THE EFFECT OF OPERATIVE LATERAL DECUBITUS AND SEMIFOWLER'S POSITION ON VITAL CAPACITY IN POST-OPERATIVE THORACOTOMY PATIENTS

by

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Date

DEDICATION

I dedicate this thesis to my parents, Mr. and Mrs. Roy F. Lyons, and to my friend, Marty, for their patience and encouragement throughout the past year.

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ABSTRACT

The purpose of this study was to determine the effect of operative lateral decubitus and semifowler's positioning on the vital capacity in post-operative thoracotomy patients. Seven patients consented to participate in the study. This study's conceptual framework was based on the physiological factors affecting pulmonary ventilation and perfusion. Pre-operative and post-operative vital capacity measurements were obtained with a Wright Respirometer with the subject positioned on the operative lateral decubitus side and in the semifowler's position.

Measures of central tendency and variation, and, two-way analysis of variance were utilized to analyze the data. The mean per cent difference, post-operatively, in the vital capacities lying on the operative lateral decubitus side versus the semifowler's position was -14.2 per cent. This difference was -1.7 greater than the pre-operative per cent difference, being greater in the direction opposite the semifowler's position. The t-test was 2.24 which indicated the results did not statistically support the hypothesis that post-operative thoracotomy patients will generate a greater vital capacity when lying on the operative lateral decubitus side than in the

semifowler's position. The pre-operative and post-operative values were compared and a summary completed.

CHAPTER I

INTRODUCTION

Post-operatively, pulmonary complications can be a frequent cause of morbidity in thoracotomy patients. These complications are caused by the thoracotomy which produces a temporary alteration in normal respirations, thus decreasing the lung volume. Surgical procedures involving the thorax result in a loss of the bellow effect of the diaphragm and thoracic cage, thus producing a reduction in the inspiratory period with each breath. This process does not permit natural sighing to occur and leads to atelectasis. By increasing the physiologic shunt, atelectasis changes the airway resistance, the work of breathing, and the lung compliance (Van De Water et al., 1972).

In 1963, Bendixen et al. stated that certain positions were possibly responsible for limiting the compliance of the lungs which results in atelectasis. In addition, other factors such as incisional pain, analgesic medication, prolonged effect of anesthesia, and general debility may affect ventilation. They found that atelectasis could be prevented with periodic deep breaths which limited the progress of alveolar collapse. This occurred as a result of higher pressures generated with deep breaths which open a completely collapsed air space. During normal tidal ventilation, the pressures and volumes are not great enough to re-inflate the collapsed air spaces. Thus tidal breathing is associated with increasing atelectasis.

Comroe et al. (1973) cited that a greater portion of the tidal volume enters the alveolar spaces with a deep breath. These findings emphasize the importance of post-operative coughing and deep breathing exercises for the thoracotomy patient. Turning accompanied with coughing and deep breathing decreases the occurrence of atelectasis by exposing various areas of the lungs to changes in ventilation and perfusion.

Statement of the Problem

What are the differences in the pre-operative and the post-operative vital capacity in thoracotomy patients when positioned in the operative lateral decubitus and in the semifowler's position?

Hypothesis

The post-operative thoracotomy patient will generate a significantly greater vital capacity when lying on the operative lateral decubitus side than when in the semifowler's position.

Purpose of the Study

The purpose of the study was to elicit the relationship between pulmonary ventilation and positioning. The results obtained from the study will enhance the nurse's knowledge in caring for patients with thoracotomies.

Significance of the Problem

As a result of the controversy in nursing literature regarding positioning of the patient who has undergone a thoracotomy (Caruso, 1973), the necessity to research various positions is of paramount importance. Documentation of the positions which generate an increase in vital capacity will suggest the most advantageous positions to decrease atelectasis, to promote re-expansion of the lung, and to maintain normal pulmonary ventilation and perfusion.

Conceptual Framework

The respiratory process is the transport of oxygen from the atmosphere to the cells, and the transport of carbon dioxide from the cells to the atmosphere. Pulmonary ventilation has to do with the actual inflow and outflow of air from the atmosphere and the alveoli. Ventilation provides the alveoli with the oxygen supply necessary for the gas exchange which takes place at that level.

The membranes of the lung's intrapleural space continually absorb any gas or fluid which enters, thus creating a partial vacuum which contributes to the lung's expansion.

The pressure of the fluid in the intrapleural space ranges between -10 and -12 mm Hg. This negative pressure maintains the visceral pleura tightly against the parietal pleura causing the lungs to enlarge when the chest cavity enlarges (Guyton, 1971).

The lung's total recoil tendency can be measured by utilizing the amount of subatmospheric pressure in the intrapleural spaces which is necessary to prevent the collapse of the lungs. This is the intrapleural pressure that normally is -4 mm Hg. As the alveolar spaces are opened to atmospheric pressure by way of the trachea, their pressure becomes atmospheric. But for the lungs to be maintained at the normal expanded size, the intrepleural space's pressure must be -4 mm Hg. (Guyton, 1971).

The ability of the lung to expand is called compliance. This is expressed as the volume increase in the lungs for each unit increase in intra-alveolar pressure. The combination of the compliance of the normal lungs and thorax is 0.13 liters per centimeter of water pressure. Thus, every time the alveolar pressure increases by one centimeter of water, the lungs expand 130 milliliters. Therefore, any condition which destroys lung tissue, blocks the alveoli, or in any other manner resists lung expansion and contraction creates a decreased lung compliance (Guyton, 1971).

The lungs are viscoelastic structures, thus a small quantity of intra-alveolar pressure will cause the lungs to expand to a comparable volume. As the intra-alveolar pressure increases, the ability of the lungs to expand to greater volumes also increases (Guyton, 1971). The thorax also possesses the viscoelastic properties. As the pressure in the lungs increases, it elicits a greater expansion of the thorax (Comroe, 1974).

The uneven expansion ratios result from variations in compliance and airway resistance, and the gradient in pleural pressure down the lung caused by gravitational forces. Alveoli with a high compliance tend to have a low expansion ratio. The differences contribute to spatial inequality of ventilation; that is, uneven ventilation with respect to volume when some alveoli have larger expansion ratios than others. Uneven ventilation with respect to time during inspiration and expiration when some alveoli fill and empty earlier is temporal inequality. This results from differences in resistance to flow of gas down the airway. The alveoli which fill early in inspiration are served by wide airways, whereas the alveoli served by the narrow airways tend to fill later in inspiration, since they take longer to fill (Cotes, 1965).

At the end-expiratory phase, the alveoli at the apices contain a greater amount of air than the alveoli at the bases. This is a result of the gravitational forces.

Alveoli at the bases can contain a greater amount of air than the apices, if inspiration commences at the functional residual capacity. This phenomenon occurs due to the lung's compliance which is nonlinear, and the alveoli in the lower transmural pressure range which receive more volume than the alveoli in a higher pressure range (Comroe, 1974).

With a decrease in pressure, the pulmonary vessels act passively and narrow. The variations of pressures in the lung are affected by the hydrostatic factors. In the upright position, the individual exhibits at the apices of the lung a pulmonary vascular pressure of about 10 mm Hg. less than in the middle at the level of the heart, and 20 mm Hg. less than at the bases. The hydrostatic effect produces differences in the flow of blood between the upper and lower lung. This is exemplified by the mean pulmonary artery pressure. At the level of the heart, the mean pulmonary artery pressure is 13 mm Hg., while it is about 3 mm Hg. at the apex, and 23 mm Hg. at the base. This verifies that the blood flow and blood volume at the bases are much greater than at the heart level (Guyton, 1971).

In the pulmonary vascular bed, gravity is the factor which elevates the pressure in the dependent area in comparison to the upper area, consequently the flow of the blood varies. In the upright position, the flow of blood is greater per unit of volume of lung at the bases than at the apices. In the lateral position, the blood flow is greater in the dependent lung, while in the supine position the flow is greater in the posterior than the anterior portions. Since the vertical dimension of the lung is less in the recumbent position, there is a more uniform perfusion (Cotes, 1965; West, 1974).

In the lateral decubitus position, gravity pulls the abdominal viscera toward the recumbent side, thus increasing the mobility of the lowermost diaphragm, and increasing the ventilation and perfusion of the recumbent lung (Bjorkman, 1934).

Assumptions

1. Incisional pain from the thoracotomy will influence the patient's ability to take a deep breath.
2. A decrease in ventilation may occur as a result of depression of the respiratory center produced by narcotics, sedatives, and anesthesia.
3. Turning, coughing, and deep breathing promote re-expansion of the lungs, increase lung volume, and assist in maintaining normal ventilation of the lung, thus preventing atelectasis.

Definitions

1. Vital capacity--the maximum volume of gas which is forcefully expelled from the lungs after a maximal inspiration (Comroe et al., 1973).

2. Atelectasis--the collapse of alveoli results from the bronchioles becoming obstructed causing stagnation of air in alveoli which is absorbed by the capillaries.
3. Semifowler's position--that position which is 30° upright from the supine position.
4. Operative lateral decubitus position--that position which is lying flat with the operative side recumbent while the other lung is uppermost.

Limitations

This study was limited by the following factors:

1. The study was permitted in one hospital in a large city.
2. The study sample included seven patients.
3. The age range of the study's subjects was wide.
4. The reason for the thoracotomy varied.
5. Lung resection occurred for three subjects.

CHAPTER II

REVIEW OF LITERATURE

The review of literature includes the effects of posture on intrapleural pressure, vital capacity, ventilation and perfusion, and atelectasis as a result of the thoracotomy.

The Effects of Posture on Intrapleural Pressure

Krueger, Bain, and Patterson (1961) and Turner (1962) demonstrated with dogs, held in the vertical position, that the intrapleural pressure increased by 0.21 centimeters of water by descent caudally. In the horizontal position, this gradient was absent.

Daly and Bondurant (1963) measured intrapleural pressure directly by utilizing the upper xenon 133 counter. They were able to elicit the absolute intrapleural pressure to be 5 centimeters of water more negative than the pressure beneath the counter in the lower zone. This indicated the intrapleural pressure swing in the upright position in the lower portion of the thorax was greater.

Milic-Emili et al. (1966) found that the vertical direction elicited a varying degree of regional lung expansion in the direction of gravity. In the upright position, the intrapleural pressure becomes progressively more subatmospheric from the lung's bases to the apices. Various positions were measured, and demonstrated the gradient to follow the direction of gravity. The dependent zones are always less subatmospheric, and consequently less expanded than the upper zones.

Effects of Position on Ventilation

Svanberg (1957, 1966) found the distribution of function between the lungs was 53 per cent for the right lung, and 47 per cent for the left lung, in the erect or supine position. When the person was placed in the right lateral position, the right lung increased its function to 59 per cent. In the left decubitus, the left lung's participation in total function also increased.

Kaneko et al. (1966) demonstrated the upper lung regions expanded more than the lower regions. This was detected when the lung volumes (residual volume, functional residual capacity, and expiratory reserve volume) were increased to greater than 30-50 per cent of total lung capacity (expressed as a fraction of the volume of each region at maximal inspiration), but was position dependent. The rate of regional expansion was invariable in each region which was demonstrated by the linear relationship between regional and overall lung volumes. The zones did not fill sequentially, but the dependent regions received a greater proportion of inspired volume than the upper zones. This occurred at all lung volumes greater than approximately 50 per cent of the total lung capacity, in all positions. In the lateral position, the lungs demonstrated an even greater proportion of inspired volume to the dependent zones than in the supine or prone positions. This was a result of the differences in the overall vertical lung distance in these positions.

In normal seated men, it was demonstrated by xenon^{133}, that regional volumes were greater in the upper zone than in the lower zone. If the lung volume was increased from the residual volume to approximately 20 per cent of the vital capacity, the changes in the regional lung volume were greater in the upper than the lower regions. The opposite was true at higher lung volumes. Thus varying both the preinspiratory lung volume and the tidal volume showed an effect on regional distribution of ventilation (Milic-Emili et al., 1966).

Milic-Emili et al. (1966) described the wide variation in alveolar size in the normal upright man. The lower lobe alveoli are smaller than the upper lobe alveoli at the normal resting phase. The smaller alveoli are more distensible to maximum volume than the larger alveoli. Thus, the lower zones have a greater quantity of air exchange than the upper lungs.

Bjorkman (1934); Jacobeus (1938); Frenkner (1950); Rothkstein, Landis, and Narodich (1950); and Steinman (1964) demonstrated an increase in oxygen uptake and ventilation. This occurred in the lateral positions in the recumbent lung.

Effects of Position on Perfusion

Svanberg (1955, 1957) studied 144 subjects with localized lesions in the bases or apices of the lung. He demonstrated that with impaired circulation to the upper half of the lung, that the oxygen uptake of that lung was greater in the sitting position. With the impaired circulation at the bases, the oxygen uptake of that lung was greater in the supine position. In patients with thoracoplasty, a greater increase was demonstrated in the oxygen uptake of the collapsed lung in the sitting position than in the supine position.

Heckscher, Larsen, and Lassen (1966) studied regional lung function using $xenon^{133}$. They found the mean $xenon^{133}$ perfusion ratio of the lower and upper lung area was significantly influenced by disease. The effect was a decrease in pulmonary blood flow on the affected side. The mean left-right ratio of the vital capacity and ventilation demonstrated decreased values of the affected lung in comparison with the healthy lung.

Autio and Lahesmaa (1963) performed differential spirometries in varying positions on normal subjects and subjects with pulmonary tuberculosis. There was an increase in ventilation of the recumbent lung, and also a greater perfusion as discerned by an increase in oxygen uptake. The shift on the mediastinum and the diaphragm, in the lateral decubitus, altered the resting ventilation of the lower lung in the expiratory direction. The vital capacity did not change equally.

Lopez-Majano (1970) studied the influence of position and disease on the distribution of pulmonary ventilation and circulation, using differential spirometry. When the right lung, whether "diseased" or "healthy," was in the lowermost position, an increase in the mean ventilation was elicited. This was also true for the left lung. When the right lung was uppermost, there was a significant decrease in its oxygen uptake, while the recumbent lung increased its volume of oxygen. There was a significant increase of the total oxygen uptake demonstrated in the left lateral decubitus and the erect position. Independent of the localization of the disease and/or the body position, there was no significant alteration in the vital capacity.

Effect of Position on Vital Capacity

Caruso (1973) measured vital capacity in the right and left lateral decubitus positions pre-operatively and post-operatively in thoracotomy patients. She found the patient generated a greater vital capacity pre-operatively when lying on the unaffected side. The mean per cent difference between sides was 9.6 per cent which was not a significant difference. Post-operatively, the patient generated a greater vital capacity when lying on the affected side. The mean per cent difference between sides was 36.9 per cent. This was statistically and clinically significant.

In comparing the pre-operative values with the post-operative values, Caruso found the vital capacity to be significantly decreased post-operatively. The mean per cent difference was demonstrated to be 60 per cent lying on the unaffected side which was a significant difference.

Atelectasis as a Result of the Thoracotomy

Browne et al. (1970) studied 326 patients who had undergone left thoracotomy for repair of hiatus hernia. The first group of 226 patients demonstrated a 50.8 per cent incidence of atelectasis post-operatively in the lower zone of the contralateral dependent right lung. The results were in agreement with those results of Craig, Bromley, and Williams (1962). The explanation of the mechanism of the occurrence was similar to Milic-Emili et al. (1966). The forces which maintain the mediastinum's position were reduced as a result of the opening of the left pleura and incising the diaphragm. This resulted in the displacement of the mediastinum into the right hemithorax, depressing the dependent right lung, and causing that portion of the lung to behave as if it was at low lung volume, having a diminished elastic recoil. The intrapleural pressure tended to close some of the airways, trapping the gas in the distal alveoli. There may or may not be subsequent atelectatic areas created, depending on the alveoli's perfusion in the closed zone, the contained gas's solubility, and the presence of collateral ventilation.

CHAPTER III

RESEARCH PROCEDURES

Design of the Study

This study used a comparative design to demonstrate how the semifowler's and operative lateral decubitus positions influenced vital capacity thoracotomy patients. Measurements of vital capacity were taken pre-operatively and post-operatively.

Measurements

Two tools were used for measuring. One was the Wright Respirometer. The other was the goniometer.

Wright Respirometer

A Wright Respirometer was utilized to measure the vital capacity. This instrument has a rotating vane which drives a clockwork mechanism. The expiratory volume pushes against the rotor which drives the clockwork mechanism (Cotes, 1965). The Respirometer does not interfere with the subject's normal breathing maneuvers, since there is a low resistance factor of 2 cc of water at a flow of 100 liters per minute (Young and Crocker, 1970).

The mouthpiece was attached to the Wright Respirometer. The subjects were familiarized with the equipment and breathed through the mouthpiece before obtaining measurements.

As in Caruso's (1973) study, slow exhaled vital capacity measurements were made. This was performed to avoid the effect of airway obstruction on forced vital capacity. Three measurements were taken in each position with the best result from each position used for analysis.

Goniometer

The goniometer was utilized to measure the 30° elevation of the head of the bed. The goniometer has 0 to 180 degree increments with a rotating arm which is secured in the middle of the hemisphere. The arm was pointed to the selected degree, giving the angle to which the head of the patient's bed was elevated.

Population and Study Sample

The seven patients participating in the study met the following criteria: underwent a thoracotomy, and were alert and able to cooperate post-operatively to obtain the data. Written permission was obtained from the patients prior to initiating the study.

Method of Data Collection

The study was approved by the hospital (see Appendix A). Consent was obtained from the surgeons (see Appendix B). The patients were approached pre-operatively, and permission was obtained for participation in the study (see Appendix C).

Pre-operatively, the patients were given a brief explanation of the study, and their involvement, if they should choose to participate (see Appendix D). Further explanation of the study was given according to the patient's questions. Instruction in and demonstration of deep breathing was given by the researcher.

Pre-operatively, the patient was randomly positioned in either the semifowler's or operative lateral decubitus side first. The vital capacity was measured in each of these positions three times using the Wright Respirometer. The results were recorded on data sheets for each patient.

Post-operatively, when alert and able to cooperate, the patient was randomly positioned in the semifowler's or the operative lateral decubitus position. The vital capacity was measured in that position. After an interval of two hours, the patient was placed in the alternative position. The vital capacity was taken three times in each of these positions using the Wright Respirometer. The best result for each position pre-operatively and post-operatively was selected to be utilized for analysis.

Method of Analysis

The data for each patient were recorded on raw data sheets (see Appendices E and F). The data were analyzed utilizing the measures of central tendency and measures of variation (Abdellah and Levine, 1965). After the vital capacity was measured three times pre-operatively and post-operatively, the best result from each position was selected for analysis. The pre-operative and post-operative differences in volumes with the patient lying on his operative lateral decubitus side and in the semifowler's position were compared. The patient was used as his own control.

The pre-operative vital capacity value was compared with the post-operative vital capacity value of lying on the operative lateral decubitus side. The same procedure was utilized for the semifowler's position. This difference (pre-operative vital capacity on the operative lateral decubitus side minus the post-operative vital capacity lying on the operative lateral decubitus side) was divided by the pre-operative vital capacity on the operative lateral decubitus side to determine the per cent difference for the operative lateral decubitus side. The same process was utilized to determine the pre-operative/post-operative per cent difference for the semifowler's position. The mean per cent differences were tested for significance using the t-test.

A two-way analysis of variance was used. This elicited a greater degree of information as to the effects of the two independent variables and their interaction. The means of the vital capacities for each of the two positions in the pre-operative and the post-operative phase were computed, and the interaction between the two were tested.

CHAPTER IV

PRESENTATION AND ANALYSIS OF DATA

The characteristics for the sample are presented in this chapter. The data from pre-operative and post-operative measurements of vital capacity and the analysis are presented.

Sample

Seven patients from one hospital in El Paso met the criteria for acceptance in the study. The sample was composed of two females and five males, with an age range of 29 years to 72 years. The mean age was 52.2 years.

Four thoracotomies were performed on the right side, and three were on the left side. The number and types of thoracotomies are categorized as follows: pneumonectomy (2), lobectomy (1), exploratory thoracotomy with biopsies (2), excision of pericardial cyst (1), and a resection of a lytic lesion of the eleventh rib (1). The four right-sided thoracotomies were performed as a surgical treatment of: a bulbous emphysemic lobe, biopsies of the lung and pleura, and small cell anaplastic carcinoma. The three left-sided thoracotomies were performed for surgical treatment of: aplastic carcinoma, excision of pericardial cyst, and bronchogenic carcinoma.

The data related to the sex, age, procedure, number of chest tubes, diagnosis, analgesia, number of hours post-operative when measurements were taken and the initial side of positioning are presented in Table 1. The data related to the sex, age, height, weight, estimated vital capacity, and incidence of post-operative atelectasis are presented in Table 2.

Findings of Pre-Operative and Post-Operative Vital Capacity Measurements

The data from the seven patients in the study are presented in the following tables and figures. The data related to pre-operative vital capacities with operative lateral decubitus side down versus lying in the semi-fowler's position are seen in Table 3 and Figure 1.

It can be seen that pre-operatively four of the subjects had greater vital capacities lying in the semi-fowler's position than on the operative lateral decubitus side. Two subjects had a greater vital capacity lying on their operative lateral decubitus side (4, 5). One subject did not generate a greater vital capacity in either of the positions. The mean per cent difference in volume was 8.4 per cent with the vital capacity taken while lying in the semifowler's position larger than on the operative lateral decubitus side. The line labeled "M" in Figure 1 indicates the mean vital capacities, pre-operatively, lying on the operative lateral decubitus side and in the semifowler's

Table 1. Sex, Age, Procedure, Number of Chest Tubes, Diagnosis, Analgesia, Number of Hours Post-Operative, and Initial Side of Positioning of Subjects

Subject	Sex	Age	Procedure	Number of Chest Tubes	Diagnosis	Analgesia	Number of Hours Post-Operative	Initial Side of Positioning
1	M	29	Right Middle Lobectomy	2	Right Middle Bulbous Emphysemic Lobe with Large Bleb	Morphine Sulfate 10 mgm IM 2' before measurements	18.5	Semi-fowler's
2	M	59	Left Pneumonectomy with Resection of Three Ribs	0	Aplastic Squamous Cell Carcinoma	Morphine Sulfate 10 mgm 1.5' before measurements	22	Semi-fowler's
3	M	72	Right Thoracotomy with Right Lung and Pleural Biopsies	2	Mesothelioma	Demeral 75 mgm IM 3' before measurements	21.5	Operative Lateral Decubitus

Table 1.--Continued Sex, Age, Procedure, Number of Chest Tubes, Diagnosis, Analgesia, Number of Hours Post-Operative, and Initial Side of Positioning of Subjects

Subject	Sex	Age	Procedure	Number of Chest Tubes	Diagnosis	Analgesia	Number of Hours Post-Operative	Initial Side of Positioning
4	M	41	Left Thoracotomy	2	Excision of Pericardial Cyst	Morphine Sulfate 10 mgm IM 3' before first measurement and 30" before second measurement	21.5	Semi-fowler's
5	F	59	Left Pneumonectomy with Biopsies	1	Bronchogenic Carcinoma	Morphine Sulfate 5 mgm IM 3' 15" before measurements	24	Semi-fowler's
6	M	67	Bronchoscopy with Right Thoracotomy with Biopsies	2	Small Cell Anaplastic	Demeral 50 mgm 5' 30" before measurements	18.5	Operative Lateral Decubitus

Table 1.--Continued Sex, Age, Procedure, Number of Chest Tubes, Diagnosis, Analgesia, Number of Hours Post-Operative, and Initial Side of Positioning of Subjects

Subject	Sex	Age	Procedure	Number of Chest Tubes	Diagnosis	Analgesia	Number of Hours Post-Operative	Initial Side of Positioning
7	F	49	Right Thoracotomy, Pleural Exploration, Thoracentesis, and 11th Rib Resection	2	Multiple Myeloma	Morphine Sulfate 10 mgm IM 5' before first measurement and 30" before second measurement	17	Semi-fowler's

Table 2. Sex, Age, Height, Weight, Estimated Vital Capacity, and Incidence of Post-Operative Atelectasis of Subjects

Subject	Sex	Age	Weight	Height	Estimated Vital Capacity[a]	Incidence of Post-Operative Atelectasis by Radiographic Studies
1	M	29	79.0 kg	177.8 cm	4335 ml	Minimal left lower lobe infiltrate
2	M	59	74.9 kg	180.3 cm	3791 ml	Minimal zone of discoid atelectasis in the right lung
3	M	72	105.3 kg	175.3 cm	3436 ml	Persistent right pleural effusion and an infiltrate at the right base
4	M	41	105.3 kg	185.4 cm	4262 ml	No abnormal changes in the lungs
5	F	59	63.6 kg	162.6 cm	2572 ml	Right lower lobe discoid atelectasis
6	M	67	110.0 kg	179.0 cm	3598 ml	Right lower lobe infiltrate and right pleural effusion; left middle and lower lobe infiltrate
7	F	49	79.5 kg	165.0 cm	2772 ml	No abnormal changes in the lungs

Estimated Vital Capacity Formula Males Vital Capacity = [27.63 − (0.112 age)] x (height in cm)

Females = [21.78 − (0.101 age)] x (height in cm)

[a]From Comroe et al. (1973, p. 10).

Table 3. Pre-Operative Vital Capacity Lying with Operative Lateral Decubitus Side Down Versus Lying in the Semifowler's Position

Subject	Operative Operative Lateral Decubitus Side	Semifowler's Position	Difference: Semifowler's - Operative Lateral Decubitus	% Difference: (Semifowler's - Operative Lateral Decubitus) / Semifowler's
1	3900 ml	3900 ml	0 ml	0
2	3000 ml	3100 ml	100 ml	3.2
3	4600 ml	6100 ml	1500 ml	24.6
4	5500 ml	5410 ml	-90 ml	-1.7
5	2950 ml	2420 ml	-530 ml	-21.9
6	2250 ml	2390 ml	140 ml	5.9
7	2050 ml	4000 ml	1950 ml	48.8
Mean Per Cent Difference				8.4

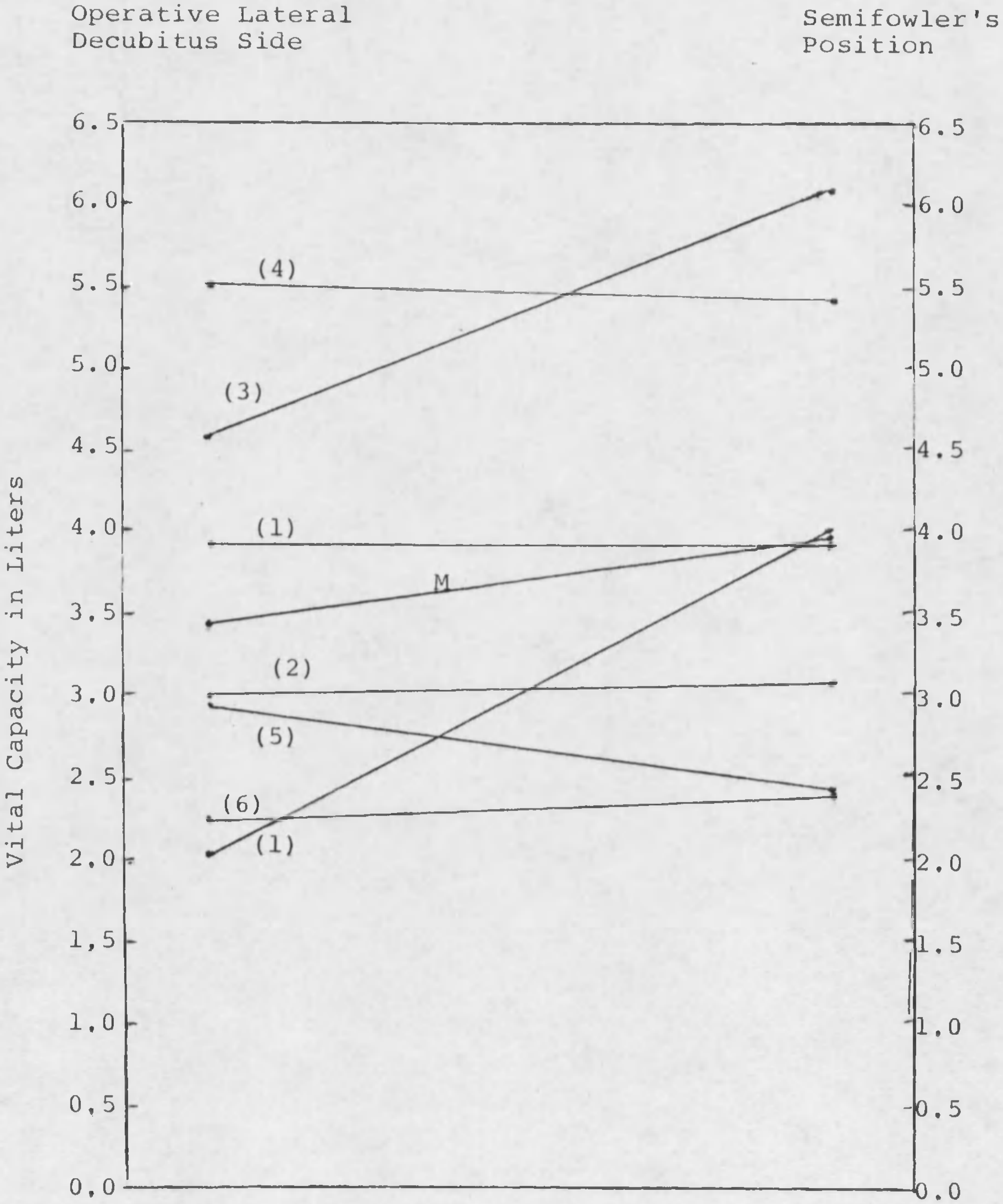

Figure 1, Pre-Operative Vital Capacity Lying on the Operative Lateral Decubitus Versus Lying in the Semifowler's Position

position. These means were 3464.3 ml and 3902.9 ml, respectively.

The data related to pre-operative vital capacities versus post-operative vital capacities lying in the semi-fowler's position are presented in Table 4 and Figure 2.

Table 4. Pre-Operative Vital Capacity in Semifowler's Position Versus Post-Operative Vital Capacity in Semifowler's Position

Subject	Pre-Operative Semi-fowler's	Post-Operative Semi-fowler's	Difference Pre-op - Post-op	% Difference (Pre-op - Post-op) / Pre-op
1	3900 ml	1250 ml	2650 ml	67.9
2	3100 ml	830 ml	2270 ml	73.2
3	6100 ml	3450 ml	2650 ml	43.4
4	5410 ml	870 ml	4540 ml	83.9
5	2420 ml	650 ml	1770 ml	73.1
6	2390 ml	1850 ml	540 ml	22.6
7	4000 ml	680 ml	3320 ml	83.0
Mean Per Cent Difference				63.9

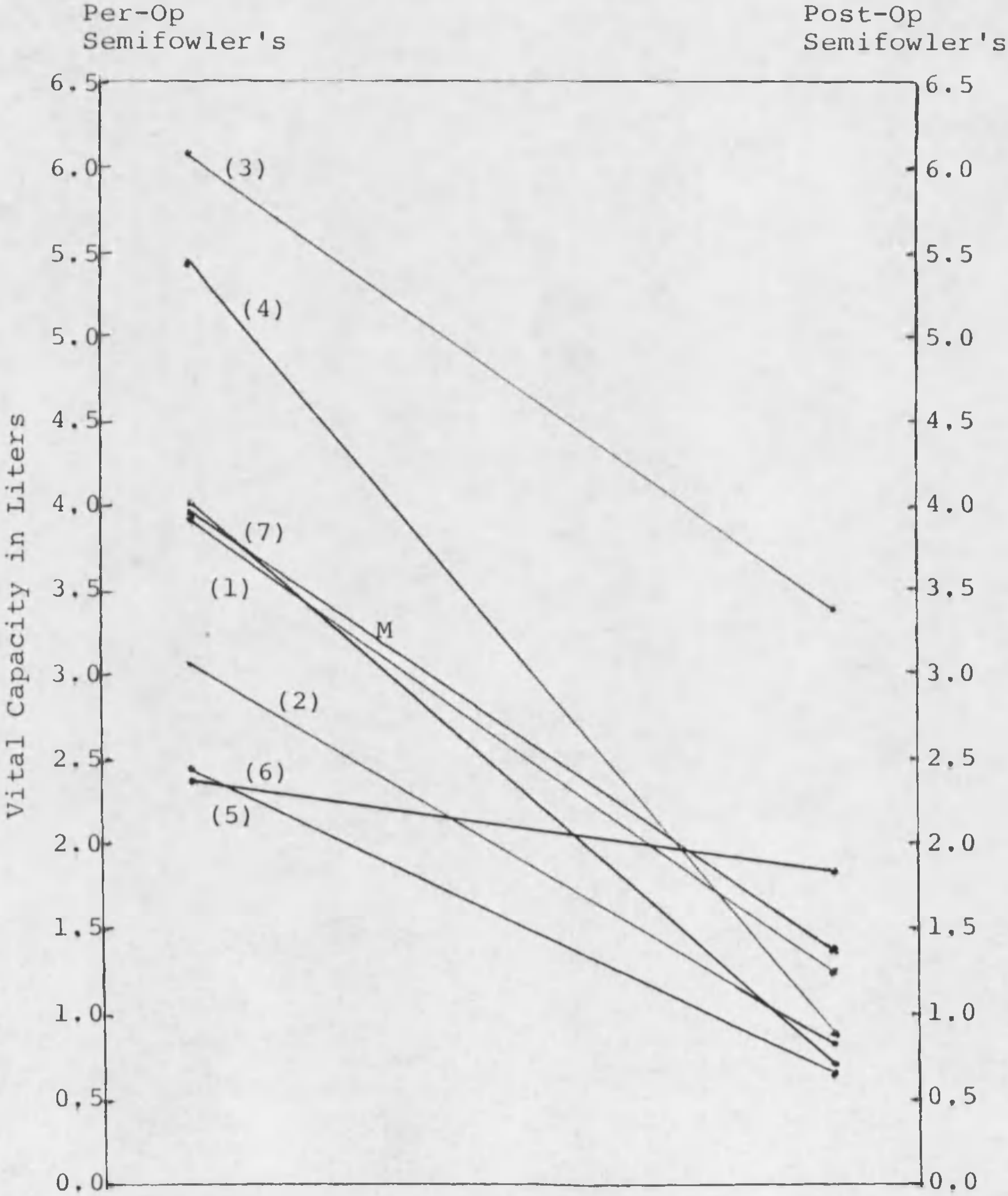

Figure 2. Pre-Operative Vital Capacity Lying in the Semifowler's Position Versus Post-Operative Vital Capacity Lying in the Semifowler's Position

Table 4 and Figure 2 demonstrate the mean per cent difference in the pre-operative vital capacities versus the post-operative vital capacities with the subjects in the semifowler's position was 63.9 per cent greater pre-operatively. The line labeled "M" in Figure 2 indicates the mean vital capacities, pre-operatively in the semi-fowler's position and the mean vital capacities post-operatively in the semifowler's position. These means were 3902.9 ml and 1368.7 ml, respectively.

The data related to preoperative vital capacities versus post-operative vital capacities lying on the operative lateral decubitus side are presented in Table 5 and Figure 3.

The mean per cent difference in pre-operative versus post-operative vital capacities with the subjects lying on their operative lateral decubitus side was 53.0 per cent. Six subjects had lesser vital capacities post-operatively lying on the operative lateral decubitus side than they did pre-operatively. One subject (3) had a greater vital capacity post-operatively lying on the operative lateral decubitus side than pre-operatively. The line labeled "M" in Figure 3 indicates the mean vital capacities, pre-operatively, lying on the operative lateral decubitus side and the mean vital capacities, post-operatively, lying on the operative lateral decubitus side. These were 3464.3 ml and 1622.2 ml, respectively.

Table 5. Pre-Operative Vital Capacity Lying on the Operative Lateral Decubitus Side Versus Post-Operative Vital Capacity Lying on the Operative Lateral Decubitus Side

Subject	Pre-op On Operative Lateral Decubitus Side	Post-op On Operative Lateral Decubitus Side	Difference Pre-op - Post-op	% Difference (Pre-op - Post-op) / Pre-op
1	3900 ml	1250 ml	2650 ml	67.9
2	3000 ml	860 ml	2140 ml	71.3
3	4600 ml	4625 ml	-25 ml	-0.5
4	5500 ml	1270 ml	4230 ml	76.9
5	2950 ml	700 ml	2250 ml	76.3
6	2250 ml	1950 ml	300 ml	13.3
7	2050 ml	700 ml	1350 ml	65.9
Mean Per Cent Difference				53.0

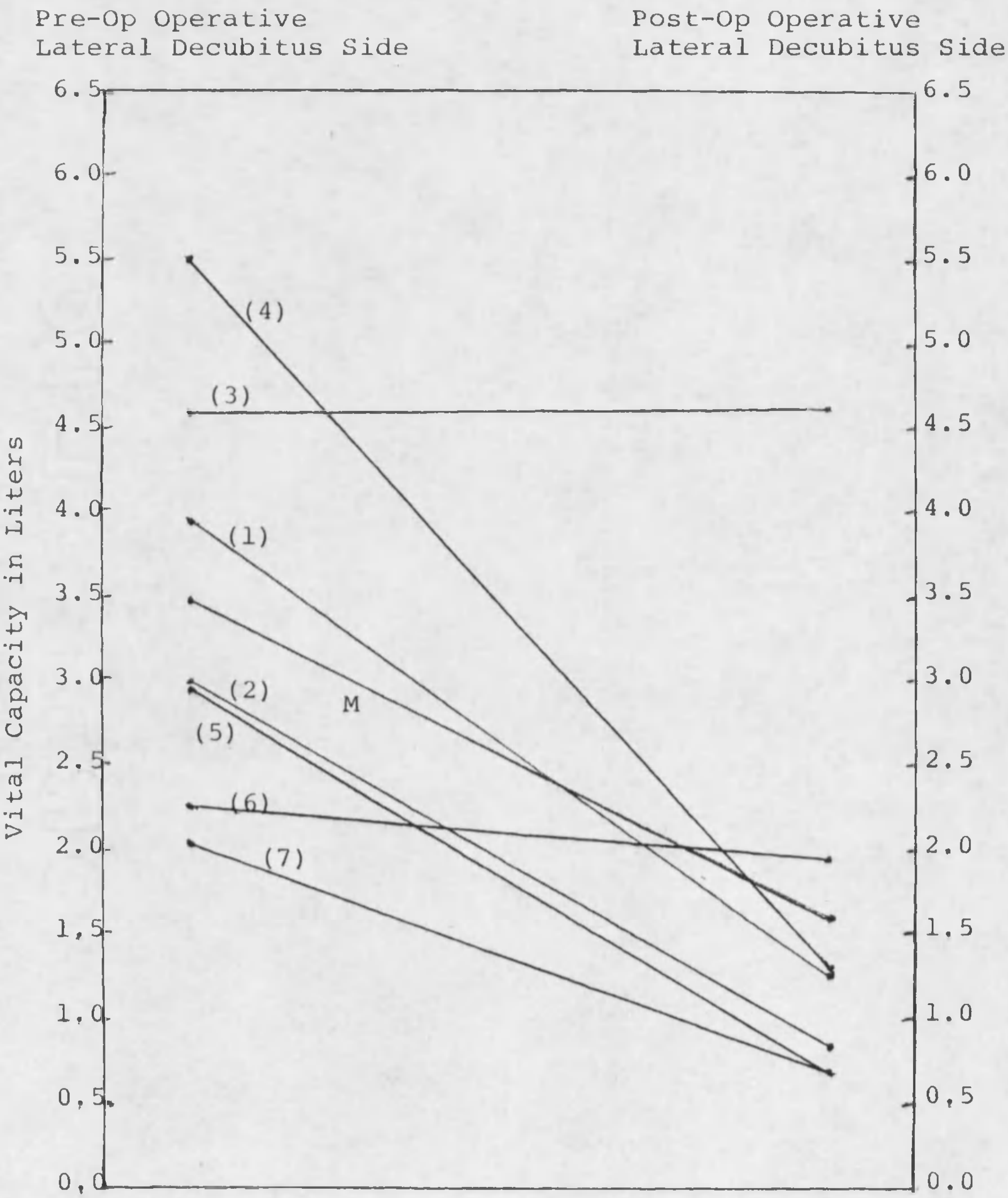

Figure 3. Pre-Operative Vital Capacity Lying on the Operative Lateral Decubitus Side Versus Post-Operative Vital Capacity Lying on the Operative Lateral Decubitus Side

Data related to post-operative vital capacities lying on the operative lateral decubitus side versus lying in the semifowler's position is presented in Table 6 and Figure 4.

