

Spirometric values in sitting, standing and supine position

Abstract

Background: Spirometry may be done either in sitting or standing position. The effect of sitting, standing and supine position on ventilatory functions has not been well studied in healthy subjects.

Objective: The objectives of this study were to compare the spirometric values between sitting position and supine/standing position and to find magnitude of change when going from sitting to supine position.

Methods: Forty five healthy subjects (30 male and 15 female) with a median age of 21 (range 19-23years) were asked to perform spirometry in sitting upright position. They were asked to repeat the tests in the standing and supine position after adequate rest and the means of the spirometric tests in the three positions were compared using paired t-tests. Differences declared statistically significant when p-values were less than 0.05.

Result: Measurements of FVC, FEV₁ and PEF_R was significantly higher in the sitting position compared to standing while there was no significant change in FEF_{25-75%}. Around 10% of decrease in above spirometric value was found in supine position as compared to sitting position.

Conclusion: Spirometry should be done in a position in which the reference values which we are using have been derived. In patients who are not able to sit in order to complete spirometry, the supine position may be preferred but the interpretation would have to be made carefully.

Keywords: spirometry, sitting, supine, standing

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Introduction

Spirometry is a physiological test that measures how an individual inhales or exhales volumes of air as a function of time. The primary signal measured in spirometry may be volume or flow. Spirometry is invaluable as a screening test of general respiratory health. It is commonly used to distinguish between restrictive and obstructive lung diseases, identifying patients susceptible to pulmonary barotraumas and bronchial hyper responsivity. It is also used in assessing pre-operative anesthetic risk in patients and patients about to undergo cardiothoracic surgery and to measure the efficacy of treatment of pulmonary diseases that show quantifiable defects.¹

According to recent guideline of standardization of spirometry, both standing and sitting positions are acceptable.¹ But some have found significantly higher spirometric values in standing position than in sitting position.² Spirometric references values in general use today in India have been derived from data collected in sitting position.^{3,4} Considering the chance of misdiagnosing patients in case of wrong interpretation of spirometry, it is imperative to know whether or not measurements taken in sitting position are significantly different than those taken in standing position and invite a false reading. The effect of sitting, standing and supine position on spirometric values has not been well studied in healthy subjects.

Differences in the lung function of healthy subjects in the supine position compared with sitting position are of interest because these are the positions usually assumed during general anesthesia and

more severe illness. Many times patient's lung functions need to be evaluate pre operatively but patients are not able to sit due to some reason, in which supine position must be used. Studies have shown that spirometric values decrease in supine position as compared to sitting position. But magnitude of change may be different.^{5,6} So, it is also important to know the magnitude of difference occurs in lung functions in supine position. To, best of our knowledge none of the study has been published in Standard English literature from India.

The aims of the study were to compare the spirometric values between sitting position and supine/standing position. This study was also aimed to find magnitude of change when going from sitting to supine position in order to help in interpreting the results of spirometry done in patients who are unable to sit upright and have to perform the test in supine positions.

Methods

The present study was carried out in SBKS Medical Institute & Research Centre, Piparia, Vadodara from March 2010 to April 2010. A prior approval from institutional ethical committee was taken. In this study 45 healthy non smoker subjects were chosen from volunteers among medical students and were asked to perform spirometry using Medikro Spirostar spirometer according to ATS guidelines.¹ To reduce variables, the subjects were previously educated about spirometry and given a demonstration of the techniques. The test was performed in the same room by the same operator. Subjects were first made to perform the test while sitting upright with their neck and chest aligned

and straight. After a rest period of 15 minutes, they repeated the test in standing position and then, in supine position again after 15 minutes rest. Each set consisted of 3-5 measurements to ensure acceptable tests and out of these measurements, the largest FVC and largest FEV₁ were taken to represent the result for that subject even if they do not come from the same curve. Mean values of FVC, FEV₁, PEF_R and FEF_{25-75%} in all three positions were measured and compared using paired t-tests. The difference in mean was used to calculate p-values by paired t-test and it was considered significant if less than 0.05.

