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IMPACT OF FLOW INCENTIVE SPIROMETRY ON THE VENTILATORY MUSCLE FUNCTION OF PATIENTS IN THE ELEVATIVE ABDOMINAL SURGERY POST-OPERATIVE

[1]Thaine Dias Dutra, [2]Mariana Aparecida Oliveira Moreira, [1]Shantala Barreto da Silva, [1]Danilo Rocha Santos Caracas, [1]Taynã Cardoso da Silva and [1]Rodrigo Rocha Ivo

[1]Undergraduate Student in Physiotherapy at the Independent College of the Northeast (FAINOR); [2]Undergraduate student in Physiotherapy at the Independent College of the Northeast (FAINOR); [3]Undergraduate student in Physiotherapy at the Independent College of the Northeast (FAINOR); [4]Physiotherapist. Master in Medicine and Human Health. Professor at the Independent Faculty of the Northeast (FAINOR); [5]Physiotherapist. Adult ICU Specialist; [6]Physiotherapist. Adult and Pediatric ICU Specialist

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****Corresponding author:***
Thaine Dias Dutra

ABSTRACT

The aim of this study was to demonstrate the effectiveness of inspiratory flow incentive on pulmonary function and peripheral muscle strength in postoperative patients after elective abdominal surgery. Methods: Data collection was performed in the immediate postoperative period, with maximal inspiratory (MIP) and expiratory (MEP) pressures using digital manovacuometry. as well as the dynamometer measurement. Results: Fifty patients were evaluated, with a mean age of 39.92 ± 15.12 years. Regarding respiratory muscle strength, it can be inferred that both the mean MIP undergoes a positive change (initial 40.96 ± 31.49 and final 52.10 ± 37.44) with ($p \leq 0.001$) and PeMax the mean increase after the procedure (initial of 33.16 ± 22.56 and final of 38.22 ± 25.95), with a statistically significant difference between the means of reassessment and evaluation ($p = 0.039$). It was possible to infer that although the sample presented initial average of 24.76 ± 10.45 and final of 24.99 ± 13.48, resulting in an increase in dynamometry, this difference has no significant statistical correlation ($p = 0.163$). Conclusion: There was an increase in MIP and MEP after intervention with the flow incentive inspirometer, but no increase in peripheral muscle strength.

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INTRODUCTION

Several authors argue that postoperative pulmonary complications (PPC) generate increased mortality, morbidity rates and consequently increase the hospital cost beyond the length of stay in abdominal, thoracic and cardiac surgeries (WEISSMAN, 2004). A basic postoperative complication is the absence of pulmonary insufflation that results in slow shallow breathing reducing ventilation to dependent lung regions, leading to the onset of atelectasis. Prolonged length of stay, incisional pain and residual anesthetic effects also corroborate the manifestation of atelectasis symptoms (JUNIOR *et al*., 2014; KUMAR *et al*., 2016). Respiratory physiotherapy plays an important role in the prevention and treatment of postoperative pulmonary complications following abdominal surgery, including: diaphragmatic breathing, inspiratory sigh breathing exercises, maximal sustained inspiration exercises, fractional inspired exercise, percussion techniques, vibration , developed to improve bronchial drainage, as well as the use of mechanical breathing devices, such as the incentive inspirometer (IS) (KUMAR *et al*., 2016)

The incentive inspirometer is a noninvasive respiratory physiotherapy tool aimed at restoring lung volume and capacity, with an extremely simple visual feedback system that helps the patient monitor the flow and volume of air mobilized with each inspiration (ALMEIDA; SANTALUCIA, 2016). Despite the relentless search for scientific evidence, there is still a large gap regarding the effectiveness of the flow-enhancing spirometer on pulmonary function and quality of life in postoperative abdominal surgery. Thus, the present study aimed to highlight the effects of flow incentive inspirometry on ventilatory and peripheral muscle function in patients undergoing elective abdominal surgery.

METHODS

This is a longitudinal, interventional, analytical and quantitative study conducted in the outpatient unit of a private hospital with an agreement with sus, in the city of Vitória da Conquista - BA. Data collection was performed between August and September 2019, and the sample consisted of 50 patients. Voluntary patients who underwent open abdominal surgery during the period of data collection, aged 18 years or over, of both sexes, assisted via the Unified Health System (SUS), with the capacity for suggested conducts, were included in this study. in the protocol. With the agreement to participate in the research, all signed the Informed Consent Form (ICF), the study was based on the principles of Resolution No. 466 of December 12, 2012 of the (National Health Council) under the approval of the Committee. of Ethics in Research of the Independent College of the Northeast. Opinion Number: 3,368,508. Individuals with any condition of chronic disease, particularly cardiovascular, pulmonary, hepatic, renal, endocrine and neurological aspects that prevent or generate confusion bias, hemodynamic instability (Heart rate> 60 or <130 / Systolic blood pressure> 120) were excluded. or<140 mmHg / Diastolic blood pressure> 80 or <90 mmHg), high pain with a Visual Analog Scale score greater than 7 and active bleeding at the incision site.

After insertion in the research, the patient took a moment to answer possible questions related to the research, and then a semi-structured questionnaire was created by the researcher containing information such as: patient characteristics, clinical and laboratory aspects, information about the type and surgery duration, type of anesthesia, pneumofunctional assessment, musculoskeletal system assessment, peripheral vascular assessment, and preoperative hospitalization time, followed by the visual analog scale (VAS) where a simple and efficient pain intensity measurement was performed. Peripheral muscle strength was evaluated using the 90kg manual digital dynamometer, InstruthermD.digital®. It was requested that in DD, with the dominant arm, positioned next to the trunk, with elbow flexion supported on the stretcher, 3 palm grips were performed, of each maneuver the result was noted where at the end of the evaluation the highest value reached was considered. To perform the respiratory muscle strength test, the Digital MVD300-U-Homed® manuvacuometer was used to evaluate the following variables, maximal inspiratory pressure (MIP) and maximal expiratory pressure (MEP). Positioning in DD was adopted due to the length of the surgical procedure, arms relaxed at the trunk side, nose occluded by a nasal clip.

To obtain the (MIP), the patient performed an expiration until reaching the residual volume, and the mouthpiece of the manovacuometerwas connected to the mouth of the subject who performed a maximum inspiratory effort. To obtain the MEP, the same positioning was used, inhaled until reaching the total lung capacity, and then the mouthpiece of the manovacuometer was connected while the individual performed a maximum expiration. Three (3) repetitions were performed in each test variable (without leaks), and a new murmur was requested whenever the last measurement was considered the highest. From each maneuver was noted the result where at the end of the evaluation was considered the highest value achieved. After 2 minutes the intervention was performed asking the patient to perform the technique of pulmonary expansion through the classic flow incentive inspirometer (Respiron®), at level 0, which has spheres that provide an aligning load, and can be graduated with a pointer that It generates difficulty levels (0 easy - 1 regular - 2 difficult - 3 very difficult), being started according to the patient's capacity. The patient took a deep breath through the mouth where the objective was to raise the three spheres gently, sequentially, holding for 3 seconds and exhaling. The prescription was 3 sets of 10 repetitions, requesting an interval of 2 minutes for each set. After 2 hours of the intervention, the reevaluation was performed, keeping the protocol. For this analysis data were tabulated and processed by the Statistical Package for Social Sciences-SPSS 22.0 for windows. The processing was descriptive (mean, standard deviation and dispersion measurement) and analytical (paired Student t test) with significance set at 5%. Graphs and tables were plotted using Microsoft Excel 2013 software.

RESULTS

The sample composed of 50 individuals has a mean age of 39.92 ± 15.12 years. Predominantly survey participants are female 45 (90.0%), residents of the city of Vitória da Conquista 27 (54%). Regarding clinical characteristics, 48% of individuals have heart disease, 40 (80%) do not have systemic arterial hypertension (SAH), are not diabetic 50 (100%), nor smokers 49 (98.0%) and did not have a pulmonary artery disease 50 (100%), as shown in Table 1.

Table 1. Sociodemographic and clinical characteristics of the sample. Vitória da Conquista - BA, 2019

Variables	AVG ± SD[1]	n	%
Age, *years*	39,92 ± 15,12	17	—
Gender			
Female		45	90,0
Male		5	10,0
City			
Vitória da Conquista		27	54,0
Otherregions		23	46,0
Heart disease			
Yes		2	4,0
No		48	96,0
SAH			
Sim		10	20,0
Não		40	80,0
DM			
Não		50	100,0
Smoker			
Sim		1	2,0
Não		49	98,0
Pulmonar Disease			
Não		50	100,0

[1]Sample Standard Derivation; Source: research data.

In most cases, the group of individuals underwent cholecystectomy 19 (38.0%), followed by hysterectomy 9 (18.0%), with horizontal 25 (50.0%) and transverse 20 (40.0%) sections. . The cut site was below 31 (62.0%) and above the umbilical scar 19 (38.0%). In all cases anesthesia was spinal cord type, according to Table 2.

Table 3 outlines the comparison between the obtained and predicted values of the study variables. Although all the mean variables were below the predicted value, only the maximum inspiratory and expiratory pressures presented a statistically significant difference (≤ 0.001 for both)

Table 2. Characteristics of sample surgery. Vitória da Conquista - BA, 2019

Variables	n	%
Surgery		
Hysterectomy	9	18,0
Cesarean	6	12,0
Myomectomy	4	8,0
Cholecystectomy	19	38,0
Oophorectomy	2	4,0
Surgicalligation	4	8,0
Appendectomy	1	2,0
Incisionalherniolastia	5	10,0
Cuttype		
Vertical	5	10,0
Horizontal	25	50,0
Crosscutting	20	40,0
Cuttingplace		
Abovethe umbilical scar	19	38,0
Belowthe umbilical scar	31	62,0
AnesthesiaType		
Spinalcord	48	96,0

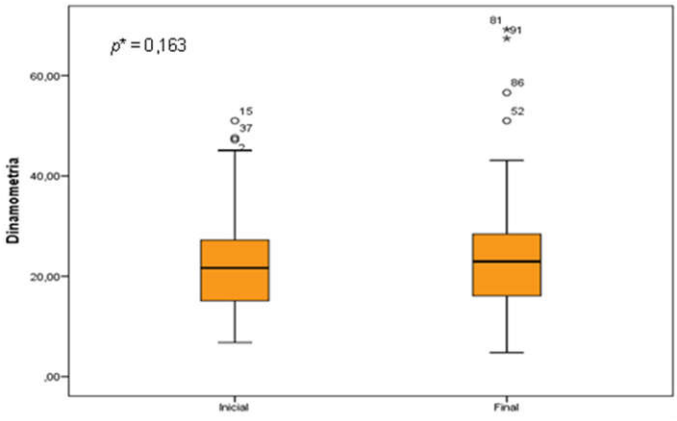
Source: research data.

Table 3. Data obtained and predicted. Vitória da Conquista - BA, 2019

Variable	AVG ± SD[1]		*p**
	Predita	Obtida	
Dynamometry	24,4 ± 6,18	22,77 ± 10,45	0,255
Pimáx	111,85 ± 60,2	40,96 ± 31,49	≤ 0,001
Pemáx	155,4 ± 31,06	33,16 ± 22,56	≤ 0,001

[1]Sample Standard Derivation; *Test t-student pareado; Source: research data

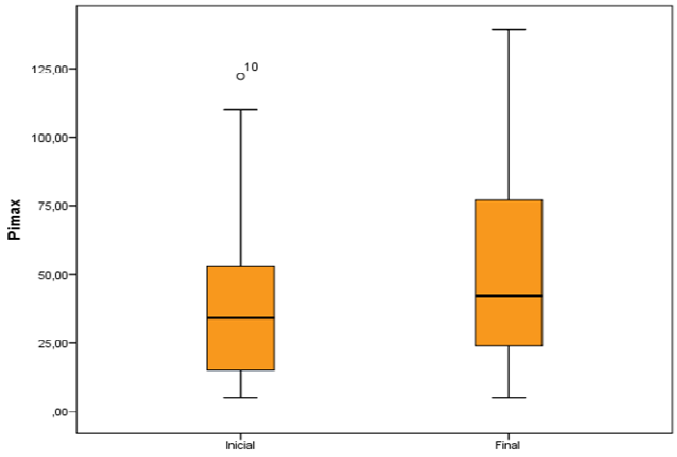
With the help of graph 1, which outlines the dynamometry evaluation and reassessment, it was possible to infer that although the sample presented an initial average of 24.76 ± 10.45 and final of 24.99 ± 13.48, resulting in an increase in the dynamometry, this difference has no significant statistical correlation (p = 0.163).



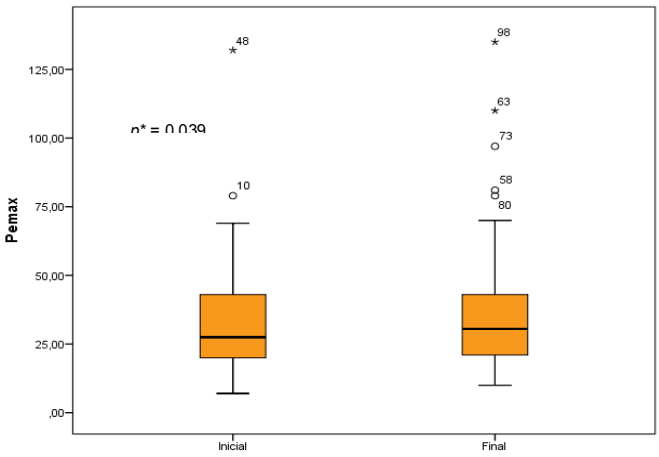
*Teste t-Student pareado; Fonte: Dados da pesquisa.