Table 6. Post-Operative Vital Capacity with the Operative Lateral Decubitus Side Down Versus Post-Operative Vital Capacity in the Semifowler's Position

Subject	Post-op on Operative Lateral Decubitus Side	Post-op Semi-fowler's	Difference: Semifowler's - Op	% Difference: (Semifowler's - Op) / Semifowler's
1	1250 ml	1250 ml	0 ml	0
2	860 ml	830 ml	-30 ml	-3.6
3	4625 ml	3450 ml	-1175 ml	-34.1
4	1270 ml	870 ml	-400 ml	-46.0
5	700 ml	650 ml	-50 ml	-7.7
6	1950 ml	1850 ml	-100 ml	-5.4
7	700 ml	680 ml	-20 ml	-2.9
Mean Per Cent Difference				-14.2

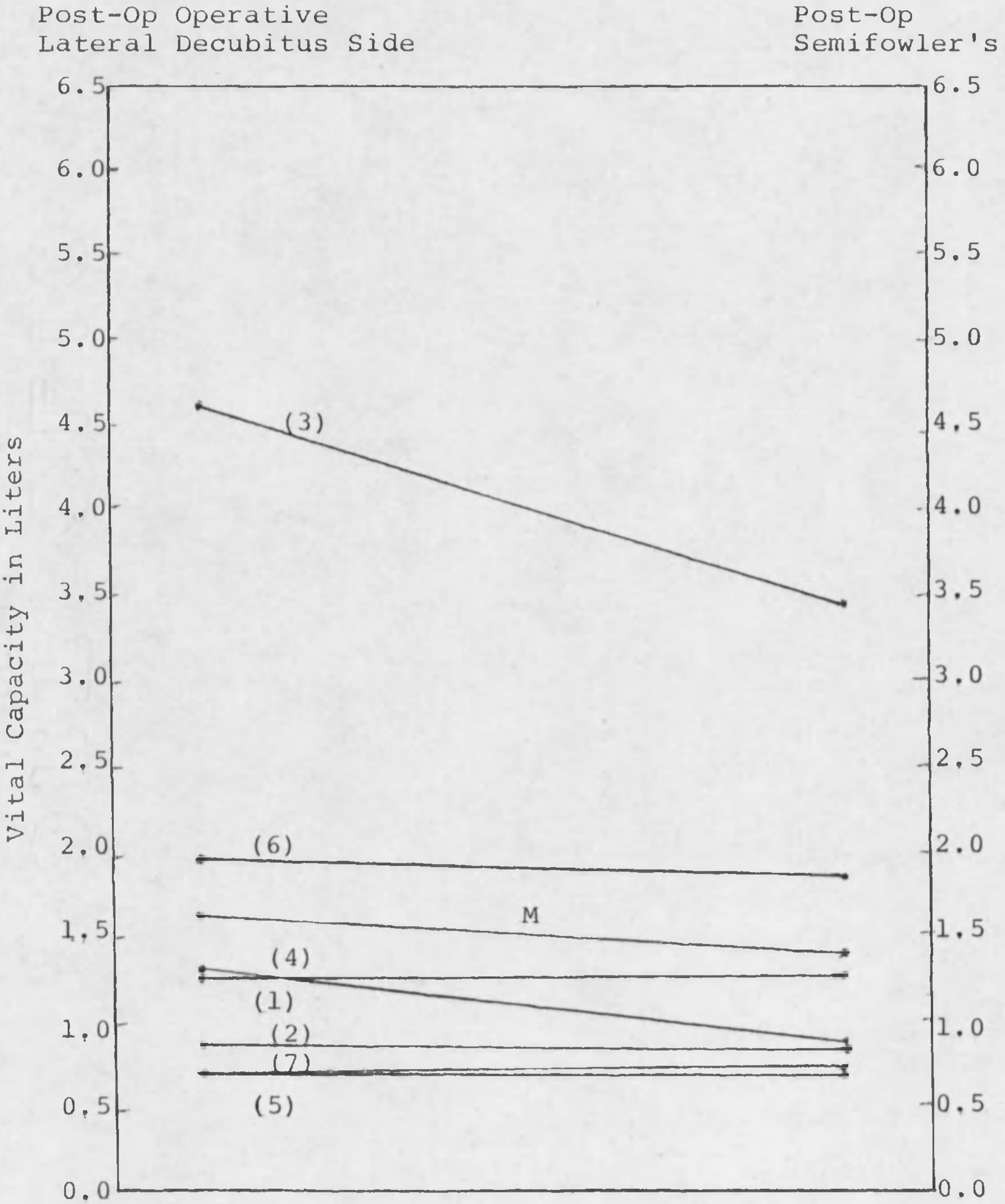

Figure 4. Post-Operative Vital Capacity Lying on the Operative Lateral Decubitus Side Versus Lying in the Semifowler's Position

In Table 6, the mean per cent difference in the vital capacities during the post-operative phase with the subjects lying on the operative lateral decubitus side versus lying in the semifowler's position was -14.2 per cent. Figure 4 shows that the subjects generated greater vital capacities lying on the operative lateral decubitus side. One subject (1) demonstrated no change in vital capacity with the change in position. The line labeled "M" in Figure 4 indicates the mean vital capacities, post-operatively, lying on the operative lateral decubitus side and the mean vital capacities, post-operatively, in the semifowler's position. These means were 1622.2 ml and 1368.7 ml, respectively.

Analysis of the Data

The measures of central tendency utilized were the mean and the median, and the measures of variation were the range and the standard deviation. From these, the standard errors were computed, the t-test applied, and the level of significance obtained.

The standard error was computed by dividing the standard deviation by the square root of the number in the sample. The t-test was then found by dividing the mean per cent differences by the standard error. The levels of significance of the t-test with 6 degrees of freedom were

2.447 at 5 per cent level, 3.707 at 1 per cent level, and 6.869 at .1 per cent level.

The pre-operative mean per cent difference of the vital capacity lying on the operative lateral decubitus side versus lying in the semifowler's position was calculated. to be 8.4 per cent. The results indicated that the vital capacity was greater while lying in the semifowler's position. Further data related to the pre-operative per cent differences of the vital capacity lying on the operative lateral decubitus side versus lying in the semifowler's position are presented in Table 7.

Table 7. Summary Table of the Measures of Central Tendency and Measures of Variation for the Pre-Operative Vital Capacity Lying with the Operative Lateral Decubitus Side Down Versus Lying in the Semifowler's Position

Mean	8.4
Median	3.2
Range	71.7
Standard Deviation	20.76
Standard Error	7.847
t-test	1.07
Degrees of Freedom	6
Significance Level	Not significant

With a mean of 8.4 and a median of 3.2, it can be deduced that there are fewer scores over the mean and more scores below the mean. As a result of only seven scores, the median becomes a more reliable measure of central tendency than the mean. With a range of 71.7 and a standard deviation of 20.76, the variation is far greater than the mean or median indicates. The range indicates the scores varied greatly which can be related to the two unexpected scores produced by subjects 4 and 5, which would also influence the mean, making it unreliable. The t-test was computed to be 1.07, which was not significant.

The pre-operative and post-operative mean per cent difference lying in the semifowler's position was calculated. to be 63.9 per cent, the vital capacity being greater while lying in the semifowler's position. Further data related to the pre-operative and post-operative per cent differences of the vital capacity lying in the semifowler's position are presented in Table 8.

With a mean of 63.9 and a median of 73.1, these values indicate that there were more scores above the mean than below. With a range of 62.3 and a standard deviation of 20.97, the variation is scattered more than centrally concentrated, which is indicated with the standard deviation being greater than one-fourth of the mean. The t-test value was 8.06, which was significant at a level greater than .001. The low scores were created by subjects 3 and 6.

Table 8. Summary Table of the Measures of Central Tendency and Measures of Variation for the Pre-Operative Vital Capacity in Semifowler's Position Versus Post-Operative Vital Capacity in Semifowler's Position

Mean	63.9
Median	73.1
Range	62.3
Standard Deviation	20.97
Standard Error	7.93
t-test	8.06
Degrees of Freedom	6
Significance Level	< .001

The pre-operative and post-operative mean per cent difference lying on the operative lateral decubitus side was calculated to be 53.0 per cent. Pre-operatively, the vital capacity was greater on the operative lateral decubitus side. Further data related to the pre-operative and post-operative per cent differences lying on the operative lateral decubitus side are presented in Table 9.

