POSTURAL DRAINAGE IN INTUBATED PATIENTS WITH ACUTE LOBAR ATELECTASIS - A PILOT STUDY

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ABSTRACT: Objectives: *The movement and mobilisation of an intubated patient in the intensive care unit is restricted by the presence of various drains and intravenous lines. Difficulty to position the patient in the correct postural drainage positions, often leads physiotherapists to using modified postural drainage positions to mobilise secretions. A comparison of effectiveness between the correct postural drainage positions and the modified postural drainage positions during the treatment of acute lobar atelectasis in the intubated patient was conducted.*

Subjects: *Intubated men and women between the ages of 13 and 85 years in the intensive care units of Pelonomi and Universitas Hospitals in Bloemfontein diagnosed with acute lobar atelectasis of the lower lobes were considered for inclusion in this pilot study.*

Intervention: *A controlled randomised clinical experiment was conducted. Group A received inhalation therapy whilst placed in a postural drainage position for 15 minutes. Thereafter percussion was done for five minutes followed by a sterile suction procedure. Group B received the same treatment but modified postural drainage positions were used. Both groups received treatment twice daily.*

Results: *On average, group A required three treatments and nil follow-up chest X-rays before the collapse was resolved, as opposed to the average of 4.5 treatments and one follow-up chest X-ray required by group B before the same result was obtained. In group A the oxygenation compared to Group B was improved. The findings were not statistically significant.*

Conclusion: *The use of postural drainage positions in intensive care suggests quicker resolution of acute lobar atelectasis and improves oxygenation.*

KEYWORDS: INTENSIVE CARE UNIT, ATELECTASIS, POSTURAL DRAINAGE, MODIFIED POSTURAL DRAINAGE, OXYGENATION.

INTRODUCTION

Postural drainage is a recognised technique used in physiotherapy for the treatment of patients with acute or chronic lung conditions (Conners et al, 1980). Postural drainage comprises the promotion of drainage of secretions from the lungs by making use of gravity (Downie, 1987). The potential positions are determined by the individual clinical problem (Belinkoff, 1969). The movement and mobilisation of an intubated patient in the intensive care unit is restricted by the presence of various drains and lines connected to the patient. For this reason it is sometimes difficult to place such a patient in the correct postural drainage position for the specific area of the lung that requires drainage. For the sake of convenience, many physiotherapists prefer to use a modified postural drainage position to mobilise secretions during physiotherapy. Very little literature is available on the difference in effectiveness between modified postural drainage positions and postural drainage positions.

As far back as 1933 Jackson and Jackson described the combination of pulmonary drainage and coughing in the treatment of respiratory conditions (Jackson and Jackson, 1933). Since the 1940s, oxygen supply has been an important focal point in the physiological literature and has formed the basis for the contemporary medical treatment of the cardiopulmonary system (Dean and Ross, 1992). Oxygen supply involves the ventilation of the alveoli, diffusion over the alveolar-capillary membrane, perfusion of the lungs, the biochemical reactions of oxygen in the blood, the pumping of the oxygenated blood to the metabolically active tissue by the heart *via* the peripheral circulation, as well as the withdrawal and utilisation of the oxygen by the tissues. Cardiopulmonary dysfunction develops when one or more of these steps are obstructed. Decreased alveolar ventilation impairs oxygen supply and, in its turn, accumulation of sputum impairs the alveolar ventilation (Dean, 1994). The application of this approach to oxygen supply is illustrated by the clinical treatment of pulmonary atelectasis, a condition for which physiotherapeutic treatment is often prescribed (Dean and Ross, 1992).

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Therapeutic body positioning and mobilisation are regarded as the primary intervention for the purpose of improving respiratory functions during the treatment of acute and chronic cardiopulmonary dysfunctions (Dean, 1994). In 1990 Stiller and co-workers conducted a research project on patients with acute lobar atelectasis in order to compare two physiotherapeutic lung treatments. The 14 patients included in this study were divided into two groups. The treatment of the patients in the first group involved positioning, vibration, hyperinflation (or deep breathing) and suction (or coughing). The patients in the second group were treated by means of hyperinflation (or deep breathing) and suction (or coughing) only. The researchers found that the patients in Group One experienced a significantly higher resolution of the atelectasis after only one treatment than the patients in Group Two. It was concluded that during the initial phase of the treatment of acute lobar atelectasis additional positioning and vibration reinforce a basic physiotherapeutic treatment of hyperinflation and suction. Stiller and co-workers posed the following question which still needs to be researched: would the use of postural drainage positions, of which some involve the head-down tilting of the patient, improve the reaction to the treatment even further (Stiller et al, 1990).

METHOD

The protocol was submitted to and approved by the Ethics Committee of the University of the Orange Free State. Intubated men and women between the ages of 13 and 85 years in the intensive care units of the Pelonomi and Universitas Hospitals in Bloemfontein suffering from acute lobar atelectasis of the lower lobes were included in the study. Consent was obtained from the consultant of these units and family members as most of these patients were sedated. Only 17 patients met the criteria for inclusion in the project as the other patients were excluded due to contraindications for use of the Trendellenburg position. Acute lobar atelectasis was diagnosed by the consultant, from the chest x-rays taken on admission to the unit. Time from diagnosis to first treatment was 2 – 4 hours. Each patient was subjected to one of two treatments according to a standardised randomisation list.

Group A: These 9 sedated patients received inhalation therapy administered via the ventilator, consisting of Mercapto-ethanesulphonate and Sodium Chloride (2 ml Mercapto-ethanesulphonate diluted by means of 2 ml 0,9 % Sodium Chloride solution). The administration of this mucolitic mixture is standard practice in these intensive care units. During inhalation the patient was placed in the postural drainage position for 15 minutes. (The specific position was determined by the lung lobe that had collapsed.) The following postural drainage positions were used: (a) for collapse of the anterior basal segments of the lower lobes, the patient was treated in supine with the foot of the bed raised 46 cm, (b) for collapse of the posterior basal segments of the lower lobes, the patient was treated in 1/4 to prone, head turned to the side and the foot of the bed raised 46 cm, (c) for collapse of the medial basal segment, the patient was treated in right-side-lying with the foot of the bed raised 46 cm, (d) for collapse of the lateral basal segment, the patient was treated in left-side-lying with the foot of the bed raised 46 cm. After this the patient was subjected to percussion for five minutes followed by a sterile suction procedure.

Group B: These 8 sedated patients received the same inhalation therapy as Group A. During inhalation the patient was placed in a modified postural drainage position in supine (anterior basal lobe collapse) or side lying (lateral basal lobe collapse and medial basal lobe collapse) or 1/4 to prone (posterior basal lobe collapse) (not head down, i.e. in the Trendellenburg position). This was followed by treatment identical to that received by Group A.

Chest X-rays were taken of each patient and arterial blood-gas values were determined before physiotherapeutic treatment was started. The chest X-rays were taken on a daily basis and were evaluated by the consultant of the intensive care unit who was unaware as to which group the patient was in. Arterial blood-gas values were taken every 6 hours and were documented by the researcher in data form. From these values the diffusion gradient ($AaDpO_2$) was calculated as

$$AaDpO_2 = P_AO_2 - P_aO_2$$

The oxygen tension ratio between arterial blood and alveolar air (a/ApO_2) was calculated as $a/ApO_2 = P_aO_2 / P_AO_2$. The respiratory index (RI) was calculated as $RI = AaDpO_2 / P_aO_2$ and the venous shunt as P_aO_2 / FiO_2. The patient was subjected to a sterile endotracheal suction procedure performed every two hours by the nursing personnel as is the custom in these units. The patients received physiotherapy treatment twice daily. The underlying pathologies for all patients are listed in Table 1. Pneomothorax and pleural effusions were drained before physiotherapy treatment started.

RESULTS

Numerical variables were summarised throughout in the form of medians, minimums, and maximums. On average the patients in the postural drainage position group (Group A) required three treatments before the collapse was resolved as opposed to the average of 4,5 treatments required by the patients in the modified postural drainage position group (Group B) before the same result

Table 1. Underlying pathology causing atelectasis.

	Group A	Group B
Guillian – Barré Syndrome	0	1
Obstruction of bronchi / bronchioles	1	1
Pain due to rib fracture, post surgery	3	2
Pleural effusion	1	2
Pneumonia	2	1
Pneumothorax / Haemothorax	2	1
Total of patients	9	8

Table 2. Real Values (Median Values).

Arterial blood gas values	Before first treatment		After final treatment	
	Group A	Group B	Group A	Group B
pH	7,43	7,40	7,45	7,45
$PaCO_2$	38,10	40,50	43,50	35,00
PaO_2	74,00	89,00	97,00	90,00
SaO_2	93,90	96,10	97,80	96,40
$AaDpO_2$	112,00	96,30	86,00	92,50
a/ApO_2	39,70	47,85	52,95	49,30
RI	151,00	110,50	88,50	102,00
Venous shunt	185,00	222,50	259,25	225,00

Table 3. Differences (Median Values).

