



Comparison of ventilatory restriction in techniques of respiratory physiotherapy and changes of position

Comparaç o da restriç o ventilat ria em t cnicas de fisioterapia respirat ria e altera es de posicionamento.

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ABSTRACT

Introduction: Body position affects the respiratory mechanics and could be favorable to pulmonary function when combined with respiratory physiotherapy. **Objective:** Was to compare the ventilatory restriction in respiratory therapy techniques and changes of position. **Method:** For analysis of lung volume was measured Slow Vital Capacity (SVC) in university students in the positions: sitting, dorsal decubitus (DD), DD with application of maneuver thoracic blockade of the right hemithorax and right lateral decubitus (RLD). In all maneuvers were instructed to perform an inspiration to total lung capacity and slow exhalation to residual volume. **Results:** It was evaluated 26 subjects with a mean age of 25.5 ± 11 years and mean body mass index of 25 ± 4 kg/m². The values obtained from SVC sitting, DD, DD with blockade and DLD were respectively 3.5 ± 1.5 liters ($87.7 \pm 26.8\%$); 2.9 ± 1.4 liters ($75.0 \pm 26.5\%$); 3.0 ± 1.4 liters ($75.2 \pm 26.2\%$); 3.5 ± 1.6 liters ($88.3 \pm 29.4\%$). Using the SVC in a sitting position as compared, there was no statistical difference in DD ($p = 0.024$) and DD with position blockade ($p = 0.036$). There was no significant difference in the DLD ($p = 0.459$) position. **Conclusion:** Can conclude that the positions DD and DD with blockade reduced lung volume, whereas DLD position showed no significant difference when compared to sitting position, suggesting that this position is an option favorable position for respiratory therapy.

Key Words: Respiratory Therapy. Lung Volume Measurements. Respiratory Function Tests. Spirometry. Physical Therapy Modalities.

RESUMO

Introdu o: A posi o corporal influencia na mec nica ventilat ria, podendo ser favor vel   fun o pulmonar quando combinada  s t cnicas de fisioterapia respirat ria. **Objetivo:** Foi comparar a restri o ventilat ria em t cnicas de fisioterapia respirat ria e altera es de posicionamento. **M todo:** Para an lise do volume pulmonar foi mensurada a Capacidade Vital Lenta (CVL) em universit rios na posi o sentada, em dec bito dorsal (DD), em DD com aplica o da manobra de bloqueio tor cico no hemit rax direito e em dec bito lateral direito (DLD). Em todas as manobras o indiv duo foi instruído a realizar uma inspira o at  a capacidade pulmonar total e expira o lenta at  o volume residual. **Resultados:** Foram avaliados 26 indiv duos, com idade m dia de $25,5 \pm 11$ anos e  ndice de massa corp rea m dio de 25 ± 4 kg/m². Os valores obtidos de CVL sentado, CVL em DD, CVL em DD com bloqueio e CVL em DLD foram, respectivamente de $3,5 \pm 1,5$ litros ($87,7 \pm 26,8\%$); $2,9 \pm 1,4$ litros ($75,0 \pm 26,5\%$); $3,0 \pm 1,4$ litros ($75,2 \pm 26,2\%$); $3,5 \pm 1,6$ litros ($88,3 \pm 29,4\%$). Utilizando a CVL na posi o sentada como compara o, houve diferen a estat stica na posi o DD ($p = 0,024$) e em DD com bloqueio ($p = 0,036$). N o houve diferen a significativa na posi o DLD ($p = 0,459$). **Conclus o:** Pode-se concluir que as posi es DD e DD com bloqueio reduziram o volume pulmonar, enquanto que a posi o DLD n o apresentou diferen a significativa quando comparada a posi o sentada, sugerindo que esta posi o seja uma op o de posi o favor vel para a terapia respirat ria.