Table 9. Summary Table of the Measures of Central Tendency and Measures of Variation for the Pre-Operative Vital Capacity Lying on the Operative Lateral Decubitus Side Versus Post-Operative Vital Capacity Lying on the Operative Lateral Decubitus Side

Mean	53.0
Median	67.9
Range	78.4
Standard Deviation	29.94
Standard Error	11.316
t-test	4.68
Degrees of Freedom	6
Significance Level	< 0.01

With a mean of 53 and a median of 67.9, the median being greater than the mean indicates more scores are above the mean. The range is 78.4 and the standard deviation is 29.94. The standard deviation is greater than one-fourth of the mean which indicates the scores are greatly scattered. The standard deviation also establishes that the two low scores produced by subjects 3 and 6 greatly diverge from the other five well-balanced scores, thus distorting the mean. The t-test was 4.68, which was significant at a level greater than 0.01.

The post-operative mean per cent difference with the operative lateral decubitus side down versus lying in the semifowler's position was calculated to be -14.2 per cent, with the vital capacity greater in the direction opposite the semifowler's position. Further data related to the post-operative per cent differences of the vital capacity with the operative lateral decubitus side down versus lying in the semifowler's position are presented in Table 10. A mean of -14.2 and a median of -5.4 indicate that there are more scores above the mean. The range is 47 and the standard deviation is 16.77, which indicates the scores to be more consistent as a result of a smaller range and smaller standard deviation. There are five values which are within eight points of each other, and the other two values diverge greatly, affected by subjects 3 and 4. The mean per cent difference post-operatively was not

Table 10. Summary Table of the Measures of Central Tendency and Measures of Variation for the Post-Operative Vital Capacity with the Operative Lateral Decubitus Side Down Versus Post-Operative Vital Capacity in the Semifowler's Position

Mean	-14.2
Median	-5.4
Range	47.0
Standard Deviation	16.77
Standard Error	6.338
t-test	2.24
Degrees of Freedom	6
Significance Level	Not Significant

significant, but was -1.7 times greater than the pre-operative differences in the two positions. The t-test was 2.24, which was not significant. The operative lateral decubitus side had a greater vital capacity post-operatively while the semifowler's position had a greater vital capacity pre-operatively.

A two-way analysis of variance was also employed which enabled the researcher to study the effects of the two independent variables jointly and elicit the positions which were significant. The data related to the summary of mean vital capacities for two-way analysis of variance are shown in Table 11.

Table 11. Summary Table of Mean Vital Capacities for Two-Way Analysis of Variance

Mean of the Vital Capacities	Pre-Operative Values	Post-Operative Values
On the Operative Lateral Decubitus Side	3464.3 ml	1622.2 ml
Semifowler's Position	3902.9 ml	1368.7 ml

For these data, the F-test significant level was 6.95363. The differences between pre-operative and post-operative vital capacity values had a F-test of 7.199, which was significant at the .013 level, meaning that 1.3 per cent of the time it would be a result of chance. The differences between the vital capacity values on the operative lateral decubitus side versus the semifowler's position had a F-test of .408, and was not significant, since 52.9 per cent of the time it would be a result of chance. The interaction between the two positions and the pre-operative and post-operative phase was computed at .508, which was also not significant.

The hypothesis that post-operative thoracotomy patients generate a greater vital capacity while lying on the operative lateral decubitus side than in the semi-fowler's position was not shown statistically in this study.

CHAPTER V

DISCUSSION OF THE FINDINGS

The findings and their meaning in terms of nursing intervention are discussed in this chapter. Discussion of findings which vary from expected findings are included.

Discussion of Atypical Cases

Many of the findings in this study were predictable. The fact that most subjects generated a greater vital capacity pre-operatively than post-operatively regardless of the position in which they were placed is an expected finding. Further, that subjects could generate a greater vital capacity post-operatively lying on the operative lateral decubitus side was the premise of the study. Some subjects, however, varied from these expectations.

Pre-operatively, subjects tended to generate a similar vital capacity in the two positions or a greater vital capacity in the semifowler's position. These findings would be expected. However, two subjects (4 and 5) produced greater vital capacities, 90 ml and 530 ml, respectively, pre-operatively while lying on the operative lateral decubitus side. No reason for this difference can be given.

When comparing the pre-operative and post-operative vital capacities of subjects in the semifowler's position, it would be expected that the vital capacities would decrease post-operatively. In two cases (subjects 3 and 6) the per cent difference in the decrease was less than for the other subjects. Subject 6 had a chest tube in place pre-operatively to treat a pneumothorax. Therefore, his vital capacity was probably decreased pre-operatively, accounting for the small decrease in his vital capacity post-operatively. Normally, the intrapleural pressure maintains the visceral pleura tightly against the parietal pleura enabling the lungs to enlarge synchronously with the chest cavity. Subject 3 also had a smaller decrease in vital capacity than the other subjects. He was ambulated early, thereby probably promoting the intra-alveolar pressure to near normal levels, and enabling the lungs to expand to greater volumes.

When placed on the operative lateral decubitus side, the subjects would also be expected to generate a greater vital capacity pre-operatively. Subject 3, however, generated a slightly higher vital capacity post-operatively. This subject was ambulating soon after surgery. Subject 6 again had only a small decrease in vital capacity post-operatively. The pre-operative chest tube undoubtedly contributed to these findings as well.

Post-operatively, it was expected that the subjects would generate a greater vital capacity on the operative lateral decubitus side than in the semifowler's position.

The findings indicate this was true for all except one subject. Subject 1 generated identical vital capacities in both positions. It is interesting to note that subject 3 generated an 1175 ml increase in vital capacity lying on the operative lateral decubitus side.

The major subjective observation was the necessity for reinforcement and for questions of the physician's explanation of the surgical procedure and the seriousness of the operation. This reinforcement coupled with the expectations of the post-operative phase are very crucial in the patient's understanding of the need for deep breathing, turning, and coughing exercises.

Relationship of the Findings to Nursing Intervention

With the vital capacity as the index of change, the nurse can establish the position most effective to promote and to maintain normal ventilation and perfusion. Statistically, the difference between the two positions post-operatively was not significant, although there was a greater vital capacity generated on the operative lateral decubitus side than in the semifowler's position. The values ranged from 0 to 1175 ml, with most values ranging from 0 to 100 ml. It seems that the subjects are more likely to generate a greater deep breathing capacity on the operative lateral decubitus side than in the semifowler's position. Caruso's (1973) study also elicited the results of a greater vital capacity post-operatively with the patients lying on the affected side than on the unaffected side.

This study's post-operative mean per cent difference of the two positions was decreased as a result of the two unexpected scores established by subjects 3 and 4. Subject 3 could have created a greater vital capacity value as a result of early ambulation, as this was the only subject to ambulate very early in the post-operative phase. If early ambulation institutes a more normal ventilation process of the thoracotomy patient, ambulation of these patients would be of paramount importance. Early ambulation could be a greater stimulation to deep breathe, thus increasing the lung's compliance, and thereby combat the occurrence of alveoli collapse. Further study should be made as to the relationship of atelectasis in early ambulatory post-operative thoracotomy patients.

Subject 4 illustrated that could occur when the optimal analgesic level is achieved. Although alleviating the pain was an important factor for one subject, this was not a true sample of the total population. Another sample of the total population should be studied eliciting the results of vital capacities before and after the administration of an analgesic.

Early ambulation could be the reason for no incidence of atelectasis on the contralateral side, although subject 4 did demonstrate an infiltrate at the right base and an increase in the pleural effusion, post-operatively. Four subjects, in this study, demonstrated atelectatic areas on the contralateral side, one on the ipsilateral side, and two demonstrated no abnormal changes in the lungs by radiographic examination.

Post-operatively, atelectasis of the contralateral side occurs as a result of the surgery which displaces the mediasternum to the contralateral side, thereby constituting that portion of the lung to act as if at low lung volume. The deep breathing, turning, and coughing exercises are employed to re-establish the lung's pre-operative pulmonary ventilation and perfusion status. If along with this regime, early ambulation could be instituted, the possibility of alleviating pulmonary complications, or decreasing the duration of the occurrence could be effected.

