	:	Yes / No
		Clubbing	:	Yes/No
		Tremor	:	Yes / No
Chest	:	Barrel chest	:	Yes/No

On examination

Vital signs : BP

Pulse Rate

Temperature

Respiratory Rate

Height : _____ cm

Weight : _____ kg

Palpation

Thoracic expansion : Yes / No

Jugular venous pulse : Yes / No

Use of accessory muscles: Yes / No

Percussion : Normal

Resonant

Hyper resonant

Auscultation

Breath sounds : Normal : Decreased

Adventious sounds :

Wheeze : Yes / No

Crackles : Yes / No

Measurement of chest expansion

After maximum expiration : After : Max

Inspiration :

Axilla :

Nipple :

Xiphisternum :

Investigation :

Chest X-ray :

ABG Test :

Pulmonary functions test :

FEV_1 Measure through spirometry

PEF meter Measure peak expiratory flow rate

Problem List

Initial Plan

Long term goal

Short term goal

Treatment plan

Aims

Patient's education

Physiotherapy

Home programme

Follow ups

Date : Signature of the Physiotherapist

Place: