

AMBUBAGGING AS A THERAPEUTIC TECHNIQUE: CLINICAL GUIDELINES

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INTRODUCTION

DEFINITION OF TERMS

Compliance is measured in a mechanically ventilated patient by recording tidal volume, airway pressure and positive end expiratory pressure (PEEP) and applying the formula of $C = TV / \text{Air Press} - \text{PEEP}$. Compliance may be described as either static or dynamic compliance. This distinction is made according to the particular airway pressure that is measured and used in the calculation of compliance.

Using peak inspiratory airway pressure (PIAP) dynamic compliance is given which reflects the resistance offered to lung inflation by both the airways and the elastic recoil of the lungs and chest wall. If plateau pressure is used then static compliance would be calculated. The term "effective" is used when estimates of lung stiffness are made with these calculations¹.

The technique of ambubagging, or simply bagging, involves the use of a manually operated self-inflating bag for artificial ventilation via a face mask, endo-tracheal tube or tracheostomy tube.

This technique of manual hyperinflation was used initially in cardio-pulmonary resuscitation and for offering temporary ventilation to intubated patients where mechanical ventilation was interrupted^{2,11}.

Physiotherapists then became aware of the ambubag as a manual technique which could hyperinflate the lungs of intubated patients with the assumption that non-functioning lung units could be recruited.

Ambubagging gradually became an accepted physiotherapeutic technique and was extensively used in the treatment of ventilated patients. The continued use of this technique was based more on clinical experience than on scientific fact.

During the period 1980 to 1992 a number of studies were conducted investigat-

ing a scientific basis for the therapeutic use of ambubagging. This direction in the research was necessary as previous studies on "bagging" had looked merely at the technique of using the bag during resuscitation and the physical properties of the manual resuscitation bag.

PAST RESEARCH: RESULTS AND DISCUSSION

The earliest of these studies (Hack I, Katz A, Eales C, 1980) investigated the airway pressure changes which take place during "bag squeezing"³. Using a pressure transducer attached to the patients catheter mount, the researchers took a very small sample (n=5) of intubated adult patients and graphically represented the pressure traces obtained during controlled ventilation versus those during bagging. From the graph paper, peak pressures of both controlled ventilation and bagging were interpreted as percentages by which the one mode was judged greater than the other. The greatest increase in airway pressure occurred during bagging. From this the researchers concluded that by using the ambubag, higher inspiratory rates were achieved followed by greater expiratory flow rates and these mechanisms were comparable with those of an effective cough. This conclusion, however, cannot be made from the reported data. The authors were assuming that higher inspiratory pressures would simulate a cough and lead to more effective secretion clearance. Perhaps these high pressures reflected only the low pulmonary compliance of their sample. Hack et al also discussed the indications and contra-indications for the use of the ambubag³.

In 1982, research was conducted by physiotherapy students and staff members of the University of the Witwatersrand to ascertain whether bagging had any effect on increasing the total static compliance of ventilated patients⁴. The project was designed so that one group would be suctioned only and returned to the ventilator between insertions of the suction catheter and the other group would be bagged between insertions of the catheter, static lung compliance improved in 43% of cases. This increase reached its peak one hour after treatment. This sustained increase in compliance was not demonstrated in the group who were suc-

SUMMARY

A review of the literature relating to ambubagging was undertaken. During the period 1980-1992, several studies that were done investigated a scientific basis for the use of bagging and conflicting evidence was found. This may have been due to discrepancies in the measuring tools used as well as the divergence of the research designs by the investigators. Guidelines for the effective use of ambubagging as a therapeutic technique are set out.

tioned only.

A continued interest in the therapeutics of the bag was now vested in the Department of Physiotherapy at the University of the Witwatersrand.

Further research ensued in 1986 by Coker et al who also used lung compliance as an indicator of the effect of bagging versus hyperinflation of the lungs by increasing the tidal volume delivered from the ventilator⁵. Compliance improved in both groups with no significant difference shown between the two groups. This suggests that it may be simply the hyperinflation that occurs which enables secretions to be mobilised rather than the high airway pressures or high flow rates achieved during bagging. This was contrary to the belief which Hack and colleagues held after their research was published in 1980³.

Eales, in 1989, then set out to determine the effects of endotracheal suctioning and ambubagging on the arterial oxygen and carbon dioxide tensions⁶. Two experimental groups were used. Both groups were subjected to standard suctioning and bagging protocols except that group 1 (n=18) were suctioned until clinically clear of secretions and group 2 (n=12) were suctioned six times only. Having taken arterial blood gas samples before and fifteen minutes after treatment it was found that arterial oxygen tension (PaO₂) dropped in both groups. This drop was more significant in group 1 and related to the prolonged suctioning procedure. From this it was concluded that suctioning a patient six times only was optimal for the prevention of significant swings in PaO₂ levels.

Arterial carbon dioxide tensions (PaCO₂) were not significantly effected at all. This was an interesting observation, as Hack et al had postulated that bagging may create a drop in PaCO₂ levels.