Conclusion

While there is no statistical significance, clinically it is significant that a greater vital capacity is more likely to be generated with the patient lying on the operative lateral decubitus side rather than being placed in the semifowler's position.

Recommendations

The following recommendations for further investigation based on this study include:

1. Another study correlating vital capacity with pO_2, specifically noting vital capacity differences between positions and their relationship to the pO_2.
2. A study of the occurrence of atelectasis in post-operative thoracotomy patients, including the area of atelectasis, duration of the process, and the occurrence and duration of the process with early ambulation.
3. A study of the results of vital capacities before and after the administration of the analgesic, in post-operative,thoracotomy patients.
4. A study of the vital capacities, in normal subjects, in the lateral decubitus positions and correlation of the values as to side of dominance.

CHAPTER VI

SUMMARY

The purpose of this study was to elicit some relationship between pulmonary ventilation and positioning, utilizing the vital capacity measurements as an index of change. The study attempted to define the effects of operative lateral decubitus and semifowler's positioning on vital capacity in post-operative thoracotomy patients.

The problem is a significant one, in that nursing intervention given to post-operative thoracotomy patients should enhance optimal pulmonary ventilation and perfusion, thus decreasing the occurrence of atelectasis, a frequent cause of morbidity in thoracotomy patients. With the vital capacity as an index of change, the nurse can determine the most advantageous position for that patient, thereby promoting re-expansion and maintaining normal pulmonary ventilation and perfusion.

The seven patients who consented to participate in the study underwent a thoracotomy under general anesthesia. They were alert and able to follow directions within 17 to 24 hours post-operatively. Prior to surgery, the patients were approached and their consent obtained. An explanation of the study was given, with instruction in and demonstration of deep breathing. The vital capacity measurements were obtained utilizing the Wright Respirometer. The measurements were taken three times lying on the operative lateral decubitus side and three times in the semifowler's position. The same procedure was repeated post-operatively between 17 and 24 hours after surgery. There was an interval of half an hour between measurements, and initial side of positioning was randomly selected.

The measures of central tendency and measures of variation used with the t-test and two-way analysis of variance were employed to analyze the data. The findings of this study related to the effects of operative lateral decubitus and semifowler's positioning on the vital capacity in thoracotomy patients include the following.

Pre-operatively, the mean per cent difference between the operative lateral decubitus side versus the semifowler's position was 8.4 per cent, with the vital capatitiy greater while lying in the semifowler's position. This difference was not significant.

Post-operatively, the mean per cent difference lying on the operative lateral decubitus side versus lying in the semifowler's position was -14.2 per cent, with the vital capacity greater in the direction opposite the semifowler's position. This difference was not statistically significant, but was -1.7 times greater than the pre-operative differences in the two positions.

The pre-operative mean per cent difference compared with the post-operative mean per cent difference lying in the semifowler's position showed a mean per cent difference of 63.9 per cent. This was significant. The comparison of the pre-operative and post-operative mean per cent values for lying on the operative lateral decubitus side demonstrated a mean per cent difference of 53.0 per cent. This was also significant.

The two-way analysis of variance was employed. This analysis demonstrated the difference between the pre-operative and post-operative values to be 7.199, which was significant. The differences between values on the operative lateral decubitus side and in the semifowler's position was .408 and was not significant. The interaction between the pre-operative and post-operative phase and the two positions was .508, and was also not significant.

APPENDIX A

HOSPITAL CONSENT

Mary E. Lyons has obtained this hospital's permission to utilize patients who are undergoing thoracotomies. This consent is given with the stipulation that the researcher obtains the physician's consent and the patient's consent.

Date______________________

Signature__________________

Title_____________________

APPENDIX B

CONSENT FORM FOR ATTENDING PHYSICIAN

Mary E. Lyons has obtained my permission to utilize my patients in collecting data for a research study conducted through The University of Arizona, College of Nursing, Graduate Division. This consent is given with the stipulation that the researcher obtains consent from each patient and from the hospital.

Signature ____________________

Date ________________________

APPENDIX C

PATIENT CONSENT FORM

I hereby consent to participate in this study conducted by Mary E. Lyons, R.N. I understand the following:

1. I may withdraw from this study at any time, and this decision will in no way affect my future care.
2. All information will be confidential, and I will not be identified in any report given of this study.
3. Prior to surgery, I will be instructed in deep breathing.
4. Measurements of vital capacity (expired air) will be taken while I am upright 30°, and when lying on my operative side before and after surgery.
5. This procedure is not painful, harmful, and does not interfere with normal breathing.

Signature______________________

Date___________________________

Forma de Consentimiento

Yo Concientó a participar en este estudio iniciado par Mary E. Lyons, R.N. Yo entiendo lo sigiente:

1. Puedo retirarme de este projecto a cual quier hora y esta decision no afectara me cuidado futúro.
2. Toda informacion sera confidencial, el reporte sera anónimo.
3. Antes de cirujia, me daran instruciones en respirar profundamente.
4. Me temaran dos differente medidas de la capacidad de aire al respirar. La primera posiscion sera con la cabeza elevada 30 grados: la segunda sera mientras este acostado en el mismo lado de mi operación. Este prueba sera hecha antes y después de mi operación.
5. Este tratamiento no me causará dolor, en ninguna manera afectara mi salud o respiración.

Firma________________________

Fecha________________________

APPENDIX D

EXPLANATION OF THE STUDY

I am a graduate student at The University of Arizona, College of Nursing. I am interested in establishing the best position for thoracotomy patients to promote maximal pulmonary ventilation and perfusion post-operatively.

If you agree to participate in this study, I will visit on the day prior to surgery and will instruct you in coughing and deep breathing. I will then take measurements of the amount of air moving into and out of your lungs during each breath, and the amount of air you expire from a deep breath, using a simple instrument into which you breathe. These measurements will be taken while you lie on your operative side and while you are upright 30°. This procedure will be repeated post-operatively. The procedure will in no way interfere with your normal breathing, harm you, or cause you pain.

All information obtained from you will be kept confidential, and your name will not be utilized in reporting any part of the study. At any time you may withdraw from this study without any effect on your future care.

APPENDIX E

PATIENT PROFILE

Name ______________________________

Sex ________

Age ________

Height __________

Weight __________

Health History: Pulmonary disease ______________________________
Heart disease ______________________________
Smoking ______________________________

Occupational History: ______________________________

Anesthesia: Agent ______________________________
Duration ______________________________

Surgical Procedure:

Type of incision ______________________________
What lobe resected ______________________________
Number and position of chest tubes ______________________________
____

Time in Recovery Room: ______________________________

Post-operative Analgesia:

Agent: ______________________________
Dosage: ______________________________
Time administered before measurements ______________

Post-operative complications: ______________________________
____

Comments: ______________________________
____

APPENDIX F

RAW DATA

Pre-Operative

Initial side of positioning: ______________________________

Operative lateral decubitus side	30° semifowler's
RT/LT	
Vital capacity	Vital capacity
1. __________________	1. ______________
2. __________________	2. ______________
3. __________________	3. ______________

Post-Operative

Number of Hours Post-Op _____

Time _______________

Initial side of positioning: _________________________________

Operative lateral decubitus side	30° semifowler's
Vital capacity	Vital capacity
1. __________________	1. ______________
2. __________________	2. ______________
3. __________________	3. ______________

APPENDIX G

CHARACTERISTICS OF SAMPLE

Subject	Pulmonary Disease	Heart Disease	Smoking History	Anesthetic Agent	Duration of Anesthesia
1	Emphysema	none	Commenced one week prior to surgery; 1/2 pack per 2 days	$N_2O - O_2$ Innovar Valium Pentothal Fentanyl Paralon	1' 45"
2	none	none	3 packs per day for 38 years	$N_2O - O_2$ Ethrane Brevital Anectine	2' 30"
3	none	none	none	$N_2O - O_2$ Penthane Pentothal Paralon	50"
4	none	none	Discontinued two weeks prior to surgery	$N_2O - O_2$ Innovar Paralon	1' 30"
5	none	Artero-sclerosis	1 to 2 packs per day for 20+ years	Pentothal $N_2 - O_2$ Anectine Fluothane-Halothane	3'
6	none	none	1 pack per day for 53 years	Pentothal $N_2O - O_2$ Halothane Anectine	1'
7	none	none	3 packs a week for 35 years	Brevital Anectine $N_2O - O_2$ Halothane	2' 5"

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