Results

In the present study total 45 healthy non smoker volunteers among medical students were included. Out of them, 30 were male and 15 were female. Their median age was 21 (Table 1).

Table 1 Subject characteristics

	Male	Female	Total
Subjects (n)	30	15	45
Age (in years)	21 (20-23)	21(19-22)	21 (19-23)
Height (in cm)	174.97±7.09	158.53±5.36	169.49±10.18
Weight (in kg)	69.40±12.00	52.93±4.98	63.91±12.82

Data presented as mean±SD unless stated otherwise. Age presented as median (range in years)

Table 2 Data comparison for results obtained in spirometry while sitting vs. standing

Measurement	Position	Value	Mean difference	p-value
FVC (L)	Sitting	4.04	0.14±0.2	< 0.001
	Standing	3.90		
FEV ₁ (L)	Sitting	3.60	0.12±0.2	< 0.001
	Standing	3.48		
PEFR (L . sec ⁻¹)	Sitting	8.33	0.55±0.96	< 0.001
	Standing	7.78		
FEF _{25-75%} (L . sec ⁻¹)	Sitting	4.46	0.13±0.54	0.109
	Standing	4.33		

Mean difference presented as mean difference±SD. FVC, functional vital capacity, FEV₁, forced expiratory volume in one second, PEF_R, peak expiratory flow rate, FEF_{25-75%}, Forced expiratory flow 25-75%

Table 3 Data comparison for results obtained for spirometry in sitting vs. supine position

Measurement	Position	Value	% difference‡	Mean difference	p-value
FVC (L)	Sitting	4.043	-7.82%	0.32±0.24	<0.001
	Supine	3.727			
FEV ₁ (L)	Sitting	3.604	-9.69%	0.35±0.18	<0.001
	Supine	3.255			
PEFR (L . sec ⁻¹)	Sitting	8.330	-11.74%	0.98±1.1	<0.001
	Supine	7.352			
FEF _{25-75%} (L . sec ⁻¹)	Sitting	4.456	-12.33%	0.55±0.66	<0.001
	Supine	3.906			

Mean difference presented as mean difference±SD

‡ % difference is calculated as difference from values in sitting position

Discussion

The principle finding of this study is that changes in the subject's position while performing spirometry significantly affects the results. The results show that the highest measurement of pulmonary functions was found when the subject had performed spirometry while sitting.

There was a significantly higher value of FVC, FEV₁ and PEF_R obtained while sitting vs. those measured while the subject was standing. For FEF_{25-75%}, although the results were higher in subjects while in the sitting position, the significance could not be established. We had done sitting tests before the standing tests while study done by Pierson et al.,⁷ in which standing tests were done before sitting tests also found the similar result of statistically significant decrease in FEV₁ and FVC and no difference in FEF_{25-75%} but the magnitude of difference was less as compared to our study. However in a study done by Townsend et al.,² using cross-over design of test sequence had found significantly higher spirometric values in standing position than in sitting position.

In our study spirometric values were very significantly lower in supine position as compare to sitting position and magnitude of decrease in supine position was around 10% in all parameters. Vilke et al.,⁵ had also found significant decrease in spirometric values in supine position as compare to sitting position but the magnitude of difference was lower as compared to our study.

Considering the significance of the differences found, however, patients who undergo spirometry will have a great chance of giving results susceptible to wrong interpretations, if done in the standing or supine position. In patients who are not able to sit in order to complete spirometry, the supine position may be preferred but the interpretation would have to be made carefully.

Our study has the limitation of being a cross-sectional study of fewer subjects, limited to healthy subjects between the ages of 19 and 23. Larger studies that use a wider age range in a larger sample size including normal subjects as well as patients with respiratory diseases are further needed.

Conclusion

Spirometry should be done in a position in which the reference values which we are using have been derived. Interpretation of spirometric values done in supine position should be done by reducing reference values according to local results after further correlation by larger studies on normal subjects and patients with respiratory diseases.

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Conflict of interest

The author declares no conflict of interest.

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