Palavras-chave: Terapia Respirat ria. Medidas de Volume Pulmonar. Testes de Fun o Respirat ria. Espirometria. Modalidades de Fisioterapia

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INTRODUCTION

For years, effects of body position in mechanical ventilation are academic reasons to both healthy and sick individuals. It is evident that body position and sex influence in certain pulmonary values.^(1, 2)

Due to the diversity of factors that affect lung function, studies are necessary so the body position combined with the techniques of respiratory physiotherapy may contribute to the efficacy of the treatment.⁽²⁾

Slow Vital Capacity (SVC) is the maximum volume of air that can be exhaled after maximum inhalation, however, without requiring much effort and intense, that is usually equal to Forced Vital Capacity (FVC), except in patients with severe obstruction boards when the FVC may become lower than CVL, due to air trapping that may occur in forced expiratory.^(3, 4)

In general, spirometry is a pulmonary function test measuring volumes and airflow, focusing on SVC, FVC, Forced Expiratory Volume in 1 second (FEV₁) and its relations (FEV₁/SVC, FEV₁/FVC). Computerized equipment that provide graphic curves volume-time and flow-volume, as well as numerical values of measured variables, are used for the test.^(3, 4, 5, 6)

On the other hand the thoracic blocking maneuver aims to increase ventilation of specific areas of the lung applying a force at the end of the expiration in patient's thorax allowing the air volume placed in the airways occupy hemithorax contralateral to blockade, expanding it.⁽⁷⁾

In this sense, the comparison of CVL in the supine position, right lateral decubitus and dorsal decubitus with application of thoracic blocking maneuver may identify the existence of restrictions on ventilatory capacity providing values for choosing the best respiratory therapy technique.

Therefore, the aim of this study was to compare the ventilatory restriction in respiratory therapy techniques and position changes. In addition, the specific objectives were: Check the slow vital capacity in the dorsal decubitus position; Check the slow vital capacity in the right lateral decubitus position; Check the slow vital capacity in the dorsal decubitus position with application of thoracic blocking maneuver; Compare slow vital capacity in dorsal decubitus position, right lateral decubitus position and dorsal decubitus with application of thoracic blocking maneuver.

METHOD

This is cross-sectional study and the population consisted of physiotherapy scholars of several semesters from "Universidade do Sul de Santa Catarina – UNISUL, Campus Tubarão". For sample selection, inclusion criteria were as follows: accept to participate in the study and sign the free, prior and informed consent (FPIC) and has more than 18 years. Exclusion criteria were as follows: respiratory infection, chronic respiratory disease. The Research Ethics Committee approved the study under number 552.454 and CAAE 24412913.2.0000.5369.

After individuals agreed to take part in the study and signing FPIC, they were directed to Clinical Physiotherapy from UNISUL, Campus Tubarão – SC and were submitted to anthropometric evaluation of weight and height, through the stadiometer and FilizolaR scale to obtain the body mass index (BMI), equated as follows, BMI = weight/height². Afterwards they performed the measurement of Slow Vital Capacity (SVC) through MultiSPIRO spirometer connected to a computer. The tests followed the guidelines for pulmonary function tests.⁽⁸⁾

To measure the CVL the individual was in a sitting position and was instructed to take a deep breath to fill their lungs completely and then make an expiration blowing the entire volume of air in the lungs. Afterwards the individual performed the same procedure in the supine position (SP) on a stretcher and after in the right lateral decubitus (RLD). Finally, the individual was in SP with application of thoracic blocking maneuvers in the right hemithorax performing the SVC maneuver described above.

Statistical evaluation was demonstrated by measures of central tendency and dispersion and compared using the paired Wilcoxon test ($p < 0.05$)

RESULTS

We evaluated 26 individuals, 19 women and 7 men. The average age was 25.5 ± 11 years and average BMI of 25 ± 4 kg/m². In table 1 are summarized the SVC results.

When comparing the SVC values of sitting position with others positions, there was no statistical difference only in RLD position, as can be seen in Figure 1.

Table 1. Description of SVC result

Variables	Average \pm standard deviation – liters (%)
SVC Sitting Position	3.5 \pm 1.5 (87.7 \pm 26.8)
SVC in SP	2.9 \pm 1.4 (75.0 \pm 26.5)
SVC in SP with thoracic blocking maneuvers	3.0 \pm 1.4 (75.2 \pm 26.2)
SVC in RLD	3.5 \pm 1.6 (88.3 \pm 29.4)

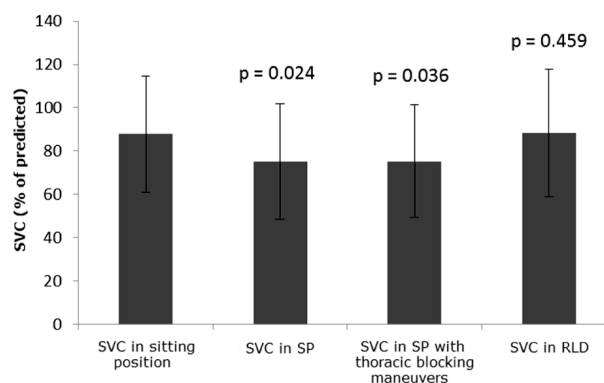


Figure 1. Comparison of SVC values.



DISCUSSION

The results showed statistically significant differences in SVC in SP and SVC in SP with thoracic blocking maneuvers when compared with SVC in sitting position, indicating a reduction in lung volume and expandability. While in SVC in RLD, there was no statistical difference when compared to sitting position.

In the sitting position, the oxygen tension and lung compliance is higher. There is also a wider distribution of ventilation in the apical, middle and basal region.⁽⁹⁾ Furthermore, due to the force of gravity on the chest and length-tension relationship of the respiratory muscles there are higher values of maximum inspiratory pressure.⁽¹⁰⁾ In SP, lungs are subject to the resultant compressive force of cardiac muscle weight. On ventral decubitus (VD) that force is directed towards the breastbone, therefore, the gas exchanges become more effective in SP when compared to VD.⁽¹¹⁾

Kera and Maruyama⁽¹²⁾ concluded that there was no significant change in tidal volume (VT) according to sitting posture (with his elbows on his knees) and in the standing position in 15 young adults men, giving the same result as the present study in sitting position. A study conducted by Kim *et al.*⁽¹³⁾ evaluated the effects of respiratory maneuvers and sitting posture of the VC and Respiratory Rate (RR) in 12 men with COPD. It was proven that there was no interaction between the pattern of breathing and the position in these patients.

Bhatt *et al.*⁽¹⁴⁾ also did not prove statistically significant differences in COPD patients when they evaluated the forced expiratory volume in 1 second (FEV₁), forced vital capacity (FVC) and Maximum Inspiratory Pressure (MIP) in sitting position and sitting while leaning forward with his hands on his knees.

However, studies conducted by Bhatt *et al.*⁽¹⁴⁾ did not prove statistically significant differences in FEV₁, FVC and MIP in SP and in sitting position, which differs from this study that proved the existence of statistical difference in the SVC of individuals in this position. Kera and Maruyama⁽¹²⁾ also did not prove differences in VC of studied individuals in SP and sitting position.

Study conducted by Lin *et al.*⁽¹⁵⁾ evaluated the effect of three different sitting postures (in a wheelchair) on lung capacity and pulmonary blood flow in 60 healthy individuals by spirometry. The three positions were sitting normally, "sitting fallen" and sitting with protruding lumbar backrest in L4, all postures with knees bent 90 degrees and feet fully supported. The study demonstrated that posture has significantly altered spirometric parameters of tested individuals. The best results were in standing posture, then sitting posture with lumbar support, followed by normal posture. The results were most committed in "sitting fallen" posture.