Gráfico 1. Avaliação e reavaliação da dinamometria. Vitória da Conquista – BA, 2019.

From the results shown in graph 2, it can be inferred that the mean IP Max undergoes a positive change (initial 40.96 ± 31.49 and final 52.10 ± 37.44). significantway (p ≤ 0.001). Similarly to the behavior observed in the PiMax analysis, the PeMax undergoes an increase in the mean after the procedure (initial of 33.16 ± 22.56 and final of 38.22 ± 25.95), and a statistically significant difference was found between the reassessment means. and evaluation (p = 0.039), as outlined in graph 3.



Graph 2. Evaluation and reassessment of PIMax. Vitória da Conquista – BA, 2019



*Teste t-Student pareado; Fonte: Dados da pesquisa.

Graph 3. Evaluation and reassessment of PeMáx. Vitória da Conquista – BA, 2019

DISCUSSION

In the present study, the effects of flow incentive spirometry on the ventilatory muscle function of patients in the postoperative period of elective abdominal surgery were evaluated. The results showed that the use of flow spirometer after elective abdominal surgery caused the strengthening of the main respiratory muscles, providing significant improvement in patient recovery, but there was no repercussion on peripheral muscle strength. Flow incentive inspirometers have been used mainly for the purpose of pulmonary expansion and consequently to reduce respiratory complications after thoracic and abdominal surgery. Working the diaphragm and external intercostal muscles, maintaining a muscle tone, improving contraction activity, avoiding loss of respiratory muscle strength, generating a higher tidal volume, causing greater torque, alveolar recruitment capacity, preventing atelectasis due to changes in the muscles. pressure gradients, consequently generating greater thoracic expandability, directly affecting PIMAX and PEMAX. (SANTOS *et al*, 2018). The results observed in the present study showed a significant increase in MIP and MEP, inferring the benefit of the flow incentive inspirometer (Respiron®) being able to generate inspiratory muscle strength, corroborating the study by Silva *et al* (2015), where the Flow-dependent inspiratory muscle training was able to increase respiratory muscle strength and the distance covered in the

6MWT when associated with the conventional cardiorespiratory rehabilitation program. This is due to inspiratory patterns with the highest possible flow, varying lung volume from residual volume to total lung capacity. This type of deep and rapid inspiratory pattern generates greater endurance and greater range of motion of the inspiratory muscles (SILVA *et al*, 2015). In contrast, Celso *et al*. (2011), in their systematic review, compared thirty studies (14 abdominal, 13 cardiac and 3 thoracic surgeries; n = 3,370 patients). In the analysis of the methodological quality, the studies reached an average PEDro score of 5.6, 4.7 and 4.8 points for abdominal, cardiac and thoracic surgeries, respectively. There was no evidence to support the use of incentive spirometry in the treatment of surgical patients. Nevertheless, the use of incentive spirometry is still widely used without standardization in clinical practice. Corroborating the study by Nascimento *et al*. (2014), where a Cochrane literature review was performed, with 12 studies with a total of 1834 participants in this updated review, evidencing the low quality regarding the lack of efficacy of incentive spirometry to prevent postoperative pulmonary complications of patients after upper abdominal surgery. The results observed in the present research showed that there is no relationship between the increase in respiratory muscle strength and the increase in peripheral muscle strength. This is due to the fact that the flow incentive inspirometer works exclusively on the respiratory muscles, besides the individuals evaluated in the present study. study were not submitted to any peripheral stimulation due to the rest time they should follow, followed by anesthetic action and medical recommendation. Another factor that may have a direct influence on the outcome of the present research was the immediate postoperative approach.

Conclusion

Through the study of the impact of flow incentive spirometry on the ventilatory muscle function of patients in the postoperative period of elective abdominal surgery, it was possible to analyze based on the outcome indicators that the use of flow incentive spirometry had a significant result on pulmonary function. However, it did not present significance regarding peripheral muscle strength. Emphasizing the need for more conclusive studies with larger samples and better defined methods.

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