Arterial blood gas values	After first treatment - before first treatment		After final treatment - before first treatment	
	Group A	Group B	Group A	Group B
pH	0,00	0,01	0,03	0,04
$PaCO_2$	-2,00	-1,00	-4,00	-7,00
PaO_2	7,00	0,00	21,00	1,00
SaO_2	1,90	0,05	2,15	0,10
$AaDpO_2$	-7.10	-0.15	-19.85	-0.50
a/ApO_2	3,80	0,10	10,70	0,30
RI	-9,00	-2,50	-46,50	-1,00
Venous shunt	26,00	0,60	48,75	2,50

was obtained. In the case of the patients in group A, the collapse had already resolved on the follow-up chest X-ray which was taken the next day. Thus an average of 0 X-rays was required before the collapse was resolved. In the case of the patients in group B, the collapse had not resolved on the follow-up chest X-ray, taken the next day, and an average of 1 X-ray was required before the collapse was resolved. The arterial oxygen tension (PaO_2), oxygen saturation ($Sa0_2$), diffusion gradient ($AaDpO_2$), oxygen tension ratio between arterial blood and alveolar air (a/ApO_2), respiratory index (RI), and venous shunt values in group A changed considerably between the first and the final treatment, as opposed to the smaller changes that took place in the case of group B. The differences with regard to the above-mentioned variables after the first treatment as opposed to before the first treatment and after the final treatment (as opposed to before the first treatment) were apparently much greater in group A than in group B.

A Spearman Rank correlation test was performed to compare the PaO_2 and the SaO_2 before the first treatment, after the first treatment and after the final treatment. The correlation test was also performed for the differences after the first treatment – before the first treatment and after the final treatment – before the first treatment for group A and group B. For both groups there was a very strong correlation between the PaO_2 and the SaO_2 throughout.

Non-parametric 95% confidence intervals were calculated for the median of the differences between the two groups. For example, after the first treatment – before the first treatment PaO_2 equalled –81 for group A and 5,2 for group B which indicated that PaO_2 in group A increased more. Furthermore the corresponding differences in SaO_2 were –14,2 and 0,5 which indicated that SaO_2 in group A increased more. The venous shunt differences of –201,3 and 11,2 for the two groups respectively indicated a better gas exchange in the lungs of patients in group A, while the differences in $AaDpO_2$ of –4,7 and 81,8 for the two groups indicated that the diffusion gradient in group A decreased more.

DISCUSSION

As this pilot study involved only 17 patients (n=17), the group was too small to obtain a statistically significant difference between group A and group B with regard to the number of treatments and X-rays required before the collapse was resolved. However, there is a trend to suggest that the treatment of group A appeared more effective than that of group B because the patients in group A showed greater changes in the real arterial blood gas values with regard to PaO_2, SaO_2, $AaDpO_2$, a/ApO_2, RI and venous shunt values from before the first treatment to after the final treatment (see Table 2). As far as the differences in arterial blood gas values from after the first treatment – before the first treatment as opposed to after the final treatment (before the first treatment are concerned), the trend seems to suggest a greater change (improvement) in group A as far as PaO_2, SaO_2, $AaDpO_2$, a/ApO_2, RI and venous shunt values are concerned, as opposed to the minimal changes in group B (see Table 3).

In group A, Table 2 shows an increase in PaO_2 values from 74 prior to treatment to 97 after the final treatment. PaO_2 values for group B increased slightly from 89 prior to treatment to 90 after the final treatment. SaO_2 for group a increased 93,9 to 97,8 and for group B from 96,1 to 96,4. The $AaDpO_2$ for group A decreased from 112 to 86 after the final treatment. For group B this parameter decreased from 96,3 to 92,5. The greatest change was recorded for the venous shunt values. For group A, it increased from 185 prior to treatment to 259,25 after the final treatment. For group B, the venous shunt values increased slightly from 222,5 prior to treatment to 225 after the final treatment. A venous shunt value of more than 200 is indicative of satisfactory gas exchange. Reading these results it would seem that group B was not as severely ill as group A, but still group A had a larger venous shunt value after the final treatment than group B. As the PaO_2, SaO_2, $AaDpO_2$

and venous shunt have a direct influence on the oxygenation process in the lungs, there is a trend suggesting that the oxygenation process in the lungs of the patients in group A improved markedly in comparison to group B where the oxygenation process improved minimally according to values in Tables 2 and 3.

CONCLUSION

From the results and discussion of this pilot study, there is a trend to suggest that postural drainage positions lead to a greater improvement in the oxygenation process in the lungs and may lead to a quicker resolution of acute lobar atelectasis in the intubated patient.

Shortcomings of this study include a too small patient population to obtain a statistical difference between group A and group B. Also the length of stay in the intensive care unit and the period of intubation were not calculated.

It is suggested that a similar study be repeated on a larger group of patients over a longer time period in order to obtain statistical differences between patients treated in postural drainage positions and patients treated in modified postural drainage positions in the intensive care unit. The period of intubation and the length of stay in the intensive care unit should be monitored. The results of such a study could then determine the importance of the use of postural drainage positions with physiotherapy treatment in the intensive care unit.

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