If the technique of ambubagging is performed by clinicians skilled in its use, and if rate and depth of bagging are taken into consideration, PaCO₂ levels need not be affected and the hypoxic effects of suctioning can be minimised.

Although ambubagging on a fractional inspired oxygen percentage of 1.0 can minimise the hypoxic effects of suctioning, Imle (1989) has stated that it is not the most effective way⁷. The preferred method to achieve this is suctioning through the catheter port without disconnecting the patient from the ventilator.

The sampling procedures in most of the previous research on ambubagging involved taking consecutive patients admitted to a general ICU. This resulted in a sample which was not homogenous. Only recently have researchers in the field started to consider the effects of this technique on specific patient populations with the same pathologies.

This was the case in a project conducted by Eales, Barker and Cubberley (1991) in the Cardio-thoracic ICU of the Johannesburg General hospital⁸. Here the effects of routinely bagging post-operative cardiac surgery patients was investigated. Having taken the effective lung compliance and full arterial blood gas profiles of each patient before and for ten minute intervals – up to one hour – post treatment, neither of the indices showed any benefit to this group of patients.

Contrasting this study is a project by Jones et al (1992) who again took 20 consecutive patients in a general ICU and bagged them to see how compliance and arterial saturations would be affected⁹. A broad division of the patient sample was made which states that ten patients had lung pathology and ten did not have lung pathology. Compliance increased in both of these groups with ambubagging and remained significantly so, up to two hours post treatment. Arterial saturations were not significantly affected by this treatment.

CONCLUSIONS

While providing arguments for and against the use of ambubagging, current research also appears to show discrepancies in the measuring tools which were used with specific reference to compliance.

The disagreement among the authors may also be related to the divergence of their research designs. This is seen in the lack of standardisation of the patient populations which were used. Many projects have overlooked the value that positioning has on lung clearance and therefore its role in treating ventilated patients. Where positioning has been included in the research design, patients have demonstrated marked improvements in static compliance¹⁰. Perhaps it is the combination of bagging and positioning in these studies which has a more favourable outcome than each used in isolation.

What is disconcerting is that despite the trends demonstrated in the literature,

clinical practice is still guided more by history and tradition.

When considering the indications for bagging a patient, the physiotherapist should ask the following question: *Can I satisfactorily match the ventilatory requirements of the patient with the bag in terms of respiratory rate, PEEP, FIO₂ and tidal volume?*

Surely this question could be competently answered only once a thorough assessment has been performed and once more information is available on the technique.

GUIDELINES FOR AMBUBAGGING

- As mechanical ventilation is known to cause progressive alveolar collapse mainly due to uneven gas distribution, the bag may be indicated to increase tidal breaths and to recruit atelectatic lung units.
- In patients with thick, inspissated secretions, the bag can drive warmed saline down the tracheo-bronchial tree and by creating turbulence in the airways, secretions are better mobilised for endo-tracheal suctioning.
- The bag can be used to facilitate or mimic a cough in sedated or paralysed patients and so promote movement and clearance of secretions.
- Hypoxic effects of suctioning can be minimised with the bag.
- The bag is also useful in offering temporary ventilation to patients who require moving or transport. In babies who are intubated with non-cuffed tubes, manipulating a bag while moving the patient eg. for positioning becomes easier than dealing with the heavy elephant tubing of the ventilator.
- When weaning patients from long-term ventilation, the bag can be used as a "respiratory muscle endurance exerciser". Since the respiratory muscles lose a great proportion of their oxidative metabolism after only 72 hours of mechanical ventilation, the physiotherapist can contract with the patient that for every two patient generated breaths he/she will receive an assisted breath. This procedure can then regain the endurance which these muscles have lost and which will be needed for successful extubation.
- The bag had its origins in and is still used for resuscitation.

Physiotherapists have failed to see that ambubagging is a technique with value when it is indicated.

CONTRA-INDICATIONS

- The patient who presents with very low pulmonary compliance and who is on pressure control ventilation. In these cases the ventilatory requirements can seldomly be matched.
- Patients with undrained pneumothoraces, with a clamped inter costal drain

or those with broncho-pleural fistulae are at risk of baro-trauma to the lungs because the operator is unaware of the inspiratory pressures created.

- Haemodynamically unstable patients are also at risk for the use of this technique due to the cardio-vascular side effects of the bag. By creating a positive intra-thoracic pressure, venous return decreases resulting in a decreased cardiac output.
- When there is malfunctioning of the apparatus i.e. the bag or the oxygen flow meter, there would be a risk of "under bagging" the patient creating hypoxaemia and other complications. All apparatus should be thoroughly checked before use.

Ambubagging should not be regarded as an "all or none" technique which is routinely applicable but rather as a modality with its own set of indications, contra-indications and precautions for its use. These elements the literature has striven to highlight but only with limited success. Future research should concentrate strongly on investigating these specific aspects of ambubagging.

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