USE OF THE TECHNIQUE OF COUNTING NUMBERS AS A PREDICTOR OF SLOW VITAL CAPACITY IN HOSPITALIZED INDIVIDUALS

Proposta de utilização da técnica de contagem como preditor da capacidade vital lenta em indivíduos hospitalizados

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ABSTRACT

Purpose: to evaluate if there is a correlation between the slow vital capacity and the maximum phonation time by techinique of couting numbers and if it is possible from the maximum phonation time estimate the slow vital capacity in hospitalized individuals. **Methods:** it is a cross-sectional study, crossover and choice of techniques (technique of numerical count and spirometry) were performed randomly (simple sortition). The slow vital capacity was measured by spirometry and maximum phonation time was assessed using the technique of counting numbers. **Results:** participated in the research 221 hospitalized patients. A positive correlation was observed between the Slow vital capacity and maximum phonation time evaluated on an absolute ($r = 0.75$; $p < 0.001$) and relative ($r = 0.76$; $p < 0.001$). From the simple linear regression of the data, were verified equations of the lines analyzed absolutely, Slow vital capacity = 55 Technique of numerical count + 735 ($r^2 = 0,56$; $p < 0,0001$) and relative Slow vital capacity = 0,84 Technique of numerical count + 14 ($r^2 = 0,57$; $p < 0,0001$). **Conclusions:** the results obtained in this study showed a good correlation between the techniques evaluated, possible to estimate the Slow vital capacity from the techinique of couting numbers in hospitalized individuals.

KEYWORDS: Respiratory Function Tests; Vital Capacity; Phonation

INTRODUCTION

For planning and implementation of an adequate treatment program of diseases that affect the respiratory system, a systematic clinical and functional assessment of the patient is necessary. Spirometry is the preferred test used to measure lung volumes and capacities. Assists prevention, confirms the diagnosis and allows the quantification of respiratory disorders in different diseases, however, it is a relatively expensive method and it is not always available in clinical practice[1].

Slow vital capacity (SVC) evaluated by a spirometer or ventilometer is defined as the greatest amount of air that a person may exhale slowly after a maximum inspiration. Slow vital capacity normative values for healthy individuals have been reported in the literature between 65-75 ml/kg and may vary according to race, age, height, gender and weight[2,3]. Values below 25 ml/kg may indicate some degree of pulmonary dysfunction[4-7].

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The slow vital capacity may be reduced in cases where there is an alteration of pulmonary mechanics and respiratory muscle involvement, usually found in hospitalized individuals. The decrease in vital capacity can be easily seen through specific devices that provide essential information for the characterization of pathophysiological status of individuals and to develop possible interventions.

The vocal production is directly related to the respiratory system, so any impairment of lung function can exert a direct effect on speech and voice[8]. The maximum phonation time (MPT) is a test used to evaluate the glottal and respiratory efficiency, allowing a qualitative and quantitative investigation of phonation. As pulmonary function is directly associated with voice production, individuals with lung disease may have altered the MPT and reduction in the amount of air available to support phonation, characterizing a problem in controlling the airflow[3,8,9].

The use of specific devices for pulmonary evaluation, addition to have a high commercial value, is not always available in clinical practice[10]. Therefore, the use of an alternative technique may be useful for evaluating patients in private clinics, family health programs and hospital setting. In this sense, the objective of this research was to assess if there is correlation between the SVC and the MPT, more specifically by the technique of counting numbers and if it is possible from the MPT estimate the SVC in hospitalized individuals.

METHODS

This study was approved by the Ethics Committee of our Institution (Protocol-478 571/13). All volunteers were informed about the research objectives as well as their rights as participants and signed an informed consent.

This was a transversal study, crossover and the order of the tests execution (spirometry technique and numerical count) were performed randomly (simple draw). The research was conducted in a public hospital in the city of Petrolina - PE, Brazil, from May through December, 2013.

The study included hospitalized subjects who were at the medical clinic and the intensive care unit, of both sexes, conscious, aged 18-80 years, presenting pulmonary, neurological, oncological, cardiac, hepatic, infectious diseases and postoperative general surgeries.

Exclusion criteria were hemodynamically unstable individuals, respiratory rate above 30 breaths per minute, signs of hypoxemia (SpO2 <90%), asthma attacks and in patients who could not conduct the investigation because of pain, in addition to those unable to understand the performing the technique.

Patients in the medical record or during the interview had reports of inflammation, infection or injury in the upper respiratory tract were also excluded. The assessment would be interrupted if the patient had any discomfort during the procedure or if any parameter described in exclusion criteria were checked after the tests started (no patient was discontinued).

To conduct the study were evaluated for each individual variables related to height, total body mass (TBM), age, gender, cause of hospitalization, slow vital capacity and maximum phonation time[11,12]. The measurement of TBM and height was conducted by evaluator following the standardization of the International Society for the Advancement of Kinanthropometry (ISAK)[13]. For both measurements we used digital scale (G-TECH, Pernambuco, Brazil) and tape (Joamarca, São Paulo, Brazil). The age, sex and cause of hospitalization variables were obtained from medical records or interview.

The SVC was measured by the MicroQuarck spirometer (Cosmed - Italy) [14-17]. To evaluate the maneuver of the SVC the subject was instructed to make a maximal inspiration to reach total lung capacity and its after blow all the air through on the devise slowly until it reached the residual volume. Then we chose the best measurement from three attempts, following by a rest period of two minutes between each maneuver[12,16]. To perform the calculation of SVC by relative form was used the following equation (female = 45 + 0,93x (height - 152.4); Man = 0.91x + 50 (height - 152.4)) [18].

For the evaluation of the maximum phonation time was selected the technique of counting numbers (TC). The individual was asked to inspire as much air as possible and during exhalation begin the counting numbers in ascending order, beginning with the numeral one to the greatest number that it could reached in a single exhalation, where the tone and the intensity should indicate naturalness featuring a habitual phonation[19]. The value chosen for analysis was the best in three attempts, following a one-minute rest between measurements[20]. The rest time between one technique and another one was five minutes and during test (SVC and TC) the patients were instructed to stay in bed in the sitting position. All procedures were performed previously trained researcher.

Statistical analysis

The sample size was performed using the program GPower 3.1.7 with **α** = 0.05, **β** = 0.05 (power = 95%) and correlation coefficient of 0.60

and a loss of 20%. Based on these data, a minimum sample of 218 individuals was found.

The data were processed and analyzed using the GraphPad Instat program (GraphPad Inc., San Diego, USA, Release 3:06, 2003). Initially underwent criteria of normality (Kolmogorov-Smirnov test). Mean and standard deviation (SD) were used to present continuous variables while categorical data were presented using absolute and relative frequencies. The relation between variables was performed using the Pearson correlation and linear regression analysis was performed by the method of least squares used in the calculation for the prediction of slow vital capacity from the counting technique. Bilateral p values were calculated, and the significance level was 5%. A multiple regression model was also tested using gender as a second independent variable. An analysis of residues in the linear regression model was performed.

RESULTS

Evaluations were made on 221 hospitalized individuals with different causes of hospital admission and mean age (± SD) of 53 (± 18.12) years, 88 (40%) were female and 133 (60%) were male. The general characteristics of the sample are shown in Table 1.

Local de inserção da tabela 1 (autores: não inserir as tabelas aqui, é apenas uma marcação)

There was a significant correlation between the slow vital capacity and the technique of counting numbers measures in an absolute way ($r = 0.75$, $p < 0.001$) and relative ($r = 0.76$, $p < 0.001$). Equations of lines were obtained from the simple linear regression model between the slow vital capacity and the technique of counting numbers (TC) evaluated absolutely, CVL TC = 55 + 735 ($r^2 = 0.56$, $p < 0.0001$) and relative CVL = 0.84 + CT 14 ($r^2 = 0.57$, $p < 0.0001$) (Figure 1A and 1B). The gender variable showed no statistical difference when included in the multiple regression analysis and was excluded from the model. Analysis of the residuals of the simple linear regression indicated that the models were well adjusted.

Table 1 - General characteristics of the sample

Variables	Hospitalized (n=221)
Age (years)	53 ± 18,2
Weight (kg)	58 ± 10,8
Ideal Weight (kg)	59,2 ± 9,2
Heught (m)	1,64 ± 0,07
SVC (ml)	1.922 ± 895
SVC (ml/kg)	32 ± 14
TC	21 ± 12
Gender	
Female	88 (40%)
Male	133 (60%)
Clinical Diagnosis	
Lung Diseases	24 (10,9%)
Heart Disease	61 (27,6%)
Oncological Diseases	13 (5,9%)
Neurological Diseases	12 (5,4%)
Liver Disease	24 (10,9%)
Urinary Diseases	16 (7,2%)
PO trauma surgery	11 (5.0%)
PO cardiac surgery	12 (5,4%)
PO abdominal surgery	48 (21,7%)

Data are expressed as mean ± standard deviation or absolute numbers (%).SVC = slow vital capacity; TC = technique of counting numbers; PO = postoperative.

DISCUSSION

The maximum phonation time is an easy and objective measure that uses only the voice as an assessment method and enables the evaluator to check qualitatively and quantitatively, the respiratory and phonation control during connected speech without the need for specific devices[21]. In this research, a positive correlation can be found between the techniques studied and it was possible to estimate the SVC from the MPT through the technique of numerical count.

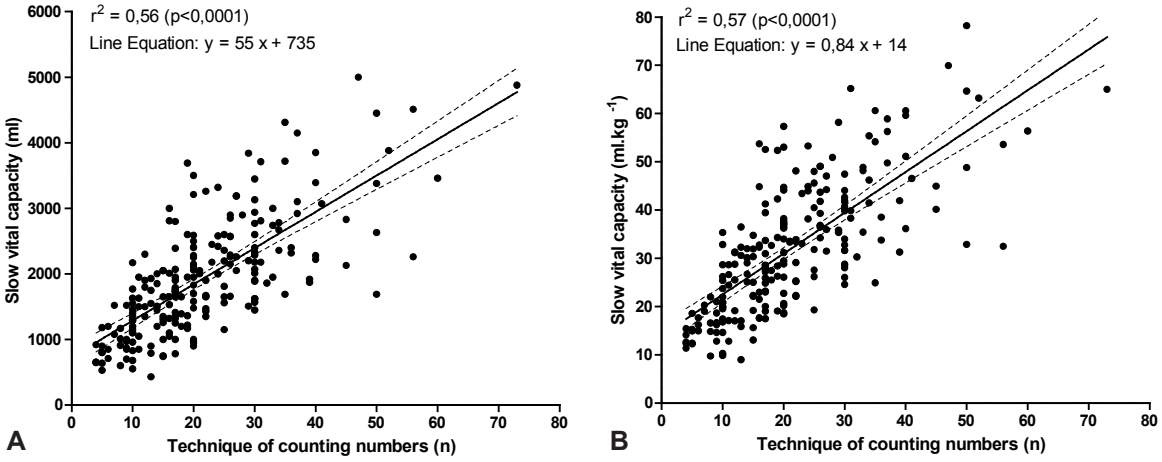

Figure 1 - Linear regression between the slow vital capacity and the technique of counting numbers in 221 hospitalized patients conducted in absolute and relative form (Figure 1A and 1B)

Several studies have emphasizing the importance of measurements of lung volumes and capacities especially in hospitalized patients. Chevrolet and Deléamont[22] affirmed that the vital capacity (VC) is an important predictor of pulmonary function, because evaluates the need for mechanical ventilation and also the success in weaning. Suesada et al.[23] showed that VC was one of the variables with the greatest injury after a short hospitalization. Gregorini et al.[24] reported that patients in the postoperative period of cardiac surgery showed decreased lung volumes and capacities reducing the number of deep breaths and efficacy of cough. The loss of deep inspiration and cough predisposes respiratory complications that atelectasis is the most common[4,25].

The attempt to evaluate the SVC by other methods different of spirometry has been described in the literature. Pinheiro et al.[10] to justify the high cost of conventional techniques and the low availability of ventilometer and/or spirometers in clinical practice proposed as an alternative to this problem using an equipment used for incentive spirometry (IS) to be a cheaper and easier method. However, although the study have shown a higher correlation between the SVC and EI as compared with SVC and counting technique data found in this study (r = 0.95 vs r = 0.76 both with p <0.001), the use of EI differs from the main objective of this research did not use specific devices, in addition, the authors did not discuss the reason and not justified to have presented an equation for the evaluated variables that would possibly be used to estimate the SVC in their results.

Normal individuals have the SVC around 65-75 ml/kg[26]. The MPT is the duration that a person maintains a sound during exhalation after a maximal inspiration, through the support of a phoneme that can be /a/, /s/ or /z/, or by numerical count. To Zemlim[27], normal adults should sustain sound comfortably around 15 s to 25 s. The average for MPT /a/ is 8s to 16s for men and women, and the MPT/s/ and MPT/z/ is expected values between 15 s to 25 s, suggesting that there is equality in issuing the deaf and audible sound according to Behlau and Pontes[8]. Until the present standard values for the technique of counting numbers or research to propose an estimated calculation of SVC using the technique of numerical count weren´t found.

Toyoda et al.[28]observed that a MPT lower of 15 seconds and a SVC less than 1500ml may be useful for evaluating respiratory muscle weakness in patients with myopathy and a significant correlation could be observed between these two tests, although weaker as compared to this study (r = 0.75 *vs* r = 0.25 both with p <0.05). To Rooper et al.[29] individuals with neuromuscular disease able to count numerically from one to at least 25, would have more than 20 ml/kg vital capacity, although do not exemplify how it came to this particular value. Even so, this research supports the proposal statement, indicating a value of 35 ml/kg for those counts to at least 25.