Palermo *et al.*⁽¹⁶⁾ assessed FEV₁, FVC, SVC, alveolar volume and lung diffusing capacity for carbon monoxide (DLCO) in 28 individuals, 14 healthy individuals and 14 individuals with

chronic and severe heart failure in the sitting position, SP, prone, left lateral decubitus (LLD) and right lateral decubitus (RLD). There was no difference in healthy individuals between positioning and pulmonary function, while in the group of cardiac patients the FEV₁ and FVC variables had a significant decrease in LLD and RLD positions. Authors explain these results due to lung compression caused by the large size of the heart. In this study, the SVC did not differ between sitting position and RLD, but had statistically significant reduction in SP and SP with right blocking.

In Santos *et al.*⁽¹⁷⁾ literature review which discusses the influence of therapeutic positioning in ventilation, perfusion, compliance and lung oxygenation, authors commented that lateral decubitus is effective in unilateral ventilation and oxygenation and can be indicated in cases of atelectasis and accumulation of secretions. However, few studies described the comparison between ventilation in sitting position and in lateral decubitus. Still, it is important to note that there are no studies comparing the difference between lateral decubitus and lock thoracic⁽⁷⁾ as a form of unilateral ventilation.

Gianinis *et al.*⁽¹⁸⁾ compared the Peak Expiratory Flow (PEF) by spirometry in 30 young and healthy individuals in sitting position, SP, RLD and LLD. It has been proven statistically significant differences in sitting position, SP and RLD. LLD position has no statistically significant difference and therefore authors concluded that this would be a good position to expiratory flow optimization.

Shinde and Shinde⁽¹⁹⁾ evaluated healthy adults and adults with COPD and found no significant tendency of peak expiratory flow (PEF) in RLD compared to LLD in both populations. This result can be explained by the fact that the right lung has a larger volume than the left lung besides the reduction of heart compression in the lungs in RLD.⁽¹⁹⁾ This study did not evaluate the LLD position; however, both right and left lateral decubitus proved to be positions that optimize respiratory flow in general.

Badr, Elkins and Ellis's study⁽²⁰⁾ analyzed changes in respiratory function of seven different body postures, among which three were sitting positions. They analyzed Maximal Inspiratory Pressure (MIP) and peak expiratory flow (PEF). Results indicated that body position has significant effects on both MIP and in PEF. The best result was in the standing posture.

Meysman and Vincken⁽²¹⁾ evaluated by spirometry in 31 healthy individuals. The study showed statistical difference in sitting position and no difference between RLD and LLD positions; therefore, according to this study sitting position optimizes respiratory function, diverging from present work, which proved significant differences in RLD and not demonstrated differences in sitting position.

According to Contensini, Garcia Junior and Caromano⁽²²⁾ changes of several parameters of pulmonary function varies in sitting position, but these changes are more evident in



individuals with a functional impairment given that healthy individuals have the ability to compensate respiratory changes caused by different body postures.

In respiratory physiotherapy, lung expansion techniques aims to increase lung volumes.⁽²³⁾ The effects of these techniques are mainly involved with the expansion of collapsed areas and removal of peripheral secretions.⁽²⁴⁾ According to this study, the patient's position in RLD seems to be more effective for unilateral re-expansion pulmonary, because in this position there was no decrease of SVC.

CONCLUSION

In conclusion, this study demonstrated that the Slow Vital Capacity changes in the supine position and lateral decubitus with right blockade as compared to the sitting position, suggesting a reduction in lung volume and expandability in these positions.

However, Right Lateral Decubitus showed no change in Slow Vital Capacity and so the result suggests that this position becomes a favorable choice to perform pulmonary expansion maneuvers, optimizing the results of this procedure.

There is controversy in literature regarding results and positions and there is a tendency in optimization of the lateral decubitus position.

Further studies on the influence of body position in lung function are suggested, especially in healthy individuals, which are scarce in literature, for obtaining of comparison of individuals with and without pulmonary impairment.

AUTHORS' CONTRIBUTIONS

KSK: Project elaboration, preparation table and graph, statistics, text revision. EI, CMFP, CMF, FRO, LBAS, MM: Data collection, data discussion.

COMPETING INTERESTS

The authors declare that they have no conflicts of interest in the research.

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