Already Latronico and Rasulo[26] in a review study, explains that a rough estimate of the SVC could be made by the technique of counting and individuals unable to count to 20 have a SVC around 15 to 18 ml/kg, being indicated noninvasive ventilation in these patients. These data are not in agreement with the estimate proposed by the authors of this study that suggest values of approximately 30 ml/kg for individuals that count up to 20, although

we agree with the use of noninvasive ventilation as a useful resource in lung expansion therapy. However, the author does not explain how it arrived at that equation and not cite any reference about this comment, preventing a possible explanation of this difference with the present study.

The use of SVC value as a method to assess the response to the intervention has been reported in patients with neuromuscular disease. A SVC less than 20 ml/kg shows a weak muscle, with sigh mechanism and cough changed, atelectasis, imbalance in ventilation-perfusion and moderate hypoxemia[30]. Usually SVC values less than 20 ml/kg are estimated as suggestive of a low generation of lung volume and risk of pulmonary complications due to alveolar hypoventilation, thus it is recommended the use of positive pressure to raise alveolar pressure and consequently the transpulmonary specifically, if there is reversible character[4,25].

From the equation proposed by this research, hospitalized individuals who have counted until the numeral 20 had the SVC of approximately 30 ml/kg. Special attention should be given to this population who cannot exceed this value and strategies for lung expansion therapy or strengthening the respiratory muscles should be designed to avoid possible pulmonary complications. The absence of specific equipment has made 56% of hospitalized individuals in this study had their SVC estimated from the CT. Thus, CT can be an important tool to be part of the evaluation process for patients at the bedside, especially for its convenience and low cost.

Conventional methods such as spirometry and ventilometry should always be considered if they are available in clinical practice, it is suspected divergent results obtained from the CT and patients with voice problems and possible reduction of MPT, like patients with glottic chink, in these cases, already standardized research techniques should be indicated. A possible limitation of this study was to homogenization of hospitalized individuals in one group, however this was an important research interest due to functional limitation in the lung and does not the characterization of the disease. Another important fact was not evaluated patients with glottic chink separately, despite having excluded patients in medical reports or during the interview had reports of inflammation, infection or injury in the upper respiratory tract. Highlight the importance of the present study, since the results described here may help guide the development of futures researches seeking to compare individuals with the same characteristics, healthy and can manage patients with voice problems.

The possibility of identifying earlier a degree of functional limitation in hospitalized patients, to assess a response to treatment undertaken and to identify a fall in this functionality using a mathematical equation that it requires only the voice and that can be performed in any environment is a very inspiring theme and a stimulus for its use in hospitalized individuals.

CONCLUSION

The results obtained in this study showed a good correlation ship between the techniques evaluated and it was possible to estimate the SVC from the TC in hospitalized individuals.

RESUMO

Objetivo: avaliar se existe correlação entre a capacidade vital lenta e o tempo máximo de fonação, mais especificamente pela técnica de contagem numérica e se é possível a partir do tempo máximo de fonação estimar a capacidade vital lenta em indivíduos hospitalizados. **Métodos:** trata-se de um estudo do tipo transversal, *crossover* e a escolha das técnicas (espirometria e técnica de contagem numérica) foram realizadas de forma randomizada (sorteio simples). A capacidade vital lenta foi mensurada por meio da espirometria e o tempo máximo de fonação foi avaliado a partir da técnica de contagem numérica. **Resultados:** participaram da pesquisa 221 pacientes hospitalizados. Foi verificada uma correlação positiva entre a capacidade vital lenta e o tempo máximo de fonação avaliados de forma absoluta ($r = 0,75$; $p < 0,001$) e relativa ($r = 0,76$; $p < 0,001$). A partir da regressão linear simples dos dados, foram verificados equações das retas analisadas de forma absoluta, Capacidade vital lenta = 55 Técnica de contagem numérica + 735 ($r^2 = 0,56$; $p < 0,0001$) e relativa, Capacidade vital lenta = 0,84 Técnica de contagem numérica + 14 ($r^2 = 0,57$; $p < 0,0001$). **Conclusões:** os resultados obtidos nesta pesquisa mostraram uma boa correlação entre as técnicas avaliadas, sendo possível estimar a capacidade vital lenta a partir da técnica de contagem numérica em indivíduos hospitalizados.

DESCRITORES: Testes de Função Respiratória; Capacidade Vital; Fonação

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ERRATUM

In the article: "USE OF THE TECHNIQUE OF COUNTING NUMBERS AS A PREDICTOR OF SLOW VITAL CAPACITY IN HOSPITALIZED INDIVIDUALS", published in the journal *Revista Cefac*, volume 17(2):559-565, pages 559, **where it is**:

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